An Introduction to Active Learning Strategies

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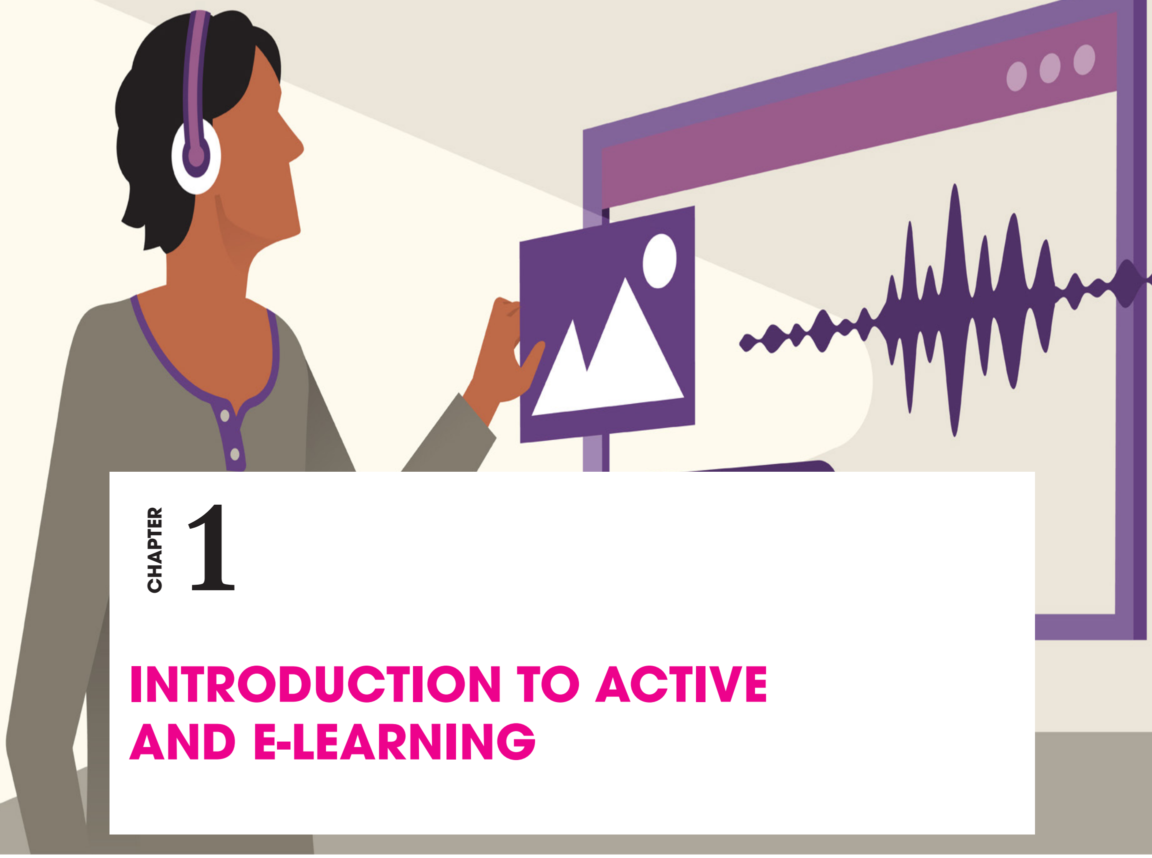
PREFACE

Active learning involves students in the process of learning through activities such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of class content. Extensive research has shown that active learning strategies are generally more effective than traditional lecture in promoting a variety of desirable educational outcomes, such as increased student learning and retention in STEM programs. However, implementation of evidence-based instructional strategies into actual classroom practice has been slow. Previous surveys of STEM instructors have revealed a number of specific barriers to their use of active learning strategies. Concerns about (a) the effectiveness of these new methods, (b) preparation time, (c) the class time required to implement active learning and instructors' ability to cover the syllabus as a result, and (d) student resistance, which includes any number of possible negative responses to the new teaching methods, are among these barriers. Active learning is an essential part of education. Students are better able to apply what they learn when they are actively involved in the learning process.

This book describes the evidence that supports the use of active-learning strategies in education, as well as strategies for incorporating active learning into curricula in the classroom and during practice experiences. Active learning is used to stimulate higher-order thinking and increase student motivation to learn. Active learning should be integrated into classroom-based courses and practice experiences throughout all professional pharmacy program curricula, including adjunct faculty preceptors.

Learning without meaning is frequently forgotten because it is difficult to apply information to future reasoning without understanding. Simply put, learning is the result of teaching, but it does not always occur simply because an instructor teaches. Teachers' understanding of learning will influence how they teach and how their students learn. It is critical for teachers to shift their understanding of learning from simple knowledge acquisition, with learners memorizing by rote, to more consequential knowledge construction with skill application. The book presents a wide range of teaching strategies that engage students as active participants in their learning with their instructor during class time. These strategies typically involve some students working together during class, but they may also involve individual work and/or reflection. These teaching methods range from short, simple activities such as journal writing, problem solving, and paired discussions to longer, more involved activities or pedagogical frameworks such as case studies, role plays, and structured team-based learning.



CHAPTER 1

INTRODUCTION TO ACTIVE AND E-LEARNING

INTRODUCTION

Understanding eLearning is simple. E-Learning is learning utilizing electronic technologies to access educational curriculum outside of a traditional classroom. In most cases, it refers to a course, program or degree delivered completely online. There are many terms used to describe learning that is delivered online, via the internet, ranging from Distance Education, to computerized electronic learning, online learning, internet learning and many others. We define eLearning as courses that are specifically delivered via the internet to somewhere other than the classroom where the professor is teaching. It is not a course delivered via a DVD or CD-ROM, video tape or over a television channel. It is interactive in that you can also communicate with your teachers, professors or other students in your class. Sometimes it is delivered live, where you can "electronically" raise your hand and interact in real time and sometimes it is a lecture that has been prerecorded.

A learning system based on formalized teaching but with the help of electronic resources is known as E-learning. While teaching can be based in or out of the classrooms, the use of computers and the Internet forms the major component of E-learning. E-learning can also be termed as a network enabled transfer of skills and knowledge, and the delivery of education is made to a large number of recipients at the same or different times. Earlier, it was not accepted wholeheartedly as it was assumed that this system lacked the human element required in learning.

However, with the rapid progress in technology and the advancement in learning systems, it is now embraced by the masses. The introduction of computers was the basis of this revolution and with the passage of time, as we get hooked to smartphones, tablets, etc., these devices now have an importance place in the classrooms for learning. Books are gradually getting replaced by electronic educational materials like optical discs or pen drives. Knowledge can also be shared via the Internet, which is accessible 24/7, anywhere, anytime.

E-learning has proved to be the best means in the corporate sector, especially when training programs are conducted by MNCs for professionals across the globe and employees are able to acquire important skills while sitting in a board room, or by having seminars, which are conducted for employees of the same or the different organizations under one roof. The schools which use E-learning technologies are a step ahead of those which still have the traditional approach towards learning. No doubt, it is equally important to take forward the concept of non-electronic teaching with the help of books and lectures, but the importance and effectiveness of technology-based learning cannot be taken lightly or ignored completely. It is believed that the human brain can easily remember and relate to what is seen and heard via moving pictures or videos. It has also been found that visuals, apart from holding the attention of the student, are also retained by the brain for longer periods. Various sectors, including agriculture, medicine, education, services, business, and government setups are adapting to the concept of E-learning which helps in the progress of a nation.

1.1 E-LEARNING

Intentional use of electronic media and Information and Communication Technologies (ICT) in teaching and learning process is referred to as e-learning, where "e" denotes "electronic". It can also be described by many other terms including online learning, virtual learning, distributed learning, network and web-based learning. E-learning includes all educational activities carried out by individuals/groups working online/offline and synchronously/asynchronously through network/standalone computers and electronic devices.

Individualized self-paced e-learning - online refers to situations where individual learners access learning resources like database or course content online through Intranet/Internet. Individualized self-paced e-learning - offline is about a learner using learning resources like database/computer assisted learning packages.

Group-based e-learning synchronously means situations where learner groups work together in real time through Intranet/

Internet. Group based e-learning asynchronously means situations where learners work over an Intranet/Internet with participants exchanges occur with a time delay.

E-learning enables higher interactivity among professors and students and study material coverage in both undergraduate/graduate students. Further, professors and assistants ensure that students' critical thinking is developed, and to provide them freedom in discussion, topics choice, exchange of ideas and information, and expansion of knowledge.

As the development of technology grows, e-learning helps students in their studies in an easy manner, anytime and anywhere. E-Learning has become a popular and acceptable way to study due to its flexibility and better innovativeness regarding introduction of new/contemporary programs as compared to traditional faculty.

Also, many faculty who opted for e-learning started implementing various software packages supporting online learning in addition to application of different studying modalities.

There are diverse ways of classifying the types of e-learning. There have been some classifications based on the extent of their engagement in education. Some classifications are also based on the timing of interaction. Algahtani divided e-learning into two basic types, consisting of computer-based and the internet based e-learning.

The computer-based learning comprises the use of a full range of hardware and software generally that are available for the use of Information and Communication Technology and also each component can be used in either of two ways: computer managed instruction and computer-assisted-learning. In computer assisted-learning, to him, computers are used instead of the traditional methods by providing interactive software as a support tool within the class or as a tool for self-learning outside the class. In the computer-managed instruction, however, computers are employed for the purpose of storing and retrieving information to aid in the management of education.

The internet-based learning according to Almosa is a further improvement of the computer-based learning, and it makes the content available on the internet, with the readiness of links to related knowledge sources, for examples e-mail services and references which could be used by learners at any time and place as well as the availability or absence of teachers or instructors. Zeitoun classified this by the extent of such features use in education, mixed or blended more, assistant mode, and completely online mode. The assistant mode supplements the traditional method as needed. Mixed or blended mode offers a short-term degree for a partly traditional method. The completely online mode, which is the most complete improvement, involves the exclusive use of the network for learning.

Algahtani described the completely online mode as “synchronous” or “asynchronous” by the application of applying optional timing of interaction. The synchronous timing comprises alternate on-line access between teachers or instructors and learners, or between leaners, and the asynchronous, to him allows all participants to post communications to any other participant over the internet. The synchronous type allows learners to discuss with the instructors and also among themselves via the internet at the same time with the use of tools such as the videoconference and chat rooms. This type according to Almosa and Almubarak offers the advantage of instantaneous feedback. The asynchronous mode also allows learners to discuss with the instructors or teachers as well as among themselves over the internet at different times. It is therefore not interaction at the same moment but later, with the use of tools such as thread discussion and emails, with an advantage that learners are able to learn at a time that suits them whilst a disadvantage is that the learners will not be able to receive instant feedback from instructors as well as their colleague learners.

1.1.1 Principles for Successful E-Learning

The intrinsic value of eLearning—its limitless accessibility, applications, and advancements—can't be overstated. Learners from classrooms to corporations have access to self-paced, just-in-time education and training at their fingertips. And with technology, eLearning is ever-changing and evolving to meet lifelong learners exactly where they are and provide them with exactly what they need, exactly when they need it.

But eLearning courseware is more than words and audio on a screen. To create an effective and impactful course, learning materials must be strategically and thoughtfully designed with appropriate Instructional Design principles.

Here, we break down and demystify 11 of these fundamental eLearning principles:

1. Multimedia Principle

This principle uses words and graphics concurrently, rather than words exclusively. This approach engages both visual and auditory elements as learners often prefer to learn from both words and pictures, rather than from words alone. With new innovations such as 3-D modeling and animation, Virtual Reality, and Augmented Reality courses are being brought to life like never before, creating maximum impact. This principle is economical, impactful and the combinations therein are virtually limitless, making it an easy choice.

2. Contiguity Principles

This principle leverages words and corresponding graphics, presenting both elements in close proximity to one another, and is broken into 2 subcategories: spatial and temporal contiguity.

- *Spatial Contiguity Principle*: This principle relies on spatial relativity, keeping the words explaining a concept and their accompanying images together, and facilitates a learner's ability to fully understand and process the information.
- *Temporal Contiguity Principle*: Conversely, this principle presents corresponding words and images simultaneously, rather than successively. Both visuals—words and images—can then be processed concurrently to facilitate retention and understanding.

Think of it like this: instead of revealing all page elements at once, learners can instead actively select certain features using a 'hover-and-reveal' or 'click-and-reveal' feature to avoid overloading the screen—and the audience.

3. Modality Principle

This principle presents words and information in the form of audio narration, rather than on-screen text. Images are described as well so learners don't risk experiencing cognitive overload, as they can instead focus on one element: the narration.

According to the cognitive load theory, the amount of information that working memory can hold at one time is limited. As such, this principle caters to the theory that related sources of information can be understood with the integration—rather than the separation—of information through narration.

The narration is a powerful tool, especially when leveraged as a real-life testimonial that conveys the intensity or severity of topics. Through impactful student testimonials, for example, there are online learning modules which use the power of storytelling narration in their online learning designed to prevent sexual assault, dating and domestic violence, and stalking on college campuses.

4. Redundancy Principle

This principle explains visuals with words in audio or text, but not both. As such, both elements instead complement one another, rather than confound a learner with an overload of all available elements, using a less-is-more approach.

An example of this principle in action is when learners are empowered to choose whether they want to listen to audio or read the text. Captions can be turned on or off, and audio can be muted for times when learners are in a shared space.

5. Coherence Principle

Similar to the Redundancy Principle, this also adopts a less-is-more approach. Irrelevant, extraneous or inapplicable information is eliminated, including audio, visuals, and words, to avoid distraction and increase learning and retention, allowing the learner to concentrate on critical elements only.

Simply put: if words, audio, or images can be omitted without affecting the impact of the message or information, omit them.

6. Personalization Principle

This principle indicates the use of a conversational-style voice and tone—rather than a formal, authoritative tone—to put the learner at ease. It serves to give the content a more approachable, intimate feel so learners can process the content more easily with increased attention and engagement.

Consider these 2 tones for explaining compounding interest from eLearning and the Science of Instruction:

Example 1:'Interest is compounded or added to the existing cash balance monthly. For disclosure on client statements, the annual percentage yield earned is calculated as follows …'

Example 2: 'Clients will often ask you to explain how the Annual Percentage Yield on their statement was calculated. This can be confusing, so let's run through an example …'

The Personalization Principle would then suggest that the second, more informal example is more relatable and, therefore, more engaging to the learner.

7. Segmenting Principle

This principle serves to manage complexity by breaking a lesson into smaller, more palatable parts. Since eLearning is predominantly self-paced, this principle helps to reinforce that process, facilitating learning with user-paced segments, rather than as a continuous module. Further, this principle gives learners more control, allowing them to find what they need, see where they've been and know what to expect.

Accordingly, micro learning, a new technique being utilized in eLearning, breaks down course material into smaller, more digestible segments.

8. Signaling Principle

This principle suggests that people learn better when cues that highlight the organization of the essential material are added, encouraging organized learning content. Further, it suggests that content should get incrementally more complex, with simpler concepts being presented first.

The simplest way to contextualize the principle is to think back on meals as a child. Just as you would spread your lima beans all over your plate to give the illusion you've eaten more than you have, breaking up blocks of content into visually smaller chunks gives the illusion of more manageable, bite-sized content.

9. Voice Principle

This principle suggests that people learn better when the narration is spoken in an intimate, informal friendly human voice rather than a robotic voice. Often, machine voices are more cost-effective but in the long run, retention and engagement suffer.

In fact, Safe Schools, for example, won a storytelling award, highlighting how effectively courses can deliver information by creating relatable scenarios with which your learners will empathize, thus fostering an emotional connection with the content.

10. Pre-Training Principle

This principle capitalizes on what essentially amounts to learning calisthenics as learners benefit when they preemptively know the names and characteristics included in the content. If you think of learning as a cocktail party, the pre-training principle is a learner's first introduction to everyone at the party, upon which they build familiarity, comfort—and then continue building once connections are fostered.

Think of it like this: before a learner is to begin a course of complex, industry-jargoned content, a course can present a list of frequently used—but relatively uncommon—terms and phrases so the learner has a much greater chance of success—and retention.

In the 'recipe' of eLearning, Instructional Design can leverage any combination of these principle 'ingredients' in order to provide limitless opportunities for learning. These design principles provide eLearning courseware and content variety—the 'spice' of learning—to make it endlessly engaging, informative, and instructional for both corporate and classroom learners alike.

1.1.2 Strategies for E-Learning

Strategies for e-learning are given as follows:

- The e-learning must be participant centered.
- A case must be made when value is not obvious and

when point to data needs assessment. Presentation of a problem/case to participants improves clarity.

- The program must ensure opportunities for success and not failure/uncertainty. To motivate/maintain involvement participants should nurture self-efficacy.
- Make it real to ensure that programs should match audience in both topic/level.
- As e-learning relies on involvement/generosity, reveal what participation will result in.
- Make it active/thought-provoking: A virtual coach reveals choices pointing out missed opportunities.
- Make it human: Showcase people/emotions/successes. Reveal how people feel about what can be learnt / achieved.
- (viii)Guide/track participants: Controlled experiments indicate that when novel information is dealt with, learners must be taught what and how to do.
- Situate e-learning within a blend: A blended experience transcends a single experience scheduled for a specific time/place.
- Relationships, collaboration and teaming should be part of effort as the idea of an online community is now increasingly important.
- Make it WOW! Which is when everything comes together to generate something dramatic, compelling, valued, and authentic. Something that attracts participants and involves them.
- Measure and continuously improve e-learning and learning management systems (LMSs) ensure executives are comfortable with technology-based information on compliance/risk avoidance.

When forming roles and responsibilities within learning systems, current and future directions should first be identified. This is done by first considering traditional learning actors roles. Two important categories of e-earning are experiential (significant) learning, and cognitive (meaningless) learning. Many methods contribute to effective knowledge building, but many also keep projects/problem-based learning as the cynosure. Problem solving techniques called problem-based learning can engage learners in knowledge building actively.

In addition to problem and project-based learning, similar learning methods including active learning, inquiry-based learning and service learning exist. As regards active learning, to ensure active involvement in a learning process, students should perform analysis, synthesis and evaluation, which means that listening alone is not enough. Active learning requires active part in comprehension by discussing, writing, playing simulation game roles and problem solving for learners. Inquiry-based learning recognizes that science topics are question-driven and open-ended to understand which, learners have to learn how to pose questions, perform investigations and obtain results from this basic aspect of science.

Based on software communication characteristics and resources for e-learning, three different e-learning environments are distinguished:

- Self-study,
- Asynchronous, and
- Synchronous.

1.1.3 The Use of E-Learning in Education

The development of multimedia and information technologies, as well as the use internet as a new technique of teaching, has made radical changes in the traditional process of teaching. Development in information technology, According to Yang and Arjomand, has generated more choices for today's education. Agendas of schools and educational institutions have recognized e-Learning as having the prospect to transform people, knowledge, skills and performance. Colleges, universities, and other institutions of higher learning race to advance online course capability in a speedily developing cyber education market. E-learning, has come to be more and more important in institutions of higher education. The introduction and expansion of a range of e-Learning tools has been initiating several changes in higher education institutions, particularly when it comes to their educational delivery and support processes.

The "adjunct e-Learning is the situation which e-Learning is employed as an assistant in the traditional classroom providing relative independence to the learners or students. In the blended e-Learning, Algahtani and Zeitoun explained that, in this way of using e-Learning, the delivery of course materials and explanations is shared between traditional learning method and e-learning method in the classroom setting. The third one which is the online is devoid of the traditional learning participation or classroom participation. In this form of usage, the eLearning is total so that there is maximum independence of the learners or students has gone further to explain that the online model is divided into the individual and collaborative learning, where the collaborative learning also consist of the synchronous and asynchronous learning.

1.1.4 Advantages and Disadvantages of E-Learning

E-learning applications/processes include computer-based, web-based and technology based learning, in addition to virtual education opportunities. Content delivery is through internet/ intranet/ extranet and audio or video tape, satellite TV, and CD-ROM including media as text, image, animation and video and audio streaming.

E-learning's main attribute is more to access information/ resources. This refers to the access of information/resources any time, any place or any pace based on one's convenience. Another characteristic is access of multimedia based resources. They are various media types like text, audio, video, animation, graphics, picture in network and communication technology are supported, and which ensure information access by not only text/pictures but also through supported animations, videos, presentations and audio.

Currently e-learning is a highly emerging knowledge tool, providing a method to deliver knowledgeable contents through CD, DVD, multimedia and other tools. Its main drawback is availability of bandwidth, e-learners willingness, and skill sets to deliver material to learners.

For most regions, e-learning did not just open up "existing learning structures/content to new customers". Many regions emphasized e-learning's new methodological potential to "transform learning process", its advantages being its greater interactivity, connectivity, adaptability, and capacity to promote digital and key skills.

Advantages of E-learning to the Trainer or Organization

The advantages of e-learning include

- Reduced overall cost is the major factor in adopting e-learning. Reduced time away from the job may be it's a positive offshoot.
- Consistent content delivery is possible through asynchronous, self- paced e-learning.
- Expert knowledge is communicated and also captured through e- learning and knowledge management systems.

- Proof of completion and certification, which are major training initiative elements, can be automated.
- On-demand availability ensures that students complete training during off-hours/from home.
- Self-pacing for slow/quick learners increases satisfaction and lowers stress.

Disadvantages to the Trainer or Organization

- Up-front investment for an e-learning solution is high because of development costs. Budgets/cash flows should be negotiated.
- Technology issues decide whether current technology infrastructure can accomplish training goals, whether it justifies additional tech expenditure and whether software/hardware compatibility is possible.

Disadvantages to the Learner

- Technology issues of learners are usually technophobia/ unavailability of needed technologies.
- Portability of training is e-learning's strength due to proliferation of network linking points, notebook computers, PDAs and mobile phones.

Web-based learning environments are of 2 types: synchronous and asynchronous. A synchronous learning environment is where an instructor teaches a traditional class with the instructor and students being online simultaneously, communicating with each other. Software tools for this learning type include audio conferencing, video conferencing, and virtual whiteboards ensuring that instructors and students share knowledge.

In asynchronous learning environment, instructor interacts with students intermittently and not in real time. Asynchronous learning is support technologies like online discussion groups, email, and online courses.

E-learning environments provide the following management, development and delivery of e-learning capabilities:

- Map Competencies to Courses: An administrator knows competencies (skills) required for specific jobs in an organization; describing learning content (courses) that teach that skill.
- Schedule Classes/Register Students: An administrator schedules synchronous classes/ posts links to asynchronous class courses. Students can register for either synchronous or asynchronous classes.
- Track Learning: The system tracks classes a student takes and how he scores in class assessments.
- Develop Learning Content: Authors are given software tools to create asynchronous courses consisting of reusable learning objects.
- Deliver Learning Content: Asynchronous courses or individual learning objects stored in the server are delivered to students via a Web browser client.

Collaborative issues in which e-learning communities unfold are characterized as complex as it requires negotiation/communication to uncover. It requires high reflexivity and involves collaborative (self/peer/tutor) assessment processes. Designing and facilitation of education approaches are sensitive to specific pedagogical cultures and educational traditions. Designing teaching and learning mediated across virtual/physical spaces in higher education contexts also come within its ambit.

1.2 ACTIVE LEARNING

Active learning is any approach to instruction in which all students are asked to engage in the learning process. Active learning stands in contrast to "traditional" modes of instruction in which students are passive recipients of knowledge from an expert. Active learning is a process that has student learning at its center. Active learning focuses on how students learn, not just on what they learn. Students are encouraged to 'think hard', rather than passively receive information from the teacher.

Research shows us that it is not possible to transmit understanding to students by simply telling them what they need to know. Instead, teachers need to make sure that they challenge their students' thinking. With active learning, students play an important part in their own learning process. They build knowledge and understanding in response to opportunities provided by their teacher.

The term peer learning refers to situations where peers support each other in learning processes. There are different forms of peer learning such as peer support groups, supplemental instruction, peer tutoring, peer teaching, and peer-assisted learning. Peer learning emphasizes the experience of all participating students. Peer learning is the acquisition of knowledge and skill through active helping and support among peers who are equals in standing or matched companions.

1.2.1 Activity-Based Teaching

Activity-based teaching is an approach to education focusing on the idea that students should be engaged through actions. This is in contrast to some traditional forms of teaching in which an educator lectures or otherwise relays information to students who are expected to absorb what they are told. In activity-based teaching, an educator serves the function of facilitator, assisting students through the learning process and providing them with guidance. Various actions and tasks can be used in this type of program, allowing students to become directly involved in the learning process, rather than remaining passive.

The purpose of activity-based teaching is for an educator to engage students directly, drawing them into a lesson so that they become a participant in their own learning. Some traditional forms of education often relied upon the educator as a knowledgeable expert who simply provided information to students. In this type of environment, the learners were expected to act as sponges that absorbed information, regardless of any particular type of effort made on their behalf. The students were taught, but there was not necessarily a focus upon them being a participant and actively learning while in a classroom.

In activity-based teaching, however, the educator uses different methods to draw the students into the lesson and make them a partner in their own education. The role of the teacher in this type of environment is to serve as a facilitator to the students, engaging them and making sure they become active in the learning process. This is often accomplished through the creation of different activities and projects that students work on as they learn. Activity-based teaching requires a great deal of effort on the part of the educator. Teachers using this method need to create lessons and plans that provide students with opportunities to take part in their education.

Group work is quite common during activity-based teaching, since it allows students to take on the role of educator and work together to better understand different subjects. In these lessons, students work together in small groups to complete a particular project. Each group then presents information learned after performing the task assigned to it to the rest of the class. The educator in this form of activity-based teaching can observe each group and ensure they stay on task, but otherwise may not need to provide much additional information. As the groups present what they have learned, the teacher guides discussion and ensures that errors are not presented, though otherwise the students become responsible for their own learning.

1.2.2 Different Types of Active Learning Techniques

Active learning techniques encourage students to get involved in the learning process, and participate on a regular basis in the classroom in order to facilitate learning. Rather than simply sitting back in their seats and listening to the lecture, active learning gets them involved in the process, making it more likely that they will retain and apply the information learned. Some of the most common active learning techniques involve posing questions to the class, requiring students to work in partnerships and share information, and asking them to summarize what they have just learned in a one-page written assignment or a daily journal.

Though the specifics will require modification based on the age groups in class, and the topics being covered, active learning techniques can be effective for students of all ages, from elementary school to university education. Many teachers will employ these techniques right in the lecture. For instance, lecturing for a brief period of time in the class, then pausing to ask a few questions on what was just covered, and randomly calling on students to answer them requires students to be engaged and actively taking notes. Following a lecture or presentation, instructors have even more opportunities to use various types of active learning techniques.

One of the theories behind active learning is to get students to put what they have learned in their own words, and apply it to their existing knowledge and critical thinking skills. As a result, instructors will often employ cooperative learning as a method of active learning, and will put students in pairs or small groups, ask a question, and have students discuss it and settle on an answer. This may then lead to a class discussion in which all the groups must participate, thereby reinforcing the information they just learned. If possible, hands-on activities might be given as well.

Some active learning techniques can be applied independently. Students may be given a surprise quiz upon entering the class, based on the previous night's assignment. They may be asked to keep a daily journal, reflecting on what they've learned, or write a brief one-page summary of what was covered in the day's lecture, to be handed in at the end of the class. Asking students to brainstorm or pose questions to themselves about what they find unclear is not only a great way to get students to really think about the material and read more carefully, but also to give the instructor clues about what he or she needs to cover more in-depth.

1.2.3 Different Types of Active Learning Activities

There are many different types of active learning activities, which require students to take a dynamic and energetic role in their education. Active learning places greater responsibility on students than traditional and more passive educational assignments do. Some types of active learning activities, which are based on hands-on assignments and activity-based learning, include reenacting historical events, observing insects in their natural habitats, solving math problems in a group using manipulatives, and creating a presentation about a work of fiction or nonfiction. The point of many of these educational activities is for students to learn more by becoming actively involved with the learning objectives for which they are responsible based on the idea that the more they are required to interact with the information, the more deeply they think through it and learn it.

In social studies classes, active learning activities often include reenacting historical events and holding debates. Students given an assignment to reenact historical events might have to read primary and secondary documents from history and contemporary accounts of an event, synthesize that information, and then write and act out the event in a group setting. After groups have acted out their interpretations of an event, the class then may analyze the event more closely and also could debate in teams about controversial issues or positions relating to the historical event.

Teachers of science classes might have students participate in active learning activities such as studying the characteristics of different insects and then observing these insects, their behavior, and the conditions in which they naturally live. A class could learn about ants, their living environment, the types of work they do, and the types of food they eat. They then could go into the woods, find ant colonies, and observe and record their findings in groups. These groups could then meet, finalize their observations in the forms of charts, drawings and narrative writing, and present their classmates with what they learned and the questions they still have. A follow-up activity could involve returning to the ant habitats for further observation and attempts to answer remaining questions about ant life.

Students in mathematics courses might engage in active learning activities such as taking a complex geometry problem, dividing into groups, and using manipulatives to solve the problem. The students might use the manipulatives — or plastic geometric shapes — their mathematics textbook, calculators and one another to come up with a viable solution to their problem. Once they solve their assigned problem, these students could present their work to the entire class. Such activities give students the opportunity to teach one another and can be more effective than simply listening to a lecture about how to solve a similar problem. Teachers act more as facilitators and coaches than leaders when they are overseeing active learning activities.

Language arts and English courses may allow students to actively learn and increase their reading comprehension and literary analysis skills by having them choose a challenging nonfiction or fiction book to read and complete a project on. The project could be multifaceted and include students reading carefully, writing journal entries, answering essay questions, creating an in-depth model or detailed visual about the book, and then developing a presentation for the class. Students could present their visual and information about the book and how it related to them before answering questions from their teacher and classmates about it.

1.2.4 Active Learning in Higher Education

Traditionally, much of higher education has consisted of courses in which professors impart information to their students by means of one-way lectures to hundreds of students. Many universities, however, have begun promoting active learning in higher education, which engages students in their education and involves critical thinking and problem solving, rather than simply retaining information. Two primary ways that this can be done are increasing teacher-student interactions and introducing **cooperative learning** models.

Professors may find it challenging to interact directly with each of their students in a class of several hundred, so they may resort to passive classroom strategies that consist entirely of lectures or other one-way communication methods. One way colleges and universities can increase active learning in higher education is by reducing class sizes, allowing for potentially more one-on-one interactions. When this is not possible, however, instructors can use alternative methods of teaching to interact with their students. Classroom discussions led by the teacher can involve a few students, but in large classes the majority of students may not be willing or able to participate.

Some universities have begun incorporating a type of technology known as clickers into their classrooms to encourage active learning in higher education. Clickers allow students to respond to professors' questions, either by multiple choice or written responses, through mobile devices. These can be used to give the professor real-time feedback on how well the material is understood by all students, rather than only the few who are willing to participate in group discussions. They also give students motivation to remain intellectually engaged with the lecture. Professors can also ask opinion or survey questions in addition to comprehension questions, in order to encourage critical thinking.

Another popular method of enhancing active learning in higher education is through some form of cooperative learning. The most familiar type of cooperative learning is group projects in which students are assigned a topic for more in-depth research than what will be specifically addressed in class. Other types of teaching add variations to the traditional lecture style of teaching as well. Students may, for instance, divide into groups for a few minutes midway through the lecture in order to compare notes. The professor may provide specific questions or talking points for this time period, or the students may decide among themselves on the most effective use of their time.

1.2.5 Active Learning in Classrooms

Classroom activities should be valuable to children. Everyday classroom experience enables them to expand their knowledge through cooperation with peers while working on various tasks. Lessons represent a process that is goal oriented. Contemporary teaching can be analyzed from the point of its organizational forms and its functionality. When it comes to organization, instruction is seen as a dichotomy, since it comprises two simultaneous processes – teaching and learning. While teaching refers to guiding the individual towards the peak of his/her ability to comprehend and create new meaning, learning is commonly defined as a relatively permanent change in behavior caused by previous experience. Therefore teaching presents a planned usage of teaching methods in order to make something "external" internalized and is based on students' own activity of learning. It stems from interaction which aims at helping students to acquire knowledge, develop their abilities and form attitudes.

The necessary prerequisite for all this is student activity. According to the constructivist view on cognition, knowledge cannot be transmitted, but must be constructed. As Bruner points out, learning is based on individual's personal construction and reconstruction of knowledge which takes place in, and is influenced by, socio-cultural context.

Instruction is perceived as functional if it equips students with competences that can be applied in their everyday life outside the school. It is demanded from students not only to possess knowledge but also to be competent. Being competent in a certain field means that one has understanding, ability and skills necessary for performing well in that field. Contemporary demands call for a new kind of knowledge, skills, abilities, values and attitudes, i.e. new competences that promote innovation, creativity, problem-solving ability, critical thinking, entrepreneurship, information literacy, etc.

The demands of contemporary education are no longer possible to meet in a system that emphasises teaching and neglects the learning that goes on in the classroom. The shift must be made towards active learning. If the existing classroom strategies are divided into teaching strategies and learning strategies, one must not forget that both groups of strategies should stimulate student activity.

Any kind of learning implies student activity, but active learning in a narrow sense of the term, Ledić defines as such learning that enables students to have a high level of autonomy and self-monitoring, and to apply various mental strategies and specific cognitive skills to differentiate between important and unimportant information, analyse and compare, construct new knowledge on the previous experiences and think critically. Due to all these processes, active learning enables long lasting retention of information.

Therefore, active learning sets the following goals: a high level of self-regulation and independence, diverse (Meta) cognitive strategies, selective information processing, building on previous knowledge, critical approach to lessons and enhanced creativity. In order to reach these goals, Simon's points out that students should plan and prepare the learning process themselves, engage in learning, regulate their learning, control it and persist in the learning activities.

Kyriacou states that active learning should constantly be present in classrooms since students benefit from it in numerous ways. It enables students to act autonomously and have control over the classroom activities. It plays a significant role in student motivation, since it links problem-based teaching to innate curiosity and the need for exploration of every child. It gives a new kind of quality to the school experience. It has greater influence on students' everyday lives. The experience of active learning has a strong impact on personality and it makes school more similar to real life.

It is necessary to introduce new learning strategies that would support active learning. It adds a new dimension to instruction, and causes students' values to change. When interacting with various contents, a student is cognitively active and starts to perceive learning as a challenge. Only then can it be expected from students to think of knowledge as something valuable and to think that the opportunity to learn is a privilege.

The effectiveness of active learning strategies depends mostly on the teacher and the way in which he/she understands his/her role in the classroom. Their main role starts to be planning and designing classroom situations that would provide active learning. They should make students aware of the teaching goals, methods applied and expected learning outcomes. Teaching contents should be presented in an interesting way so that the students could see that they correspond to human needs and improve our understanding of the world.

Desforges claims that a lot can be done to make stronger associative bonds in the process of learning. There are various active learning strategies and one can distinguish between questioning techniques, small groups, whole class involvement, and reading and writing exercises (Meredith & Steele, 2010). The questioning techniques are applied when both teachers and students ask questions. The type of their question is the indicator of which cognitive level is being stimulated, whether it is pure memorising or evaluation based on solid arguments, on the other end of continuum. Cooperative learning changes the relationship between students and the teacher, but also the relationship between students. Instead of classroom competition, cooperative learning promotes mutual support, emphasising that the procedure is equally important as the goal accomplished in the end. Whole class involvement is most evident when a discussion or debate are employed, while reading and writing strategies focus on individual progress in comprehension. Basically, all these strategies enable students to construct their knowledge. By implementing them in teaching methods, students are given the opportunity to be active learners/ constructers of new schemata. New knowledge represents the result of cognitive activity and therefore it cannot be "transmitted" to the passive learners, since students must take an active part in the process of building their own knowledge.

Classroom communication combined with teaching strategies determines the atmosphere in a certain class. Constructivist classroom differs from a traditional one when it comes to student-centred teaching. Active student participation (students asking questions, exploring, dealing with different materials, solving problems, conducting various projects, etc.) leads to their own personal construction of knowledge. This is why the time spent to achieve a goal is as valuable as the knowledge gained in the end.

Therefore, Mušanović claims that the constructivist model of education is characterized by transformation of student-teacher relationship, the use of numerous sources of information (apart from textbooks) and activity-based curriculum. These three dimensions of active learning in lower primary and higher primary classrooms. Active learning strategies are mostly used with older students and college students, which excludes young learners, although such strategies could be applied and should be implemented at all levels of education.

The research aim was to determine whether contemporary instruction is a context used for active learning. More specifically, the intention was:

- to explore what active learning strategies are used in contemporary classrooms,
- to explore the potential difference in the use of active learning strategies based on student age (grade 4 versus 8) and type of school (partner schools versus ordinary schools)

1.2.6 Nature of Active Learning

There are a wide range of alternatives for the term "active learning" like learning through play, technology-based learning, activity-based learning, group work, project method, etc. the underlying factor behind these are some significant qualities and characteristics of active learning. Active learning is the opposite of passive learning; it is learner-centered, not teacher-centered, and requires more than just listening; the active participation of each and every student is a necessary aspect in active learning. Students must be doing things and simultaneously think about the work done and the purpose behind it so that they can enhance their higher order thinking capabilities. Many research studies have proven that active learning as a strategy has promoted achievement levels and some others say that content mastery is possible through active learning strategies. However, some students as well as teachers find it difficult to adapt to the new learning technique. Active learning should transform students from passive listeners to active participants and helps students understand the subject through inquiry, gathering and analyzing data to solving higher order cognitive problems. There is intensive use of scientific and quantitative literacy across the curriculum and technology-based learning is also in high demand in concern with active learning. Barnes suggested principles of active learning:

- Purposive: the relevance of the task to the students' concerns.
- Reflective: students' reflection on the meaning of what is learned.
- Negotiated: negotiation of goals and methods of learning between students and teachers.
- Critical: students appreciate different ways and means of learning the content.
- Complex: students compare learning tasks with complexities existing in real life and making reflective analysis.
- Situation-driven: the need of the situation is considered in order to establish learning tasks.
- Engaged: real life tasks are reflected in the activities conducted for learning.

Active learning requires appropriate learning environments through the implementation of correct strategy.

Characteristics of learning environment are:

- Aligned with constructivist strategies and evolved from traditional philosophies.
- Promoting research based learning through investigation and contains authentic scholarly content.
- Encouraging leadership skills of the students through

self-development activities.

- Creating atmosphere suitable for collaborative learning for building knowledgeable learning communities.
- Cultivating a dynamic environment through interdisciplinary learning and generating high-profile activities for a better learning experience.
- Integration of prior with new knowledge to incur a rich structure of knowledge among the students.
- Task-based performance enhancement by giving the students a realistic practical sense of the subject matter learnt in the classroom.

Constructivist framework

Active learning coordinates with the principles of constructivism which are, cognitive, meta-cognitive, evolving and affective in nature. Studies have shown that immediate results in construction of knowledge is not possible through active learning, the child goes through process of knowledge construction, knowledge recording and knowledge absorption. This process of knowledge construction is dependent on previous knowledge of the learner where the learner is self-aware of the process of cognition and can control and regulate it by themselves. There are several aspects of learning and some of them are:

Learning through meaningful reception by David Ausubel, he emphasizes the previous knowledge the learner possesses and considers it a key factor in learning.

Learning through discovery by Jerome Bruner, where students learn through discovery of ideas with the help of situations provided by the teacher.

Conceptual change: misconceptions takes place as students discover knowledge without any guidance; teachers provide knowledge keeping in mind the common misconceptions about the content and keep an evaluatory check on the knowledge constructed by the students.

Social Constructivism by Bandura and Vygotsky, collaborative group work within the framework of cognitive strategies like questioning, clarifying, predicting and summarizing.

1.2.7 Active Learning as an Instructional Approach

Conceptually, active learning is not an easy target. Its theoretical roots are in constructivist learning theories. Constructivism has become a leading learning paradigm, and it views learning as a construction process of new knowledge in relation to previous knowledge. Constructivism criticizes the idea that learners receive knowledge from external sources and highlights understanding instead of memorizing. Aiming to understand, rather than memorize, is also characteristic of a 'deep approach' to learning. Depending on the constructivist theory, learning can be considered as individual cognitive processes (cognitive constructivism), social co-construction of knowledge (social constructivism), or as a hybrid of these two.

Nevertheless, it is difficult to define aspects of effective constructivist teaching because constructivism is a theory of learning and not a theory of teaching. Constructivism can be and has been used as a guide for forming instructional strategies that aim to enhance deep understanding. For example, active learning as an instructional approach aims to enable constructivist learning by emphasizing students' self-construction of knowledge, and students' responsibility for their own learning. However, instruction that aims to be constructivist does not always succeed in its intentions. Any constructivist instructional methodology should, but often fails to, elicit prior knowledge, create cognitive dissonance concerning the prior and the new knowledge, and include application of the knowledge with feedback as well as reflection on learning.

Thus, it is not mandatory to use a specific activity to be recognized as constructivist, and, similarly, adopting a specific activity does not ensure that the activity is constructivist. This applies to active learning activities, as well. Even though the concept of active learning relies on constructivism, or is at least inspired by it, the concept captures a wide range of views. The authors of present that there is often a lack of clarity and consensus on the meaning of active learning, and definitions of it frequently lack robustness. Usually, the definitions include the broad idea of being instructor-driven activities that are used to activate students. Active learning has been tied to formal instructional events in a classroom, or at least to being introduced in a classroom. It is often contrasted to passive learning, e.g., lectures, where knowledge is more passively obtained. This can be problematic from the viewpoint of constructivist learning theories that consider that all knowledge, regardless of its source, is constructed. Overall, active learning is not just something that students do on their own but is somehow organized and monitored by an instructor, therefore, being an instructional approach that guides learning. However, the authors of note that, in some instances, active learning has been also understood as an approach to learning, therefore, focusing on a learning process instead of an instructional process.

As a consequence of the wide range of definitions, active learning as an instructional approach can include different forms of activation, such as increased physical activity, interaction, social collaboration, deeper processing, elaboration, exploration of the material, or metacognitive monitoring. In addition, the various activities under the concept of active learning may involve different forms of instruction and be related to different cognitive processes. The lack of clear definitions of active learning and shared terminology may cause some discrepancies when active learning activities are considered. For example, researchers and instructors in a field such as engineering might have little experience on educational theories, which they could reflect in their experiments. Consequently, applying active learning without an insufficient experience or knowledge on it may not yield the expected learning results, and may even have the opposite impact of demotivating and discouraging students. In addition, the varying terminology of active learning is a challenge for research and raises the question of whether it is possible to generalize results of the effectiveness of active learning if the activities can vary to a great extent. Thorough descriptions of the fine features of active learning strategies as well as their appropriateness in reaching certain learning goals could help in comparing different strategies.

As interest in active learning has increased, many instructors have been eager to try out new procedures and also report them to their fellow instructors. For example, the authors of suggest that action research, with spiraling steps of planning, action, fact finding and reflection or evaluation, is an appropriate way for engineering educators to study active learning in their instructional practices. However, the research on active learning is not without problems. For example, measurement methods of learning and their validity are seldom reported in the active learning literature. Further, although instructors agree with researchers about the direction of educational development of Finland, a review study showed that instructors actively piloted new teaching methods without conducting any research on them. Ishiyama reviewed studies that had applied simulation studies in political science education and discovered that most of the articles were mere descriptions of procedures without providing any systematic evidence on their effects on learning, and that some of those that provided evidence were only anecdotal cases. In addition, the authors of reviewed studies on experiential learning techniques and argued that even though it can be noted that learning had occurred in the original articles, the methodological investigation revealed that the results did not meet the highest of research design and measurement standards and, therefore, can lead to only tentative conclusions about the true effectiveness of the approaches. Prince notes that comprehensive assessment of active learning is often difficult because studies do not usually consider a broad range of learning outcomes and when they do, the results are often mixed or a matter of interpretation. Overall, more discussion is still needed on the measurement methods of learning in active learning research.

1.3 INFORMATION RETRIEVAL (IR)

Information Retrieval (IR) includes locating unstructured (text) material (documents) which satisfies information need from large collections (stored on computers). Information Retrieval systems are distinguished by their operational scale. It is being useful to understand 3 prominent scales. The system searches more than a billion documents in millions of computers in a web search. Personal information retrieval is at the other extreme. Recently, consumer operating systems have integrated information retrieval.

The space for enterprise, institutional and domain-specific search, where retrieval is possible for collections like a corporation's internal documents, patents database or research articles on biochemistry is in between.

Information Retrieval is locating from a large collection, documents that fulfill a specific information need. Much Information Retrieval research concerns proposing and testing methodologies to perform this job. It can be considered that a formal relationships model between queries, documents, meaning and relevance can be used as a base for information retrieval. There can be no such model as humans cannot be left out of the equation, and yet cannot be modeled. Information retrieval techniques account for language, culture and behavior. For example, similarity estimation was circumscribed or bounded, as in cosine measure. Experiments are reliant on a standard test, but the aim is to measure users, and hence data over which prior knowledge could be asserted should be chosen so that it is not constrained by prior failures. This is important, as variables should not be present in systems: as effectiveness measurements must be controlled.

Two distinctions are of importance:

- An unstructured information system deals with issues like the Reformation's economic impact.
- Finding versus creating answers. IR/database systems only locate what is already in existence.

IR has traditionally concentrated on locating entire documents which include written text; much IR research specifically focuses on text retrieval. IR is computerized retrieval of machine readable text sans human indexing.

Information retrieval systems deal with huge data amounts and should be able to process gigabytes or even terabytes of text. It should build and maintain an index for millions of documents.

1.3.1 Inference Network Model

Document retrieval is modeled through an inference process in an inference network, in this model. Most IR system techniques are implemented through this model. In this model's implementation, a term is instantiated with certain strength by a document and credit from multiple terms is gathered following a query to compute a numeric score equivalent for the document. From an operational perspective, a term's instantiation strength for a document is considered the term's weight in the document, and simple document ranking in this model is similar to vector space model ranking and probabilistic models described. A term's instantiation strength for a document is not model defined and so any formulation can be utilized.

Natural Language Processing (NLP) enhances retrieval effectiveness, with limited success. Document ranking is a critical IR application, but it is not the only one as many techniques have been developed to attack varied issues including information filtering, topic detection and tracking (or TDT), speech retrieval, cross-language retrieval, question answering etc.

IR documents are partly structured, e.g., it has a structured header and unstructured body. The header has metadata, i.e., data about document, instead of the document's information content. For example, a book's structure consists of certain components due to it being a book, e.g., it contains title page, etc. IR retrieves documents based on unstructured components content. An IR request (called a "query") may specify a document's structured and unstructured components characteristics for retrieval.

1.3.2 Information Retrieval Systems

IR tries to locate documents in a collection "about" a given topic or which satisfies a specific information need. Topic or information need is expressed through a user generated query. According to users, documents which satisfy a query are "relevant" and those not about a topic is "nonrelevant". A query may be used by an IR engine to classify a documents collection (or in an incoming stream), returning a documents subset which meets some classification criterion for the user. The higher the proportion of user returned documents that are relevant, the better the classification criterion.

Relevance judgments effectiveness is quantified by two measures: recall (relevant documents number identified by a subject for a query divided by total relevant documents, within examined ones, for the query), and judgments precision.

Most automatic information retrieval systems are experimental in nature. Experimental IR is usually tried out in 'laboratory' situations whereas those which are operational are commercial, charging for their services. Both systems are evaluated differently. 'Real world' IR systems are evaluated regarding 'user satisfaction' and the price a user pays for services. Experimental IR systems evaluation is by comparing retrieval experiments with specially constructed standards.

Information storage and retrieval are simple in principle, if there is a document cluster and a person (user) formulates a question (request or query) for which a document set is the answer, satisfying his question's information need.

When high speed computers were available for non-numerical work, many felt a computer could 'read' an entire document collection to extract relevant documents. It soon was apparent that use of a document's natural language text not only resulted in input and storage problems, it also left unsolved document content characterizing problems. Future hardware developments may ensure feasible natural language input and storage. Automatic characterization where software tries to duplicate human 'reading' process is a very sticky issue. Specifically, 'reading' involves extracting information - both syntactic and semantic - from text to decide whether a document is relevant to a particular request. The difficulty is in extracting information and using it to decide relevance. Modern linguistics slow progress on the semantic front and machine translation's failure reveal that such issues are yet unsolved.

Presents three IR models: the first being called Boolean, the second is Vector Space Model (VSM) and the third is called probabilistic. Boolean model is based on binary algebra: queries being expressed as logical conditions. Probabilistic approaches estimate a document's probability being relevant to a specific query. This needs many training queries which are hard to get.

Documents are represented as vectors in Vector Space Model (VSM) and their relevance to user queries is measured by appropriate matching functions. There are two major components in the IR process: the first is term extraction by a document matrix performed for a given database, once. The second is document identification as relevant to a query and performed every time a query is submitted.

The term by document matrix 'A' is obtained through many steps: preprocessing, normalization and indexing. Preprocessing removes elements not useful in retrieval.

Normalization removes variability not useful to retrieval and is performed through two steps: stopping and stemming. During stopping, all words which have poor index terms (stop words) are removed. Stemming is replacing different inflected forms of certain words with their stems.

In Information retrieval systems started electro-mechanical searching devices, adoption of computers to locate user query relevant items. Both electro-mechanical and computer-based IR systems search style is Boolean retrieval. A query is a logical term (a synonym to word in IR literature), which result in a documents set that match the query exactly. An alternative approach is where each collection of document is given, a score to indicate its relevance to a query. This ranked retrieval search approach was taken up by IR researchers, who over decades refined and revised documents sorting regarding a query. This approach effectiveness over Boolean search was proved over the years.

Information retrieval systems effectiveness is measured by comparing performance on a common queries set and documents. Many tests evaluated such comparison's reliability.

Test collections are used for retrieval systems comparison and evaluation. These collections comprising of documents, queries (or topics), and relevance judgments are key Information Retrieval (IR) research for years; collections are based on research or practice in collection formation and retrieval effectiveness measurement. Effectiveness computation is made by measuring systems relevant documents location ability. The measured score indicates a system's performance relative to another; it is being assumed that similar relative performance is observed on other test collections operational settings.

1.3.3 Natural Language Processing (NLP)

Natural language processing (NLP) is a way of translating between computer languages and human languages. The goal of this field is to allow computers to understand what a text says without being given precise values and equations for the data that the text contains. In essence, natural language processing automates the translation process between human and computer languages. While much of this field relies on statistics and models to determine likely meanings of a phrase, there are and have been many different approaches to this problem. Findings in this field have applications in the areas of speech recognition, human language translation, information retrieval, and even artificial intelligence.

Evolving out of a background in computer science and linguistics, natural language processing faces many problems because language is not always consistent and not all clues to meaning are contained in language itself. Even a complete account of the entire grammar of a language including all exceptions does not always allow a computer to parse the information contained in a text. Some sentences are syntactically ambiguous, words often have more than one meaning, and some combinations of sounds or symbols change their meaning depending on the boundaries of the words — all of which can be problems for a computer that does not understand context. More importantly, much of language depends on a connection to the physical and social universe — some sentences, such as speech acts, do not convey information as much as act on the world. Even if a computer has a perfect understanding of human language syntax and semantics, the text to be analyzed must be free of human devices, such as sarcasm or passive aggression, for the computer to correctly ascertain what the text means.

Ideologically, natural language processing is a system of human-computer interaction that is governed by the idea that most computer users are more comfortable working with computers in a human language they already know than adapting to a computer's language. It also capitalizes on the fact that much of human knowledge is already encoded in human language, and the texts that contain that knowledge can be translated into logical structures that can be streamlined for a computer. While many projects in this field work to extract computer-readable data from human language texts, natural language processing is also used to generate human-readable texts from computer data. Both these understanding and generating facilities can be used by the same technology, such as in the case of applications that translate from one human language to another by first decoding the text into a computer language, then encoding it in another human language. The innovations obtained in natural language processing endeavors are also strikingly applicable to artificial intelligence projects because of the degree to which human-like intelligence is defined by a mastery of the complexities of human language.

1.3.4 Motivation and Problem Statement

The advent of internet technology to share educational contents and experiences ensured that institutions globally, offered a federated search to courses, lesson plans, contents, assignments, seminars and experiments, all of which are stored in repositories of learning content management systems controlled by a learning management system. The problem faced by a learner's community is in accessing, sharing and delivering quality relevant to content for online teaching learning systems. Today peer to peer networks are used for daily sharing of videos, audios, images, music or other distributed learning digital processes. Hence, sophisticated search and information retrieval solutions are necessary. Many existing web based course structures developed in e-learning system are considered as course ontology and can be mapped into a model. This ontology based solution increases information retrieval accuracy through high precision and recall.

Language Model defines documents probability distribution using them to predict likelihood of query terms observation. Language model has been defined for all documents and it is used to inquire about chances of query generation. Nominal Language Model (NLM) based language modelling goes with part of speech of a given query's literal language, constituting factors with noun and adjectives. Informational query attempts to capture a document with data, relevant to analysis area. NLM based Information Retrieval process is an efficient method to extract relevant documents. Language modelling is processed with natural language processing methods.

A term/phrase can have many meanings, while a domain specific concept is unambiguous. It is useful to use the domain specific concepts in documents than terms to retrieve documents from a specific domain. In this proposal, NLM is assembled with rate specifications and ratio calculations through use of probabilistic terms involving comparing query terms occurrence with data store using conditional probability theorem.

Feature selection in classification is being viewed as a most fundamental issue in machine learning. Data clustering is a popular data labeling technique where unlabeled data is issued, and similar samples put in one pile called a cluster with dissimilar samples being in other clusters. Data clustering, an NP-complete problem of locating groups in heterogeneous data by minimizing some dissimilarity measure is a basic tool in data mining, machine learning and pattern classification solutions.

Query expansion methods were long studied - with debatable success on many occasions. This study presents a probabilistic query expansion model based on similarity thesaurus constructed automatically. The latter reflects domain knowledge about specific collections from which it is constructed. Two important issues with query expansion are addressed here: selection and weighting of additional search terms. Compared to earlier methods, queries are expanded by addition of terms similar to query concept, instead of selecting terms similar to query terms.

Mobile Agents are independent smart programs moving through networks, seeking and interacting with available/compatible services on user's behalf. Another attractive paradigm property is that it allows an application to be really distributed, as tasks in an application, embodied in a mobile agent, are worked out on participating systems in a decentralized process.

It addresses pre-processing and various source documents retrieval to achieve improved Information Retrieval systems and investigates tools/techniques used for autonomous classification or documents clustering; new methods are proposed based on concept expansion.

1.3.5 Objectives of the Thesis

Locating learning material groups relevant to learning goal (query), results in learning process efficiency. The scope of this thesis is in increasing content retrieval efficiency and accuracy through a query refining and reformulation method through pre-processing operations like stemming, stop word removal, dimensionality reduction and relevance feedback mechanism. Reuter's dataset and Movielens dataset are used in this research.

The following summarizes the objective of the thesis:

- Propose a concept expansion for creating corpus
- Propose a language modeling based on Nominal Language Model
- Propose a cluster based Feature selection method based on Particle Swarm Optimization and Genetic Algorithm
- Optimization of document clustering using proposed Mobile Agent

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CHAPTER 2

PEER REVIEW

INTRODUCTION

Peer review is often identified with peer observations, but it is more broadly a method of assessing a portfolio of information about the teaching of an instructor under review. This portfolio typically includes curricula vitae, student evaluations, self-evaluative statements, peer observations, and other evidence such as syllabi, assignments, student work, and letters solicited from former students. This said, peer observations will figure prominently in what follows.

It is also worth noting a common distinction between two very different forms of peer review: formative and summative. Formative evaluation typically is oriented solely towards the improvement of teaching and is part of instructional mentorship and development. Summative evaluation, in contrast, is that done to inform personnel decisions. To improve the freedom and exploration of individual faculty, formative reviews may be shielded from scrutiny for a period of years until such time that there needs to be accountability to standards of excellence for personnel decisions. At this point in time, summative evaluations are more common since they are tied to decisions related to reappointment, promotion, or tenure. Because the more consequential nature of summative evaluations tends to diminish the formative value of the peer review process, it is important to maintain a clear distinction between these types of evaluation and be transparent with those under review. It is also common to have different faculty involved in each form of assessment – mentor faculty in the formative evaluation and departmental or program administrators, such as chairs, involved in summative evaluations.

2.1 STUDENT PEER REVIEW

In a student-learning context, peer review is understood to mean the educational arrangement in which students consider or evaluate the value, quality or success of work produced by their fellow students and provide each other with feedback. Peer review involves students giving and receiving feedback on each other's work.

The use of student peer review means a shift away from the traditional notion of assessment and feedback as being solely the role and responsibility of the teacher. Rather, peer review allows and encourages students to take an active role in managing their own learning. It is closely related to self-assessment as the skills required for peer review are similar to those required for self-review or self-assessment, which is critical for lifelong learning.

Peer review comes in various forms and has broad application. For over three decades, it has been used to evaluate a wide range of student work including written assignments, oral presentations, artwork and architectural designs, programming and code reviews, musical performances, as well as being used in various teamwork and capstone projects . It may involve a component that includes graded peer assessment of student work, graded assessment of the review, or a combination of both.

Students' level of involvement in the peer-review process may also vary from using the set criteria (or model answer) provided by staff in evaluating their peers' work, to negotiating and developing the criteria with staff before applying these standards to their peers' work. Through engaging in this process, students gain a better understanding of what the criteria are for good learning and this enhances their ability to select 'good evidence'. The process thereby helps students to develop skills that facilitate their own learning.

2.1.1 Benefits of Peer Review

Feedback is an essential part of the learning process. Effective feedback can motivate students, change their behavior and improve their learning. Through engaging in peer review and receiving feedback from a number of peers, students are exposed to a greater diversity of perspectives than just those of their tutor or lecturer. Indeed, the ability to ensure that students receive feedback from a number of different people is one of the main benefits of student peer review.

For teaching staff, implementing student peer review can be a way of ensuring that all students receive prompt and detailed feedback that can then be used for self-reflection and to make improvements to their work. This is particularly beneficial in large classes where it may be difficult for the lecturer/tutor to provide detailed and timely feedback to all students.

In addition to the benefits from receiving feedback, numerous studies have highlighted the learning benefits derived from being involved in the process of reviewing and providing feedback on peers' work. Peer review of students' writing, for example, allows for meaningful interaction with peers, greater exposure to ideas, and new perspectives on the writing process.

The review process requires students to analyses, review, clarify and sometimes correct each other's' work. This can help to clarify and reinforce the reviewers' knowledge and understanding of the area and encourages the development of advanced critical thinking and higher-order cognitive skills.

The peer-review process can also enhance student learning by:

- building problem solving skills through identifying areas needing improvement and providing constructive suggestions;
- encouraging reflection and thereby promoting skills in self-assessment;
- enhancing greater meta-cognitive self-awareness;
- increasing student motivation by fostering a sense of responsibility and ownership for their peers'
- learning;
- promoting independent learning and reducing dependence on staff as 'the experts';
- improving self-confidence; and
- providing valuable experience and preparation for the professional workplace

2.1.2 Potential Impediments to Implementing Student Peer Review

Although numerous studies have highlighted the benefits of engaging in peer review, various authors have also identified several issues and potential impediments to implementing student peer review. While these are generally not causes for concern in the formative types of peer assessment discussed in this guide, there are still a number of practical and potential impediments that need to be considered to ensure that students achieve the intended learning benefits of engaging in peer review.

An important consideration (and potential obstacle) in implementing student peer review is related to student perceptions and attitudes about the peer review process. Several studies have shown that students may dislike evaluating another student's work. For example, note that some students resent being required to review and comment on other students' work, because they hold the belief that assessment is the 'teacher's responsibility'. This view is confirmed by Brindley and Scoffield's study in which the majority of students regarded assessment (and feedback) as solely the role of the tutor, and by Fallows and Chandramohan (2001) who also note that their students challenged the shift in responsibilities.

Another reason for students' discomfort with the idea of peer review is because they may lack confidence in their own ability to evaluate their peers' work. They may similarly doubt the competence of other student reviewers. To deal with this concern, Fallows and Chandramohan advise providing guidelines or training for reviewers and discussing the rationale for, and benefits of, peer review. This will strengthen the students' awareness of the process and assist them to critique their peers' work. It may also add positively to students' overall satisfaction with the review process.

Some students may be reluctant to engage actively with the peer review process because undertaking peer review of two or more students' work may be perceived to be overly time consuming, and they may feel that the 'cost' (in terms of time), outweighs the learning benefits they receive.

2.2 PEER REVIEW IN TEACHING

Peer Review of Teaching (PRoT) is a broad category of practices applied variably to academic development and assurance within the higher education sector. The term teaching in this context refers to all aspects of the process including the act of teaching, curriculum design, design of learning activities, assessment design and practice across all delivery modes. The broad typology Peer Review of Teaching (PRoT) is defined as 'academic colleagues giving and receiving feedback on their teaching'. Within this broad domain, approaches, purposes and practices vary considerably, as do the aims of implementing such programs. Differing terminology is used in the literature, often interchangeably.

Reflecting on the last two decades of literature available on peer review of teaching (PRoT) confirms its potential to enhance teaching quality and improve student learning. In addition to these high level and desirable quality outcomes, the literature also highlights specific potential benefits which may accrue at both the individual and institutional level, namely:

- Individual: improved confidence in one's teaching ability; enhanced awareness of student learning experience; insights into and adoption of new and innovative and more engaging teaching strategies; develop capacity of both reviewers and reviewees as reflective practitioners; enhancement of supportive collegial relationships and opportunities to share ideas, good practice strategies and challenges associated with teaching.
- Institution: expanding the range of quality data indicators beyond the traditional student evaluation; an additional source of data around teaching practices and challenges which can inform improvement strategies and academic development programs; demonstrate to students institutional commitment to quality improvement in teaching practice; contribution to the scholarship of learning and teaching (SoLT); when part-time staff are included, an enhanced sense of belonging to the institution results.

- Individual and institutional: raising the status and recognition of teaching within institutions, providing evidence for promotion and teaching awards; increasing the visibility of teaching activities within the academy, reducing the levels of isolation in which it is usually practiced, and increasing opportunities for transferability of good practice.

In terms of quality enhancement and assurance, peer review is advocated as complimentary to student evaluations e.g. SFUs/ SFTs, recognizing that peers have the expertise to assess aspects of teaching and curriculum which students cannot, including course objectives & content, assessment practices, learning activities, instructional materials and professional behaviors. A separate report has been compiled by the Office of Quality and Performance into the validity of the Student Feedback on Unit (SFU) and Student Feedback on Teaching (SFT) data. PRoT may support reflection on student evaluative feedback, providing an additional perspective and evidence to inform responses to student feedback.

2.2.1 Types of Peer Review

PRoT programs can be both formative and summative in nature. Formative processes focus on improvement of practices through constructive feedback, whereas summative are designed to provide evaluative evidence to inform decision making, such as for promotions or awards etc. Many institutions offer both types of review, however because of the more consequential nature of summative evaluations, it is generally recommended that a clear distinction is maintained.

Approaches to PRoT can be placed along a continuum according to the dominance of the following characteristics, aligning with the formative/summative distinction:

Within these two broad categories Gosling (2014) describes three broad models of peer review, distinguishable by their purpose or function and associated implications on the power relationships between academics which characterise them, namely: Evaluative, Development and Collaborative Models.

2.2.2 Why Peer Review?

Peer review serves many functions in the process of evaluating faculty, courses, or entire programs.

- **What's good for research is good for teaching.** As in peer reviews of research, it is a vital means of receiving expert assessments of one important part of scholarly practice: teaching. As with research, peer review ensures that faculty internalize, in the words of Pat Hutchings, scholarly "habits of mind" by identifying goals, posing questions for inquiry, exploring alternatives, taking appropriate risks, and assessing the outcomes with learned colleagues. When this process of scholarly engagement and deliberate improvement is part of the institutional expectations for teaching, as it is with research, it can function to support a community of scholarship around teaching.
- **Enables teaching to be a community endeavor**. Relatedly, too often in higher education teaching is subject to what Pat Hutchings has called, "pedagogical isolation," but peer review provides opportunities for us to open our teaching up to a community of colleagues who can nurture improvement.
- **Peer review allows for less exclusive reliance on student evaluations.** Student evaluations have become institutionalized in higher education and for the most part provide extremely useful information for the purposes of evaluating faculty, courses, and even entire curricula. However, students may not always be the best evaluators since they often have limited disciplinary training, they can have biases against certain faculty unrelated to teaching effectiveness, and they can be less cognizant of institutional goals or values than faculty. Indeed it is for these reasons that the American Sociological Association, along with other professional societies, have cautioned universities not to overly rely on student evaluations.

- **Greater faculty experimentation and rigor.** Just as importantly, an over-reliance on student evaluations in processes of professional review can cause faculty to become overly concerned about receiving positive student evaluations. In the worst of moments, this can lead faculty to adopt a consumer model of education, shaping our teaching to meet the needs of students over the needs of our disciplines or institutions. This, in turn, results in faculty becoming overly cautious by refusing to challenge student expectations by using conventional teaching methods, by becoming less rigorous in their standards, and at worst, by feeling a need to entertain more than educate. Peer review, when done in formative and summative forms alongside student evaluations, can ensure both faculty and students will have a voice in their evaluation, and that faculty have greater autonomy to innovate and to teach rigorously. This can give faculty the opportunity to focus more intentionally on what helps students learn best, and therefore more directly focus on the quality of their teaching.
- **Allows for both formative and summative evaluation.** When done well, peer review involves both formative and summative evaluations. The inclusion of greater formative evaluation allows for more significant faculty and instructional development by encouraging more critical reflection on teaching and by providing a safer,

less risky, and more collegial setting for assessment.

- **Improves faculty approaches to teaching.** Daniel Bernstein, Jessica Jonson, and Karen Smith (2000), in their examination of peer review processes found they positively impact faculty attitudes and approaches toward teaching. While their study did not reveal a necessary shift in faculty attitudes towards student learning and grading, it did change several important aspects of teaching practice. First, it dramatically impacted in-class practices, particularly the incorporation of more active and collaborative learning, and less reliance on lecturing. Second, it improved faculty willingness to ask students to demonstrate higher order intellectual and critical thinking skills. Third, for some faculty it increased the quality of feedback they gave to their students on assignments, and thus improved student understanding and performance. And lastly, they enjoyed discussing substantive disciplinary and teaching issues with their colleagues, enhancing the scholarly community in their departments and programs. Peer review therefore shows an ability to improve faculty joy in teaching by improving the relations among faculty and students, and among faculty themselves.

2.2.3 How to Select Peer Reviewers

Peer review may take many forms, but usually begins with the selection of peer reviewers drawn most often from within the same department or program as the instructor being reviewed. The reviewers typically are senior faculty, but sometimes junior faculty as well, who have significant expertise in teaching. These faculty may be chosen to undertake all peer teaching reviews for the department or program during a specific period, or they may be selected specifically because they share some expertise with the instructor being reviewed. The person under review also may be granted some choice as to whom one or more of the reviewers may be. The number of the reviewers may vary but usually include at least two and rarely more than four.

In selecting reviewers, one must be mindful of several criteria**.**

- **Institutional Experience.** It helps if reviewers are highly familiar with the department or program, school, and institutional goals, and particularly the processes of peer review itself and the criteria that form the basis of the assessment.
- **Integrity.** Peer reviews also function best when reviewers have commitments to integrity, fair-mindedness, privacy, and understanding the reasoning behind the teaching choices of the person under review.
- **Trust.** Peer reviewers, especially in formative reviews, work collaboratively with the faculty under review to establish a clear process of evaluation and reporting, therefore peer reviewers who can establish trust are particularly effective.
- **Mentorship.** Those under review are particularly vulnerable and often anxious, therefore reviewers who have grace and tact in the process of assessment, can offer feedback with integrity and support, and who can help advise on strategies for faculty development will be most helpful.

- **Thorough and Practical.** Peer reviewers should be able to provide summary reports that clearly and thoroughly represent all phases of the process, and that make recommendations that are specific and practical.

2.2.4 How to Evaluate?

The peer evaluation itself usually focuses on several aspects of teaching through a process that usually has a series of activities. The following list of peer evaluation activities represents a sequential, reasonably thorough, and maximal model for peer review, but not all are necessary.

Develop Departmental Standards for Teaching

Without a clear set of learning goals for all departmental programs it is difficult to assess teaching with any validity or reliability, and it can leave departments open to biases, inconsistencies, and miscommunications in peer evaluation processes. One of the greatest benefits of peer reviews of teaching is that it provides an occasion for departments and programs, if not entire schools and universities, to be more intentional, specific, and clear about quality teaching and learning, and the various means to achieve it. This may be the work of an entire department or a special teaching committee that researches disciplinary and institutional benchmarks and proposes guidelines for review.

Preliminary Interview

Peer review processes usually begin with a conversation, sometimes framed as an interview, between the peer reviewers and the teacher being reviewed. The prime purpose of this is to provide the teacher in question an understanding of the process of peer review, and to offer them the opportunity to provide their input on the process. The conversation also allows the peer reviewers to begin collecting information about the teaching context, particularly the courses, of the teacher being reviewed. This context helps to provide better understandings of the teacher's goals and teaching choices, and may be divided into several dimensions related to the design of their courses.

- Logistical contexts. How many students? Is the course(s) lower division, upper division, a graduate class, etcetera? How frequent and long are the class meetings? Is it a distance-learning course? What are the physical elements of the learning environment?
- Goals. How have the learning goals of the course(s) been shaped by the department, college, university, or discipline? Are the courses required or electives? What kinds of intellectual and skill outcomes is the focus of the course(s)?
- Characteristics of the learners. What are their ages and other demographic factors that may bear upon teaching? What is their prior experience in the subject? What are their interests and goals? What are their life situations?
- Characteristics of the teacher. What expertise does he or she have in the subject areas? What are his or her own assessments of his/her strengths and weaknesses? What models of teaching did he or she encounter as a student? What theoretical or practical orientations ground his or her approach to teaching and learning? What from the teaching and learning scholarship has been influential on his/her teaching? How do these influences take shape in the teaching of the instructor's different courses?

Class Observations

The goal of the class observations is to collect a sample of information about the in-class practices of teaching and learning. They typically include two to four class visits to gain reliable data. If the teacher being reviewed teaches multiple courses, as they often do, the process may involve fewer observations per course (e.g., two).

What to observe? The goal is to create a thorough inventory of instructor and student practices that define the teaching and learning environment. These may vary widely across discipline and teachers, and can be drawn from a broad array of pedagogies, depending on learning goals. This said, there are several categories of instructor and student practices to note during the observation(s).

- Content knowledge
- Use of instructional materials
- Class organization
- Presentation form and substance
- Teacher-Student interactions
- Student participation
- Assessment practices

How to assess teaching practices? In many institutions, inventories of teaching practices are combined with assumptions about what is conducive to student learning. It is important for the peer reviewers and the administrators who guide them to be conscious of what they regard as effective teaching and the appropriate evidence for it before committing to an observation process, lest the peer review gather invalid or unreliable data, and lest the process invite peer biases and unexamined pedagogy into the evaluation. A reasonably representative list of teaching practices, along with more or less explicit value for learning, would include the following:

Content knowledge:

- Selection of class content worth knowing and appropriate to the course
- Provided appropriate context and background
- Mastery of class content
- Citation of relevant scholarship
- Presented divergent viewpoints

Clear and effective class organization:

- Clear statement of learning goals
- Relationship of lesson to course goals, and past and future lessons
- Logical sequence
- Appropriate pace for student understanding
- Summary

Varied methods for engagement, which may include:

- In-class writing
- Analysis of quotes, video, artifacts
- Group discussions

- Student-led discussions
- Debates
- Case studies
- Concept maps
- Book clubs
- Role plays
- Poster sessions
- Think aloud problem solving
- Jigsaws
- Field trips
- Learning logs, journals
- Critical incident questionnaire (see Brookfield)

Presentation:

- Project voice
- Varied intonation
- Clarity of explanation
- Eye contact
- Listened effectively
- Defined difficult terms, concepts, principles
- Use of examples
- Varied explanations for difficult material
- Used humor appropriately

Teacher-Student Interactions:

- Effective questioning
- Warm and welcoming rapport
- Use of student names
- Encouraging of questions
- Encouraging of discussion
- Engaged student attention
- Answered students effectively
- Responsive to student communications

- Pacing appropriate for student level, activity
- Restating questions, comments
- Suggestion of further questions, resources
- Concern for individual student needs
- Emotional awareness of student interests, needs

Appropriateness of instructional materials:

- Content that matches course goals
- Content that is rigorous, challenging
- Content that is appropriate to student experience, knowledge
- Adequate preparation required
- Handouts and other materials are thorough and facilitated learning
- Audio/visual materials effective
- Written assignments

Student engagement:

- Student interest
- Enthusiasm
- Participation
- Student-to-student interaction

Support of departmental/program/school instructional efforts:

- Appropriate content
- Appropriate pedagogy
- Appropriate practice

In-class, formative assessment practices:

- Background knowledge probes, muddiest point exercises, defining features matrix and other "classroom assessment techniques" described in greater detail here
- Ungraded in-class writing exercises, such as minute papers
- Discussions

- Questioning

Out-of-class, summative assessment practices:

- Class participation
- In-class writing exercises, graded
- Presentations
- Examinations
- Projects

Use of observation forms. To make the process more transparent, reliable, and valid, many departments and programs use observation forms, constructed from items like those listed above, to help peer evaluators track and evaluate teaching and learning practices. These may include nothing more than checklists of activities; they may provide rating scales (e.g., Likert scales) to assist the evaluation; they may have open-ended prompts that provide space for general commentary and analysis; or, they may involve some combination of all three. The most thorough forms guide the observer in what exactly they should observe, and prompt them to provide some synthesis and evaluation of their observations

Evidence of Student Learning

End-of-course student work. To more thoroughly assess the effectiveness of instruction, peer reviewers may collect evidence of student learning in the form of examinations, written assignments, and other projects from the course of the teacher under review. Collecting this evidence may be helpful in assessing core competencies expected from the course.

Student work throughout the course. Evidence of student learning may be more thoroughly assessed by collecting examples of student work at various times during a course so as to gain perspective on student growth and development. To do this requires some preparation and lead-time to ensure the teacher under review is sure to collect work from students, and gain their consent for sharing it.

Grades. Student grades also may be used as an indicator of student performance, if they are accompanied by contextual information such as a grade distribution, the criteria used to assign those grades, and samples of student work at A, B, C, D, and failing levels.

Student Evaluations. In addition to reviewing standard end-of-course evaluations, peer reviewers may choose to solicit letters of evaluation from a sample of students, current or alumni, who have had at least one course with the teacher in question, preferably two or more. Requesting these from graduates who have a more mature perspective on the effectiveness and impact of the teacher under review can be especially useful. The request for evaluation letters can be more or less specific in its prompts, but at a minimum typically introduce the importance of the evaluation process for the individual and the institution, and ask for them to assess how effective the teacher was as an instructor, what limitations he or she may have, and what impacts he or she made to their educations.

Engagement with Centers for Teaching. If the person under review has attended consultations, workshops, or other programs offered by a campus center for teaching and learning, the evaluation process may consider this to be part of the analysis.

Advising Activity. Peer evaluators may wish to make note of the advising activities and load of the teacher in question, along with any special service to the teaching mission of the department, school, or institution. This may involve some data collection from students the teacher has advised and peers with whom the teacher has collaborated in their teaching service. For some faculty, this kind of teaching outside typical course structures can be a substantial contribution to the teaching mission of the department.

Professional Publications, Presentations, and Recognitions. Peer reviewers also may wish to collect evidence of the scholarly activities in teaching and learning by the teacher in question, such as professional publications, presentations, or awards for their teaching.

Collaborative Analysis. Together, each of the activities above provides information that can be assembled into an overall picture of the teacher under review. After meetings between the peer evaluators to review the data collected, any missing information can be sought and unresolved questions can be answered. It is then incumbent upon the evaluators to discuss the form and substance of a final assessment and to divide the work of writing it.

Overall Recommendation. Typically the written evaluation includes some clarification of the process, the methods, the data collected, and of course any positive feedback and constructive criticism that is necessary, along with suggested improvements. This will be the substance of a formative or summative assessment by the peer evaluators, one that may be shared with the relevant administrators and the teacher under review, depending on the process adopted. If the evaluation is formative, this may accompany a series of suggested improvements for teaching and a plan for instructional or curricular development that could include ongoing mentorship, the use of professional development resources such as the Center for Teaching, and further peer evaluation. If it is a summative evaluation, the recommendation will be used by departmental and university committees and administrators as the basis for a reappointment, promotion, or tenure decision.

2.2.5 Possible Limitations of Peer Review

Limitations of Peer Observations

While peer review may be a process that allows for a more rigorous evaluation of a teaching portfolio, it is worth noting that peer observations alone are often insufficient data on which to base an entire teacher's assessment. Peer observations represent merely a snapshot of teaching, and thus must be only one component of a teaching portfolio that is subject to peer evaluation, including student evaluations, evidence of student learning, course materials, and self evaluations, just to name a few.

Bias

Surely, all methods of teaching evaluation risk biases of one form or another. One common criticism of peer review processes is that they may invite some bias if they involve limited or unprofessional approaches to information collection and analysis. This may occur because of several reasons. Personal relationships between reviewers and those being reviewed can create either hyper- or hypo-critical approaches to evaluation. Standards of excellence or their application can be highly subjective and individual teaching styles may vary widely, therefore evaluations can be contentious if standards are not defined in advance through rigorous research and open, collaborative processes. Power relations in departments or programs also can unduly influence open and thorough evaluation. Other factors may cause peer evaluator bias as well. Therefore, to avoid the worst cases of bias, peer review must be established via processes that guarantee the greatest rigor, openness, and transparency.

Collegiality Issues

Under the best of circumstances, peer review can shape a dialogue about teaching that fosters a teaching community among educators and can lead to more growth-oriented forms of professional development. However, when it is implemented in less collaborative and more adversarial forms, or when it involves unavoidable consequences such as promotion or job security, anxieties and frustrations can be triggered for both reviewers and those being reviewed. Therefore peer review must adhere to the highest standards of transparency, integrity, and care for the sake of those under review.

Time and Effort

Possibly the most common critique of peer review processes, and the reason they are not more commonly used in the academy, is that they require significant time and effort. Departmental and campus administrators must define the process, establish standards, train and prepare reviewers, perform peer observations, review portfolios, draft assessments, and have multiple dialogues with those under review. Each step requires preparation if it is to be fair, transparent, and professional. Any shortcut may compromise the rigor, care, or goals of the evaluation. However, there are several shortcuts each with potential costs.

Rely on the expertise of senior colleagues, administrators, and the Center for Teaching

There are typically those on campus that may have sufficient knowledge to assist in defining departmental learning or teaching goals, in determining what data to include in a teaching portfolio, in training peer observers, in drafting assessments, etcetera. These sources of expertise may be helpful in streamlining the process with little cost to its integrity, as long as their suggestions may be tailored to the needs of the department or program in question.

Use Predefined Standards for Teaching and Learning

Rather than spend significant time adjudicating which learning and teaching goals are appropriate, department or program leaders may decide to use existing language in university or departmental missions, course catalogs, accreditation reports, other constituting documents, or the operating principles of the Center for Teaching. This may grant some efficiency with limited costs to the integrity of the peer review process. However, vague and imprecise learning goals that sometimes characterize constitutional documents (e.g., "critical thinking") may be of little help in benchmarking a specific set of courses or teaching strategies. Likewise, departments and programs may have particular teaching challenges that broad standards may not take into consideration. Both difficulties can leave departments or programs open to unclear standards, unfair or inconsistent judgments, and miscommunications.

Collect Data Judiciously

One of the more time consuming tasks of peer review is combing through all facets of a teaching portfolio, particularly if it includes samples of student work. To save time, some peer review processes rely largely upon peer observation, in addition to student evaluations of teaching, and do not collect teaching portfolios or examples of student work. Others collect only limited samples of student work, such as grade distributions and examples of student work at A, B, C and D levels to evaluate an instructor's assessment and grading strategies. Other data collection short cuts may be possible as well. However, more limited data may allow fewer contextual interpretations of a teaching career, and peer observations alone are merely in-class snapshots of instructional performance, not a more encompassing perspective on all phases of teaching. These may lead a department or program to make less informed and fair judgments.

Use Templates for Written Peer Evaluation Reports

Final written reports need not be highly expansive analyses, but may represent more of a thorough check list with brief sections of commentary on challenges and successes that become points of discussion between peer reviewers and the instructor under review. This form or report can save valuable time, but it also may provide limited feedback to the instructor under review, possibly affording him or her less useful guidance on where to improve his or her teaching.

Only Summative Evaluation

A department or program may limit peer evaluation to only summative and not formative assessments of teaching. This would limit opportunities for faculty development, hinder data collection, create more tensions between reviewers and those being evaluated, and thwart the formation of collegial cultures that improve teaching for entire departments and programs. However, many departments and programs have used this shortcut to conduct peer review.

2.3 PROCESS OF PEER REVIEW

This proposed peer review of teaching process is one that is designed to be more formative than summative. It could be a component of a continuous improvement program. Its main purpose is to provide faculty with meaningful feedback that will help the faculty member set goals and take steps toward improving teaching abilities. These goals are derived from the process of faculty self-assessment, peer observation, and collegial dialogue. Utilizing consultations with teachers before and after peer observation is essential and provides insight into the teaching objectives and strategies utilized by the teachers being observed. The results of peer review may also be summative when utilized by faculty department chairs for the purpose of developing growth plans within the institution's faculty appraisal system. It has been observed that peer review programs in many universities contain very similar elements and processes. The similarity is probably due to their basis being derived from the established literature on this subject. This peer review process has been adapted from these same sources.

Peer review can consist of these basic steps, conducted in this order:

- Review of course materials
- Preobservation consultation
- Teaching observation
- Postobservation consultation and feedback

- Written evaluation
- Monitoring the peer review process

Step 1: Review of Course Materials

Reviewing course materials is a starting point of peer evaluation. This allows the reviewers to examine the syllabus, course guides, samples of presentations (eg, Power Point slides), required and suggested readings, handouts, assignments, tests, and other student evaluations. Course materials are very important in supporting the learning that takes place in a course. A look at a test can tell much about the level of learning goals in the course, the instructor's perception of what is important, and the instructor's pedagogical style toward the students. Combining review of course materials with evidence gathered in other ways, such as observations, is necessary to arrive at a full picture of instructors' teaching abilities.

When the peer reviewers are selected, the teacher under review can provide a copy of the course materials. Some of the factors that may be evaluated to determine the quality of these materials include the following:

- Are presentations, handouts, readings, and/or assignments relevant and current?
- Are they effectively coordinated with the syllabus?
- Are they challenging for students?
- Do they include opportunities for active learning or collaboration?
- What is your overall judgment on how thoroughly these materials reflect the instructor's preparation for his or her teaching work?

The faculty member may also supply to the reviewer a copy of his or her teaching portfolio containing a statement of the professor's philosophical beliefs about teaching and student learning, along with teaching strategies, sample(s) of best work, and plans for self-assessment of teaching effectiveness.

Step 2: Preobservation Consultation

This step initiates the interaction between the peer reviewer(s) and the teacher. The consultation allows the reviewer(s) to gain insight into the goals and strategies utilized by the teacher. There should be ample time allowed for the development of meaningful and collegial dialogue. It is important to meet with the reviewers ahead of time to discuss the educational intentions, aspects of the teaching for which the teacher seeks feedback and constructive advice, and whether different methods or strategies will be used. The person to be observed generally recommends an observation focus—for example, student activity, presentation skills, clarity of explanation, interactivity, use of aids, and/or questioning skills. Before the teaching observation, the reviewer(s) can schedule a meeting with the instructor, at which time, several points may be discussed, including course materials, overall course objectives, teaching method and objectives for the specific learning event to be observed, and other topics considered important by either party.

Step 3: Teaching Observation

Peer review of another faculty member is not a simple task. It should be no surprise that most faculty, not having been trained to teach or having practiced teaching in a scholarly manner, find peer review of teaching to be complex and confusing. It should be more than simply "come and observe my teachings," which could result with just dealing with the surface aspects of the teaching. Classroom observation is perhaps the most familiar form of peer review. An advantage of classroom observation by peers is that the peer's own development may be fostered through the ideas obtained from watching a colleague. Reciprocal classroom observations are a strategy employed in many faculty development programs, such as the New Jersey Master Teacher Program.

Observations of primary teaching mode should be the focus. For clinical teaching, peer review in a patient care setting should be considered. Care should be taken to observe the more common teaching mode used. Ultimately, it should be the prerogative of the reviewer to choose the teaching event observed. The reviewer should use a checklist for teaching observation as a guide for evaluating the faculty member's performance. A checklist rubric should be developed by involved faculty in order to obtain evaluation criteria that can be objectively and fairly applied during peer review. This should be developed according to the objectives and goals of the institution. Areas that need improvement, are satisfactory, or are exceptional can be defined. For both classroom and clinical teaching, the appendix provides an example. In addition to an evaluation rubric worksheet, an observation checklist of clinical teaching strategies can be utilized. In a review of the literature, Heidenreich et al identified the following strategies in clinical teaching: orienting learner, prioritizing or assessing the learner's needs, problem-oriented learning, priming, pattern recognition, teaching in the patient's presence, limiting teaching points, reflective modeling, questioning, feedback, and teacher/learner reflection.

At the end of the visit, the reviewer can ask the students to complete a feedback form on whether the activities observed were typical of the course's norm. Sample questions can include: Any reactions to or comments about today's activities? How typical were today's teaching activities compared with others? How useful were today's activities?

Step 4: Postobservation Consultation and Feedback

This meeting works best as a discussion, not just the observer giving feedback. Giving the teacher the first opportunity to comment allows for active participation and discussion. Start by discussing what the teacher is doing well, and why. Areas of focus from the first consultation can be revisited. Also, the same items mentioned earlier in the area of self-reflection can be a starting point.

In order to provide timely feedback, the reviewer can schedule a meeting with the faculty member within 1 week of the observation. The teacher and reviewer may wish to review the performance in the categories listed on the observation checklists. The most and least effective elements of the teaching observed can also be discussed, as well as suggestions on how to improve performance. This may also be a good time for the teacher to clarify any elements of the mode of teaching that are unfamiliar to the reviewer. In short, this time can be used to cover any topics considered important by either party.

The process of giving feedback is critical for improvement of teaching. How feedback is provided is as crucial as the process of peer review itself. The chances that teaching improvement will occur increases when feedback is accurate and specific (often better with examples), is given in a supportive and nonjudgmental manner, provides specific alternatives for aspects of teaching that need change or improvement, is focused and relevant, and allows room for discussion and interaction. In the discussion, the term *work* or *contribution* is used to describe the matter on which feedback is given.

Step 5: Written Evaluation

Within a reasonable period after the postconsultation, the reviewer can prepare a written evaluation of the professor's teaching and supply the evaluation to the teacher's supervisor. The supervisor can then supply the faculty member with a copy of the evaluation. The faculty member should then have the opportunity to respond to this evaluation in writing. After the completion of the peer review, a copy of the evaluation should be provided to the faculty member and the department chair. As in all faculty evaluations, these documents should be kept confidential.

Step 6: Monitoring the Peer Review Process

The faculty member being reviewed may complete an exit survey, which will serve to give the peer review committee feedback regarding the strengths and weaknesses of the peer review process. The exit survey can also be given to the department chair. This can cover the following areas:

- Was there an effective exchange of teaching and learning strategies with the reviewer(s)?
- Does the evaluation document the observed use of teaching and learning strategies?
- What was the most positive or helpful aspect of the peer review process for you?
- What was the least helpful or most negative aspect of the peer review process for you?

- What would be the most helpful or beneficial to the development of your teaching effectiveness?
- The peer review committee, in consultation with interested parties, should reevaluate this peer review procedure periodically. The results of this review can be presented to the faculty, along with any recommendations on how the procedure should be amended.

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CHAPTER 3

DISCUSSION

INTRODUCTION

Discussion is important to learning in all disciplines because it helps students process information rather than simply receive it. Leading a discussion requires skills different from lecturing. The goal of a discussion is to get students to practice thinking about the course material. Your role becomes that of facilitator. You design and facilitate the discussion rather than convey information. If you want to hold a discussion, don't do all the talking yourself; don't lecture to the group or talk to one student at a time.

3.1 CONCEPT OF DISCUSSION

Discussion is "the effort of a group of individuals who talk informally together in order to solve commonly recognized problems or to arrive at an understanding of values. Although bearing a long history and used extensively in all types of educational settings, permeating through various teaching methods, discussion rose to the focus of research and practice fairly recently, having been overshadowed by teacher talk, which dominated classroom activity until late 1980s.

Today's educational literature continues to explore discussion as a close parallel of cooperative learning, where students of all levels of performance work together in groups to achieve a common goal. In discussions, students "compare existing ideas and opinions, generate new ones, and pursue questions of personal interest" in order to explore concepts rather than discovering facts. In higher education settings, discussion can take the format of short discussion sessions interspersed between lectures, or scheduled as separate blocks apart from classroom lectures. Discussions can be conducted in large or small groups, and can be prompted by teacher questions or by assigned group leaders. Discussion has been commonly studied as an effective form of active learning, with highlighted examples of using small-group discussion and peer discussion in undergraduate classes of biology, genetics, physiology, engineering, anatomy, communications, business and geology.

Discussion is an efficient way to generate dynamic engagement even in large classes. It can help to create "excitement" in classrooms. While students may experience anxiety in speaking in a large class, group discussions allow them to share thoughts first among a small number of peers, which appears less daunting than voicing a personal opinion. Discussion serves two compensation functions: it compensates for limited individual time in traditionally lecture-based classrooms, particularly for large classes in undergraduate foundational courses; it also supplements instructor explanation to foster substantial conceptual understanding and enable students to reflect and restructure their learning as active participants instead of passive spectators.

Empirical research has proved the positive effects of discussion on enhancing conceptual understanding and generating interest in learning. Group discussion is found to help achieve higher performances in tests, as verbalizing an idea or concept helps with memorization and integration with other concepts. In particular, with its positive effect on recall and understanding, short discussion as "interactive windows" between lectures helps improve students' performance in examinations, particularly in short answer and essay type questions. In general, discussion promotes students' interests in more serious and purposeful reading, as well as their ability to learn things that they find little relevance with or that contradict with their existing beliefs.

While scholars have yet to determine whether more frequent discussion leads to greater knowledge acquisition, evidence is found for its contribution to improved higher-order thinking. Discussion requires students to recall prior knowledge and better integrate information. The verbal expression process inherent in discussion enhances students' abilities in effective presentation of problems and evaluation of identified solutions. Ultimately, students will gain better proficiency in justifying arguments, conducting critical examination of others' opinions, and developing the "communicative and metacognitive skills that are crucial components of disciplinary expertise".

The importance and provided tips on the careful preparation for an effective discussion, including preparing good discussion-starting questions, providing a safe and encouraging space and classroom norms, and effectively leading the discussion. For small group discussions, it is preferable to have groups of eight to ten. It is also useful to conclude student-centered activities with a brief, instructor-led, whole-class discussion that provides feedback to students on their responses and makes additional connections to the lecture material.

3.1.1 Preparing for Discussions

To start planning a discussion (or any instruction, for that matter) decide what you want your students to get out of the discussion. For example, do you want them to share responses, make new connections, and articulate the implications of a text? Should they be able to work certain problems by the end of the hour? Should they be able to interpret and critique a journalistic photograph or a piece of art? Deciding on and articulating the objective for the discussion will help you decide what kinds of discussion activities will best help your students reach that objective. Remember that you can organize a discussion in many different ways: you can have students work in small groups, role-play, choose sides for a debate, or write and share a paragraph in response to the theme in question1. You will also want to leave time to wrap up and summarize the discussion for your students (or have students summarize it), or to debrief after activities such as debates or role-plays.

3.1.2 Develop a Clear Goal for the Discussion

Knowing the content to be covered is not enough. Naming the chapter your students will read is not enough. If you've only thought as far as, "I want students to know ..." you haven't thought through enough what needs to be accomplished. You should be able to articulate what the students will be able to do with the information or ideas. For example, in a philosophy class for which students have read a chapter on epistemologies or theories of knowledge, you might want students to be able to construct legitimate arguments for and against any epistemology about which they have read.

3.1.3 Problematize the Topic

Having a clear goal in mind makes it much easier to plan a discussion. You know what you want students to get out of it. But it is not enough: An instructor at IU several years ago told the story of how she wanted her students to deal with the issue of prejudice. She tried to start discussion merely by saying "Discuss prejudice." No one spoke. She then asked if anyone had seen prejudice. One student raised a hand. When she asked what it was like, the student merely said "awful." She had a goal, but not a problem or an activity to get the students to engage the ideas to achieve the goal.

The opposite end of the spectrum is also a problem. While "Discuss prejudice" is too open-ended, merely asking for the basic facts won't work either. You've probably heard a professor rattle off a list of questions that require only brief factual replies and little student involvement:

Q. When was the Battle of Hastings?

A. 1066.

The result could hardly be called a discussion. So, give your students an open-ended problem to solve, a task to complete, a judgment to reach, a decision to make, or a list to create—something that begs for closure.

3.1.4 Select a Discussion Format

Many discussion activities can be used in the classroom. Choose one that will help your students meet your goals for the discussion. The more specific you can be in assigning the task, the more likely your students will be to succeed at it. Consider the protocols for tasks such as Think-Pair-Share, Affinity Mapping, Chalk Talk and other conversation structures.

3.1.5 Choose a Method to Assign Students to Groups

When assigning students to groups, consider the following questions.

- ***How big should the groups be:*** Two to six is ideal. Smaller groups (two-three) are better for simple tasks and reaching consensus. Also, students are more likely to speak in smaller groups. Larger groups of four-five are better for more complex tasks and generating lots of ideas.

- ***How should students be assigned to groups:*** Randomly assigning students to groups avoids the problem of friends wanting to get off track. For long-term groups, you may want to select for certain attributes or skills (e.g. a statistician, a geology major, and a writer) or by interest in the topic, if different groups have different tasks.
- ***How long should the groups meet:*** Just for this activity or for all semester. Stop the discussion groups while they are still hard at work; next time, they will work doubly hard. Long-term groups allow students to practice collaborative skills and make stronger bonds, but sometimes they get tired of each other.

3.1.6 Choose a Debriefing Method

Always debrief students; it is the most important part of a discussion, the time to summarize and synthesize. Most of learning in discussions happens during debriefing, so don't squeeze it in—a rule of thumb is to use one-third of the total discussion time for debriefing.

You can use debriefing to correct incorrect notions. You can slip in any points that students neglected but that are important. You can pick which student reports from each group, though you should tell them in advance that you plan to do this. This makes everyone in the group responsible. You don't have to hear back from every group, but can instead choose a few at random. When groups start repeating ideas, it's time to stop.

Many techniques can get students to share what their smaller groups have done with the entire class: verbally, on newsprint/flipchart, blackboard or overhead, ditto/photocopy, etc. And you don't have to hear from everyone; calling on a few groups at random to report works quite well. To encourage student cross-team competition in Team-Based Learning, reporting out from groups is simultaneous. Answers can be posted to a Powerpoint slide or pieces of newsprint hung on walls of class.

3.1.7 Problems with Discussion

- ***Getting Started:*** Students are often reluctant to get down to work in a discussion. Students are more likely to join in discussion if you divide them into pairs or small groups and assign a specific discussion question. After a few minutes of small group discussion, ask several groups to report out their ideas to the entire class. This often helps to get discussion going because students have had a chance to "try out" their ideas on their peers. Alternatively, give students time to write individually before opening up a discussion; they are much more likely to speak up if they have some notes to speak from. Further, by allowing for this kind of pre-discussion activity, you will be able to ask more complex and interesting questions. At the same time you will be promoting equity in the conversation, allowing everyone in the class to gather his or her thoughts before speaking rather than privileging the bold or the entitled, who can otherwise dominate the discussion.
- ***Attendance:*** Despite the fact that discussion section participation is a requirement for many introductory courses, students may believe that their attendance is not mandatory since the AI rather than the professor is in charge. Therefore you may want to devise a way to structure required assignments, projects or presentations into your sections so that section participation will be a part of the final course grade. If students know that the AI has some responsibility for determining their grades, that AI will have considerably more authority in the classroom or in any interactions with students.

- ***Losing Control:*** One fear about discussion is the possibility that the discussion will be TOO enthusiastic or not remain civil. Develop ground rules as a class. Gently, students can be reminded that behavior X (e.g., interrupting, blatantly ignoring the conversation, showing disrespect) is not appropriate in the context of the rules the class agreed on. If no rules have been established, or if the inappropriate behavior doesn't seem to fit under the rules, you should address it immediately. Otherwise, you send a message to the students that such behavior is acceptable. Often, simply walking toward the student(s) will resolve the problem, as they will see that you are paying attention. Sometimes, however, you will need to address the problem directly. Try not to get rattled—take a deep breath, allow some silence, and then respond. This gives you some time to plan a response that models for the students how to handle a difficult situation. Remember: never shame or humiliate a student, and don't take student remarks personally—although an attack may seem personal, it may be directed at authority figures in general rather than at you in particular.
- ***Discussion Monopolizers:*** If the same students answer all the time, you might say, "Let's hear from someone else." Then don't call on students who have already spoken. Do not allow one student to speak for an inordinate amount of class time. Take that person aside and ask him or her to limit comments in class. If the student does not respond to this hint, tell him or her an exact number of times he or she will be allowed to respond in class, and do not call on him or her after that number has been reached in any class period.
- ***Controversial Topics:*** If you teach charged topics, prepare students for discussing them. For an article about how to build up the skills necessary to discuss sensitive topics, see "Controlled Fission: Teaching Supercharged Subjects".

3.1.8 Strategies for Building Discussion throughout a Class Session

- ***Delay the problem-solving part*** until the rest of the discussion has had time to develop. Start with expository questions to clarify the facts, then move to analysis, and finally to evaluation, judgment, and recommendations.
- ***Shift points of view:*** "Now that we've seen it from [W's] standpoint, what's happening here from [Y's] standpoint?" "What evidence would support Y's position?" "What are the dynamics between the two positions?"
- ***Shift levels of abstraction:*** if the answer to the question above is "It's just a bad situation for her," quotations help: "When [Y] says "_____," what are her assumptions?" Or seek more concrete explanations: "Why does she hold this point of view?"
- ***Ask for benefits/disadvantages of a position*** for all sides.
- ***Shift time frame***—not just to "What's next?" but also to "How could this situation have been different?" "What could have been done earlier to head off this conflict and turn it into a productive conversation?" "Is it too late to fix this?" "What are possible leverage points for a more productive discussion?" "What good can come of the existing situation?"
- ***Shift to another context:*** "We see how a person who thinks X would see the situation. How would a person who thinks Y see it?" "We see what happened in the Johannesburg news, how could this be handled in [your town/province]?" "How might [insert person, organization] address this problem?"
- ***Follow-up questions:*** "What do you mean by ___?" Or, "Could you clarify what you said about ___?" (even if it was a pretty clear statement—this gives students time for thinking, developing different views, and exploration in more depth). Or "How would you square that

observation with what [name of person] pointed out?"

- *Point out and acknowledge differences in discussion*—"that's an interesting difference from what Sam just said, Sarah. Let's look at where the differences lie." (Let sides clarify their points before moving on).
- *Compare topics from a previous week*—"Use the four systems of though/intellectual movements we have studied to create a slide that answers the following questions..."

3.2 DISCUSSION TECHNIQUES FOR ACTIVE LEARNING

When using lecture or discussion in the classroom, it's often difficult to tell what students have learned without testing them. Quick and easy formative assessments can gauge what students know without burdening you or them with a formal test.

3.2.1 Affinity Map

Ask an open-ended question that has many possible answers. Have the students write one idea per post-it note about the question. Instruct students to work silently on their own. Reminding students to remain silent, have them organize ideas by "natural" categories. Once they have done this ask them to converse about the sorting and come up with a name for each category. Review and discuss the group categories and use them as a springboard to further deeper understanding of the topic.

3.2.2 Think-Pair-Share

After posing a complex question, ask students to respond in writing for 1–2 minutes, depending upon the complexity of the question. Then ask students to pair up and talk with their neighbor about their response for 1–2 minutes. Finally, ask selected pairs to share their responses with the whole class. This technique improves the quality of students' responses to questions by allowing for processing time. The technique also improves the participation of generally quiet, shy, and unsure students.

3.2.3 Partial Problem

This activity helps students practice parts of problems that typically cause them difficulty. Instructors can see how well students grasp this part of the problem or whether students need additional instruction. In a problem requiring several steps, work the problem for the students or with them until a critical point. At that point, stop and ask what the next step is. Students should be able to identify what must be done and complete the problem. Students only work the part of the problem that they most need to focus on. The "easy part" is either worked for them or omitted all together.

3.2.4 Save the Last Word for Me

In groups of three or four, each participant silently chooses an idea or passage from a reading which s/he found to be significant. When the group is ready, a volunteer begins by reading his/her passage but says nothing about why s/he chose that point. The other two or three participants each have one minute to respond to that idea. The reader then has three minutes to state why s/he chose that passage and to respond to his/her colleagues' comments. The same pattern is followed until all members of the group have "had the last word." The instructor keeps track of time; talk has to stop when time is called, and if the speaker finished before time is called, the group sits in silence reflecting. When the process is complete, the instructor debriefs the process, asking, for example, "How did this work for you?" and "What didn't work for you?" Debriefing is essential and must not be skipped.

3.2.5 Minute Paper

Use this method at the start of the class to appraise students' preparation for the class, or at the end of class to see how well they understood the day's topic. Pass out a blank 3x5" or 4x6" index card. Tell students they have one minute to write a thoughtful but brief response to a question you write on the board or project with the overhead. For example, "What was the most important thing you learned?" or "What remains unclear to you about today's lecture?" Unless you schedule the minute papers in your syllabus, don't have the students put their names on the cards. The feedback will be more honest, and the students will not feel intimidated by the unscheduled assessment.

3.2.6 ConcepTest

This technique gives faculty members quick feedback in class on students' understanding of course concepts. Students answer a multiple choice question posed by the instructor in class. This question focuses on a single concept, can't be solved by an equation, and is intermediate in difficulty. Students then raise their hand for their answer choice. If all students are in agreement, then the instructor knows to move on with the material. If there is disagreement about the correct responses, the instructor knows to spend more time with the concept. The technique can be followed up with a think-pair-share in which students talk to their neighbor about why they think the answer they gave is correct. The instructor can then ask for another show of hands to see how peer instruction changed students' responses.

3.2.7 Pro/Con Grid or Categorizing Grid

Have the students create a list of the pros and cons of a particular action or argument. Alternatively, they could list costs and benefits of a decision, or alternate solutions to a problem. Be sure to tell them how many pros & cons you want them to devise. Also tell them whether you want a list of words and phrases or if you want responses in full sentences. This method is useful to judging the depth and breadth of student understanding, and also their objectivity about the issue at hand.

3.2.8 Fishbowl

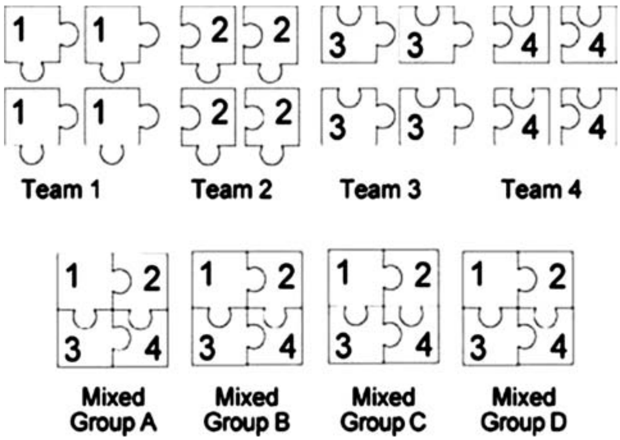
This discussion technique is useful for having the students summarize a discussion and works well in large classes. Before the next class discussion, ask a subset of the class (about a third) to be prepared to be in the fishbowl at the next class where they will actively participate in a discussion. During the discussion, these "fishbowl" students sit in a circle in the middle of the room. The rest of the students sit in a concentric circle outside the fishbowl looking in at the discussants; they are observers and note-takers about the discussion. At the end of the discussion, the observers share their observations and ask questions. Their notes might be provided online to the rest of the class.

3.2.9 Human Graph

The instructor puts up posters on four walls, and opposing walls have opposing viewpoints on them. Students then use the walls to positions themselves in the room according to their position on those axes. For example, students might arrange themselves on an axis reflecting their level of concern for nature in itself, and a second reflecting their belief in economic libertarianism. Once they are in the initial four main areas defined by the graph, they talk to the people around them about the topic under discussion, and clarify their positions relative to the others around them. The four quadrants can then be used to form new heterogeneous groups for follow-up discussions.

3.2.10 Jigsaw

Choose material that can be broken into segments like a research article. Divide the class into groups equal to the number of segments. Group 1, in a collaborative study group, learns the material in the first segment, group 2 studies the second segment, etc. After the study period, new groups are formed so that each new group contains a member of each former study group. Each group member now teaches the material they studied to the other members of the group.



3.2.11 Microlab

Based on a reading or concept, the instructor prepares at most three questions of increasing complexity or depth. Students are put into groups of three and are given one to two minutes to think and write about the first question. Then each person is given a minute (or two minutes if time allows) to talk about his/her response to the question. While one person is talking, the others are listening. After the time is up, the next person speaks, and so on until all three members of the group have spoken about the first question. The process is repeated for the follow-up questions. On the first question, begin with person #1, then #2, then #3. On the second question start with person #2, then #3, then #1. On the third question, start with person #3, then #1, then #2. The instructor keeps track of time; talk has to stop when time is called, and if the speaker finished before time is called, the group sits in silence reflecting. When the process is complete, the instructor debriefs the process, asking, for example, “How did this work for you?” and “What didn’t work for you?” Debriefing is essential and must not be skipped.

3.2.12 Send-a-Problem

Each group member writes a review question on a card. They then take turns asking the group to solve the question. If there is a consensus on the answer, it is written on the back of the card. After all questions are answered, the card stack is sent to the next group, who repeats the process without looking at the first group’s answer until they have reached a consensus. Time required: 2-3 minutes per person for each group that works through the card stack.

3.2.13 Chalk Talk

A silent way to reflect, generate ideas, check on learning, develop projects, or solve problems, chalk talk uses either a chalkboard or a very large sheet of newsprint. The facilitator makes many pieces of chalk or markers available and explains VERY BRIEFLY that Chalk Talk is a silent activity. (No one may talk at all. Anyone may add to the chalk talk as they please.) Students can comment on other people’s ideas simply by drawing a connecting line to the comment. To start the facilitator writes a relevant question in a circle on the board, such as, “What do you know about Croatia?” or “How shall we proceed?” The facilitator can stand back and let it unfold or expand thinking by circling some ideas, writing questions about a participant comment, or adding his/her own reflections or ideas.

3.3 ENGAGING STUDENTS IN DISCUSSION AND ACTIVE LEARNING

An effective way of supporting students learning through discussion is to embed it in collaborative learning.

You can give them a practical learning task they must do together, where they have to discuss the topic in order to create a joint product.

The video introduces different kinds of digital tools that students can use to make their own digital products, and then how to embed them in a collaborative learning task. The learning design on computational thinking in Downloads shows how a collection of tools is used to engage students in active study without the teacher.

Engaging all students in discussion activities is challenging. This is the most difficult of the active learning types because all the others involve the student in doing something practical.

There will always be some students (e.g. students who are shy, those with English as a 2nd or 3rd language, teenage boys, etc.) who may be reluctant to join in class discussions. But as many teachers have discovered, in online discussion groups, where they are able to take their time to think and respond in writing, and not 'perform', those same students can become amazingly vocal. With careful teacher encouragement, this can be a way to scaffold their progression to do the same thing in class.

In this step we look at the part of the teaching-learning process that helps students work towards being able to learn through discussion. In Step 2.10 TLAs 1, 2, and 4 offered examples of this.

As the Conversational Framework shows, discussion has a two-fold value to the individual: you have to generate ideas and listen to ideas, ask questions and reply to questions, challenge points made and respond to challenges. All these cycles of interaction require students to engage in rapid succession in different ways of thinking about the topic.

3.3.1 Run a series of online classes, to scaffold their increasing confidence in being able to contribute to a discussion:

- Begin the process by allowing students to be anonymous in their contributions to Chats.
- Move later to asking for names, and for everyone to post a comment.
- Encourage those who tend to be silent with a ‘private’ comment to them.
- Set up asynchronous small group discussion forums for them to discuss in writing a key issue and decide on what to bring to the main group.
- Monitor the discussions and offer encouragement and advice to groups and individuals.
- Move on to synchronous breakout rooms for small groups to discuss in person an interesting question, where they can speak without ‘performing’.
- Drop into the breakout rooms as you would walk round a class.
- The final stage is to encourage every student to say something in a class discussion.

3.3.2 Run a special session on learning how to use discussion:

- Use one of the TLAs from Step 2.10, but start it by discussing with them why discussion helps their learning.
- After the TLA use Mentimeter or Padlet for them to post their answers to the questions, in three columns: What made your discussion useful? What didn’t work so well? Do you have one tip for what makes a good discussion?
- Then discuss the points made to raise their awareness of what they can learn from discussion.

3.3.3 Run small group sessions, where students working together in small discussion groups is less daunting than the whole class:

- The Maths Education Group at UCL-IOE offer guidance for self-study group work in a synchronous session, which includes individual activities along with timed group collaborations and breaks.
- The Moodle version of the guidance to students is in the Download 'Guidance for self-study and group work'. The learning design embedded in the session, 'Teaching of Maths (Worksheets)', is also available in Downloads, and is on the Learning Designer site.
- As in most cases, the subject content of the pedagogy being described is minimal here – most references to maths are in the digital resources used.

3.4 CLASS DISCUSSION STRATEGIES

The problem wasn't them; in most of the classrooms where they'd sat as students, that's exactly what a class discussion looked like. They didn't know any other "formats."

So here they are: 15 formats for structuring a class discussion to make it more engaging, more organized, more equitable, and more academically challenging. If you've struggled to find effective ways to develop students' speaking and listening skills, this is your lucky day.

3.4.1 Higher-Prep Discussion Strategies

Gallery Walk

Basic Structure: Stations or posters are set up around the classroom, on the walls or on tables. Small groups of students travel from station to station together, performing some kind of task or responding to a prompt, either of which will result in a conversation.

Variations: Some Gallery Walks stay true to the term *gallery*, where groups of students create informative posters, then act as tour guides or docents, giving other students a short presentation about their poster and conducting a Q&A about it. In Starr Sackstein's high school classroom, her stations consisted of video tutorials created by the students themselves. Before knew the term Gallery Walk, shared a strategy similar to it called Chat Stations, where the teacher prepares discussion prompts or content-related tasks and sets them up around the room for students to visit in small groups.

Philosophical Chairs

Basic Structure: A statement that has two possible responses—agree or disagree—is read out loud. Depending on whether they agree or disagree with this statement, students move to one side of the room or the other. From that spot, students take turns defending their positions.

Variations: Often a Philosophical Chairs debate will be based around a text or group of texts students have read ahead of time; students are required to cite textual evidence to support their claims and usually hold the texts in their hands during the discussion. Some teachers set up one hot seat to represent each side, and students must take turns in the seat. In less formal variations (which require less prep), a teacher may simply read provocative statements students are likely to disagree on, and a debate can occur spontaneously without a text to refer to. Teachers may also opt to offer a continuum of choices, ranging from "Strongly Agree" on one side of the room, all the way to "Strongly Disagree" on the other, and have students place themselves along that continuum based on the strength of their convictions.

Pinwheel Discussion

Basic Structure: Students are divided into 4 groups. Three of these groups are assigned to represent specific points of view. Members of the fourth group are designated as "provocateurs," tasked with making sure the discussion keeps going and stays challenging. One person from each group (the "speaker") sits in a desk facing speakers from the other groups, so they form a square in the center of the room. Behind each speaker, the remaining group members are seated: two right behind the speaker, then three behind them, and so on, forming a kind of triangle. From above, this would look like a pinwheel. The four speakers introduce and discuss questions they prepared ahead of time (this preparation is done with their groups). After some time passes, new students rotate from the seats behind the speaker into the center seats and continue the conversation.

Variations: When high school English teacher Sarah Brown Wessling introduced this strategy in the featured video (click Pinwheel Discussion above), she used it as a device for talking about literature, where each group represented a different author, plus one provocateur group. But in the comments that follow the video, Wessling adds that she also uses the strategy with non-fiction, where students represent authors of different non-fiction texts or are assigned to take on different perspectives about an issue.

Socratic Seminar

Basic Structure: Students prepare by reading a text or group of texts and writing some higher-order discussion questions about the text. On seminar day, students sit in a circle and an introductory, open-ended question is posed by the teacher or student discussion leader. From there, students continue the conversation, prompting one another to support their claims with textual evidence. There is no particular order to how students speak, but they are encouraged to respectfully share the floor with others. Discussion is meant to happen naturally and students do not need to raise their hands to speak.

Variations: If students are beginners, the teacher may write the discussion questions, or the question creation can be a joint effort. For larger classes, teachers may need to set up seminars in more of a fishbowl-like arrangement, dividing students into one inner circle that will participate in the discussion, and one outer circle that silently observes, takes notes, and may eventually trade places with those in the inner circle, sometimes all at once, and sometimes by "tapping in" as the urge strikes them.

3.4.2 Low-Prep Discussion Strategies

Affinity Mapping

Basic Structure: Give students a broad question or problem that is likely to result in lots of different ideas, such as "What were the impacts of the Great Depresssion?" or "What literary works should every person read?" Have students generate responses by writing ideas on post-it notes (one idea per note) and placing them in no particular arrangement on a wall, whiteboard, or chart paper. Once lots of ideas have been generated, have students begin grouping them into similar categories, then label the categories and discuss why the ideas fit within them, how the categories relate to one another, and so on.

Variations: Some teachers have students do much of this exercise—recording their ideas and arranging them into categories—*without* talking at first. In other variations, participants are asked to re-combine the ideas into new, different categories after the first round of organization occurs. Often, this activity serves as a good pre-writing exercise, after which students will write some kind of analysis or position paper.

Concentric Circles

Basic Structure: Students form two circles, one inside circle and one outside circle. Each student on the inside is paired with a student on the outside; they face each other. The teacher poses a question to the whole group and pairs discuss their responses with each other. Then the teacher signals students to rotate: Students on the outside circle move one space to the right so they are standing in front of a new person (or sitting, as they are in the video). Now the teacher poses a new question, and the process is repeated.

Variations: Instead of two circles, students could also form two straight lines facing one another. Instead of "rotating" to switch partners, one line just slides over one spot, and the leftover person on the end comes around to the beginning of the line. Some teachers use this strategy to have students teach one piece of content to their fellow students, making it less of a discussion strategy and more of a peer teaching format. In fact, many of these protocols could be used for peer teaching as well.

Conver-Stations

Basic Structure: Another great idea from Sarah Brown Wessling, this is a small-group discussion strategy that gives students exposure to more of their peers' ideas and prevents the stagnation that can happen when a group doesn't happen to have the right chemistry. Students are placed into a few groups of 4-6 students each and are given a discussion question to talk about. After sufficient time has passed for the discussion to develop, one or two students from each group rotate to a different group, while the other group members remain where they are. Once in their new group, they will discuss a different, but related question, and they may also share some of the key points from their last group's conversation. For the next rotation, students who have not rotated before may be chosen to move, resulting in groups that are continually evolving.

Fishbowl

Basic Structure: Two students sit facing each other in the center of the room; the remaining students sit in a circle around them. The two central students have a conversation based on a pre-determined topic and often using specific skills the class is practicing (such as asking follow-up questions, paraphrasing, or elaborating on another person's point). Students on the outside observe, take notes, or perform some other discussion-related task assigned by the teacher.

Variations: One variation of this strategy allows students in the outer circle to trade places with those in the fishbowl, doing kind of a relay-style discussion, or they may periodically "coach" the fishbowl talkers from the sidelines. Teachers may also opt to have students in the outside circle grade the participants' conversation with a rubric, then give feedback on what they saw in a debriefing afterward, as mentioned in the featured video.

Hot Seat

Basic Structure: One student assumes the role of a book character, significant figure in history, or concept (such as a tornado, an animal, or the *Titanic*). Sitting in front of the rest of the class, the student responds to classmates' questions while staying in character in that role.

Variations: Give more students the opportunity to be in the hot seat while increasing everyone's participation by having students do hot seat discussions in small groups, where one person per group acts as the "character" and three or four others ask them questions. In another variation, several students could form a panel of different characters, taking questions from the class all together and interacting with one another like guests on a TV talk show.

Snowball Discussion

Basic Structure: Students begin in pairs, responding to a discussion question only with a single partner. After each person has had a chance to share their ideas, the pair joins another pair, creating a group of four. Pairs share their ideas with the pair they just joined. Next, groups of four join together to form groups of eight, and so on, until the whole class is joined up in one large discussion.

Variations: This structure could simply be used to share ideas on a topic, or students could be required to reach consensus every time they join up with a new group.

3.4.3 Ongoing Discussion Strategies

Whereas the other formats in this list have a distinct shape—specific activities you do with students—the strategies in this section are more like plug-ins, working discussion into other instructional activities and improving the quality and reach of existing conversations.

Asynchronous Voice

One of the limitations of discussion is that rich, face-to-face conversations can only happen when all parties are available, so we're limited to the time we have in class. With a tool like Voxer, those limitations disappear. Like a private voice mailbox that you set up with just one person or a group (but SOOOO much easier), Voxer allows users to have conversations at whatever time is most convenient for each participant. So a group of four students can "discuss" a topic from 3pm until bedtime—asynchronously—each member contributing whenever they have a moment, and if the teacher makes herself part of the group, she can listen in, offer feedback, or contribute her own discussion points. Voxer is also invaluable for collaborating on projects and for having one-on-one discussions with students, parents, and your own colleagues.

Backchannel Discussions

A backchannel is a conversation that happens right alongside another activity. The first time we saw a backchannel in action was at my first unconference: While those of us in the audience listened to presenters and watched a few short video clips, a separate screen was up beside the main screen, projecting something called TodaysMeet (update: TodaysMeet has shut down. Use YoTeach! instead.) It looked a lot like those chat rooms from back in the day, basically a blank screen where people would contribute a few lines of text, the lines stacking up one after the other, no other bells or whistles. Anyone in the room could participate in this conversation on their phone, laptop, or tablet, asking questions, offering commentary, and sharing links to related resources without ever interrupting the flow of the presentations. This kind of tool allows for a completely silent discussion, one that doesn't have to move at a super-fast pace, and it gives students who may be reluctant to speak up or who process their thoughts more slowly a chance to fully contribute.

Talk Moves

Talk moves are sentence frames we supply to our students that help them express ideas and interact with one another in respectful, academically appropriate ways. From kindergarten all the way through college, students can benefit from explicit instruction in the skills of summarizing another person's argument before presenting an alternate view, asking clarifying questions, and expressing agreement or partial agreement with the stance of another participant. Talk moves can be incorporated into any of the other discussion formats listed here.

Teach-Ok

Whole Brain Teaching is a set of teaching and classroom management methods that has grown in popularity over the past 10 years. One of WBT's foundational techniques is Teach-OK, a peer teaching strategy that begins with the teacher spending a few minutes introducing a concept to the class. Next, the teacher says Teach!, the class responds with Okay!, and pairs of students take turns re-teaching the concept to each other. It's a bit like think-pair-share, but it's faster-paced, it focuses more on re-teaching than general sharing, and students are encouraged to use gestures to animate their discussion. Although WBT is most popular in elementary schools, this featured video shows the creator of WBT, Chris Biffle, using it quite successfully with college students.

Think-Pair-Share

An oldie but a goodie, think-pair-share can be used any time you want to plug interactivity into a lesson: Simply have students think about their response to a question, form a pair with another person, discuss their response, then share it with the larger group.

3.4.4 Ideas for Great Class Discussions from Our Active Learning Fellows

Many courses are based on course discussions, where we want students to be engaged, to learn and to make connections. A good course discussion is both a great learning experience and an exciting, energizing, and even fun course activity.

There are many techniques for making class discussions a more vital and exciting part of your course. The keys to success with discussions are preparing and motivating your students for class, setting expectations for discussion behavior, using activities to deepen and focus discussions, and assessing discussions to improve them over time.

Below is a list of ideas for preparing and running course discussions. Perhaps one or more will make your good course discussions great.

Prepare students

- Outline your expectations for discussions in the syllabus.
- Tell students why discussions are a vital part of the class and how they can use these skills later.
- Set a tone for conduct with discussion guidelines and reference them often in early class sessions.
- Have students participate in forming discussion guidelines or "contract" to give them a stake in course conduct.
- Prepare some questions and points to consider about the materials before the class session and share them with students. Encourage students to your questions bring their own preparatory notes to class.
- Build questions and prompts that require students to use what they learned in their readings, but also requires them to learn and apply something new.
- Have students generate the questions prior to class and submit them (to you or to each other, where they gather and summarize the other students' questions).

Facilitating Discussions

- Start with an active learning activity to get students thinking about the topic.
- Have students brainstorm topics and questions based on their pre-class notes to frame the discussion outline.
- Move around the room and watch the dynamics between students during the discussions. Monitor who is and isn't speaking and encourage everyone to participate.
- Ask open-ended, difficult questions to prompt deeper discussion.
- Use humor, drama, or controversy to engage students with the discussion.
- Counter groupthink by adopting opposing viewpoints.
- Break down or rephrase questions back to the students to create deeper dialogue.
- Encourage students to talk to each other, rather than directing comments to the instructor.
- Require students to connect their comments to the larger ideas as the discussion progresses to keep the discussion on track.
- Break students into smaller groups to consider some questions and have all the groups report out to the larger class.
- Use a different assigned notetaker in each class session to track the discussion and provide reference notes for the class.
- Use bulleted guideposts and timed reminders to keep on track during the class.
- Pause to have students write down new questions they have that were prompted by the discussion so far.
- Have students role play to understand other points of view.

- Since students may be a different levels in the class, consider the expertise level of students when responding and prompting the discussions.

Assessing Discussions

- Have handouts or slides of key concepts you want to see used in discussions. Have students turn in notecards with ideas about these concepts brought up during the discussions.
- Use a short writing assignment after the discussion to see if students achieved your goals for the class session.
- Have students prepare a longer writing assignment, such as a blog post, after the class session where they explore new ideas prompted by the discussion and connect key ideas to larger topics in the course.
- Have students fill out a short self-evaluation at the end of the class session to think about their own behaviors during and contributions to the discussions.
- Make discussion participation part of your grade. For example, you might give a point for showing up, more points for participating, and bonus points for particularly helpful or profound contributions.
- If appropriate for the demographics of your class, make the discussion session more competitive. For example, you might give points to students or teams of students that have their questions chosen by the class for discussion during the session.
- Review comments and feedback from class sessions to refine and improve your techniques for discussions.

Quiet students

During class discussions, you may find that some students are particularly quiet during class discussions. There may be many personal reasons for this – students might have anxiety about public speaking, need more time to gather their thoughts during discussions, or may have other factors that influence their preparation for the class sessions.

- Suggest help and campus resources for students experiencing anxiety about speaking in public.
- Include activities that give students time to gather his/her thoughts before having to speak and respond.
- Help students gain confidence by having initial discussions in small groups.
- Clearly communicate to students what will be discussed next in class so they can prepare.
- Suggest help and resources for unprepared students on time management

Confrontational Discussions

Some class discussions may wind up being confrontational or make you and the students feel uneasy. Keep in mind that individual students may have different perspectives and perceptions of what is said or intentions behind remarks in class or be unaware how their remarks might be offensive or unhelpful to the discussions.

Encouraging all students in the class to talk with you during office hours about how they feel about the class discussions can be helpful to begin solving these problems.

- Encourage students who feel they being "forced" to speak out to say they don't have an opinion and why neither side convinces them.
- If students appear frustrated, or as though they are not able to participate well, have them meet with you to discuss strategies for participation, which may include preparing differently and/or writing a brief reflection after the discussion.
- Examine the class culture and what you can do to encourage guidelines for respect.

- Conduct an anonymous survey for feedback on how the students feel about the discussions and offer their suggestions.
- Remind students that communication and participation skills practiced in the discussion will be useful in other classes and, perhaps more importantly, in their future career.
- Reach out to diversity units on campus for ideas on improving difficult conversations about controversial subjects and dealing with direct racism, homophobia, or bigotry or "microaggressions" in class sessions.

3.5 DIFFERENT FACTORS OF DISCUSSION

Discussions can be an excellent strategy for enhancing student motivation, fostering intellectual agility, and encouraging democratic habits. They create opportunities for students to practice and sharpen a number of skills, including the ability to articulate and defend positions, consider different points of view, and enlist and evaluate evidence.

While discussions provide avenues for exploration and discovery, leading a discussion can be anxiety-producing: discussions are, by their nature, unpredictable, and require us as instructors to surrender a certain degree of control over the flow of information. Fortunately, careful planning can help us ensure that discussions are lively without being chaotic and exploratory without losing focus. When planning a discussion, it is helpful to consider not only cognitive, but also social/emotional, and physical factors that can either foster or inhibit the productive exchange of ideas.

3.5.1 Cognitive Factors

Determine and communicate learning objectives

For discussions to accomplish something valuable, they must have a purpose. Consider your goals for each discussion. How do the ideas and information to be discussed fit into the course as a whole? What skills, knowledge, perspectives, or sensibilities do you want students to walk away from the discussion with? Your goals for a particular discussion should be consistent with your course objectives and values as an instructor. You might, for example, want students to be able to:

- Articulate the arguments made by the authors of two assigned readings and assess the evidence used to support them. Evaluate the arguments alone and in comparison with one another and discuss their contemporary policy implications. Or…
- Formulate arguments and counter-arguments for a legal position. Or…
- Imagine a particular approach to the design of cities and discuss the impact such a design would have on the lives of people in different socioeconomic categories. Suggest and justify design changes to optimize the benefits for the most number of people.

When you can clearly envision the purpose of the discussion, it is easier to formulate stimulating questions and an appropriate strategy for facilitating the discussion. Communicating your objectives to your students, moreover, helps to focus their thinking and motivate participation.

Plan a strategy

After determining the objectives for your discussion, ask yourself: How will make sure that students meet these objectives? Plan the discussion out, even if you end up deviating from your plan. Some of the questions to consider when formulating a plan include:

- How do I want students to prepare: read a case study? (if so, in class or as homework?) do a team exercise? watch a documentary? reflect on a set of questions?
- What questions will I pose to spark or guide discussion? to encourage deeper analysis?
- Will I open the discussion to the entire class or ask students to discuss the issue in pairs, small groups, or some combination of the above?
- What will I do if students simply aren't participating? If certain students dominate the discussion?
- How will I allocate and manage the time I have?
- How will I deal with digressions or unanticipated shifts in topic?
- How will I correct students' misconceptions or inaccuracies without stifling participation?
- How will I (or my students) synthesize the ideas at the end of the class period?

Your answers to these questions will depend on your goals. For example, correcting factual inaccuracies might be critical in some circumstances, less so in others. Digressions may be productive if your primary purpose is to explore connections, and undesirable if the goal of your discussion is more focused.

Ask Good Questions

Good questions are the key to a productive discussion. These include not only the questions you use to jump-start discussion but also the questions you use to probe for deeper analysis, ask for clarification or examples, explore implications, etc. It is helpful to think about the various kinds of questions you might ask and the cognitive skills they require to answer. Lists a range of question types, including:

- **Exploratory questions:** probe facts and basic knowledge
- **Challenge questions:** interrogate assumptions, conclusions or interpretations
- **Relational questions:** ask for comparisons of themes, ideas, or issues
- **Diagnostic questions:** probe motives or causes
- **Action questions:** call for a conclusion or action
- **Cause-and-effect questions:** ask for causal relationships between ideas, actions, or events
- **Extension questions:** expand the discussion
- **Hypothetical questions:** pose a change in the facts or issues
- **Priority questions:** seek to identify the most important issue(s)
- **Summary questions:** elicit synthesis

These question types can be mapped onto Bloom's taxonomy of learning objectives, which shows increasing levels of cognitive complexity as students move from fairly simple tasks (such as recall of information) to more complex tasks (such as synthesis, evaluation, or creation.) While you might frame the entire discussion in terms of a Big Question to grapple with, it is a good general strategy to move from relatively simple, convergent questions (i.e., questions with correct answers, such as "According to this treatise, what is Argentina's historical claim on the Falklands?" or "What kinds of tax cuts does this bill propose?") to more complex, divergent questions (i.e., questions with many valid answers, such as "Why did Argentina invade the Falklands?" or "To what extent would this bill's proposed tax increases resolve the budget deficit?"). Starting with convergent questions helps discussion participants to establish a base of shared knowledge and builds student confidence; it also gives you, the instructor, the opportunity to correct factual inaccuracies or misconceptions before the discussion moves into greater complexity and abstraction. Asking a variety of types of questions can also help to model for students the ways that experts use questions to refine their analyses. For example, an instructor might move an abstract discussion to a concrete level by asking for examples or illustrations, or move a concrete discussion to a broader level by asking students to generate a generalization or implication.

When instructors are nervous that a discussion might flag, they tend to fall prey to some common questioning errors. These include:

Asking too many questions at once: Instructors often make the mistake of asking a string of questions together, e.g., "What do you think the author is trying to say here? Do you agree with him? Is his evidence convincing? Did you like this article?" Students may get confused trying to figure out which question to address first. Asking a number of questions together may also conflate issues you really want to help students distinguish (for example, the author's thesis versus the kinds of evidence he uses to support it).

Asking a question and answering it yourself: We have all had the experience of asking a question only to encounter blank stares and silence. The temptation under these circumstances is to jump in and answer your own question, if only to relieve the uncomfortable silence. Don't assume, though, that students' silence necessarily indicates that they are stumped (or unprepared); sometimes they are simply thinking the question through and formulating an answer. Be careful not to preempt this process by jumping in too early.

Failing to probe or explore the implications of answers: One mistake instructors can make in leading a discussion is not to follow up sufficiently on student contributions. It is important not only to get students talking, but to probe them about their reasoning, ask for evidence, explore the implications of what they say, etc. Follow-up questions push students to think more deeply, to substantiate their claims, and consider the practical impact of particular perspectives.

Asking unconnected questions: In the best discussions, there is a logical progression from question to question so that, ultimately, the discussion tells (or reveals) a story. When you are planning your discussion questions, think about how they fit together.

Asking yes/no or leading questions: Asking questions with a yes/no answer can be the starting point of a good discussion, but only if there is a follow-up question that calls for explanation or substantiation. Otherwise, yes/no questions tend to be conversation-stoppers. By the same token, discussions can stall if the instructor's questions are overly leading, i.e., if there is clearly an answer the instructor wants, and the students' task is simply to guess it, rather than to think for himself.

Ignoring or failing to build on answers: If students do not feel like their voices have weight in discussion, their motivation to participate drops. Thus, it is important to acknowledge student contributions, responding enthusiastically when they are insightful ("That's an excellent point, Sarah; could you elaborate further?") and pointing out when they contain inaccuracies or problematic reasoning ("Take another look at the article, Tranh; is that really what the author is claiming?"). If you do not wish to play such a directive role yourself – and want students to develop the habit of assessing and responding to one another's contributions – you can throw student comments back to the class for evaluation (for example, "Do the rest of you agree with John's recommendation? What would be some possible consequences if this plan of action were followed?")

3.5.2 Provide Direction and Maintain Focus

Discussions tend to be most productive when they have a clear focus. It may be helpful to write out a few questions that the discussion will address, and return to those questions periodically. Also, summarize key issues occasionally as you go and refocus student attention if the discussion seems to be getting off track (for example, "How do the issues that have just been raised relate to the question originally posed?" or "That's an interesting point, Alexis, and one we will return to later in the course.")

While some lulls in discussion are to be expected (while participants are thinking, for example) the instructor must be alert to signs such as these that a discussion is breaking down:

- Excessive hair-splitting or nit-picking
- Repetition of points
- Private conversations
- Participants taking sides and refusing to compromise
- Apathetic participation

If the discussion seems to be flagging, it can help to introduce a new question or alter the task so as to bring a fresh kind of thinking or a different group dynamic to bear. For example, you might switch from discussing an ethical issue in the abstract to a concrete case study, or shift from large-group discussion to small group or pair-work.

Bring Closure

It is important to leave time at the end of the discussion to synthesize the central issues covered, key questions raised, etc. There are a number of ways to synthesize. You could, for example, tell students that one of them (they won't know who in advance) will be asked at the end of every discussion to identify the major issues, concerns and conclusions generated during discussion. You could also ask students individually to write down what they believe was the most important point, the overall conclusion, and/or a question the discussion raised in their mind (these can be collected and serve as the basis of a follow-up lecture or discussion.) You might also provide students with a set of 2 or 3 "take-home" points synthesizing what you thought were the key issues raised in discussion. Synthesizing the discussion is a critical step for linking the discussion to the original learning objectives and demonstrating progress towards meeting those objectives.

3.5.3 Social and Emotional Factors

Demonstrate Relevance

While students generally enjoy discussions, they may have difficulty recognizing what they gain from participating in them – in contrast with lectures, in which students may take copious notes and have a sense of having covered clearly discernable ground. This can be particularly true for international students from cultures <link to Cultural Variations> in which discussions are not a regular or valued part of the educational curriculum.

It is helpful to tell students up front how you think the skills they gain from participating in discussion will help them in academic and future pursuits. For example: "The ability to articulate and defend a position thoughtfully and respectfully will serve you well in the work world when you are arguing for a particular policy solution or course of action. Discussions for this class will give you the opportunity to practice that skill."

Beyond explaining the relevance of discussion in general, it is a good idea to point out the relevance of particular discussions vis-à-vis contemporary social issues, your students' future plans, etc. For example, "Today we'll be discussing the advantages of Chinese traditional medicine over Western medicine in the treatment of pain and chronic illness. As we talk, think about a conversation with a colleague in medical school and imagine how you would articulate this argument and suggest a productive fusion of both approaches to medicine."

Encourage Participation

Many issues can affect students' willingness to participate in discussions, from cultural background (Are discussion classes new and unfamiliar to them?) to preparedness (Have they done the background work – reading, for example – to prepare for the discussion?) to the kinds of questions asked (Are the questions too difficult or, alternatively, are the answers too obvious?). Below are some strategies that can help encourage meaningful student participation.

Create a discussion climate early.

If you want to use discussion in your class, encourage active student participation from the first day of class <link to first day of class html page>. Plan an icebreaker early in the semester that gets students talking and interacting, preferably while doing an activity that is integral to the content material for the course. Also, create a climate in which students feel comfortable taking intellectual risks: respond to their comments respectfully, even when you correct or challenge them, and make sure (perhaps by establishing clear behavioral ground rules) that their peers do as well.

Require students to prepare for discussion.

Discussions often break down because students simply haven't done the reading or work upon which the discussion is based. Discussions tend to be most productive when students have already done some preparatory work for them. It can be helpful to give assignments to help students to prepare for discussion. This could be a set of questions to answer, a question or two to write, an informal one-page (or paragraph) "reflection" on a reading, film, work of art, etc. For example, recommend "structured, critical pre-reading" focused on these kinds of questions:

- Epistemological questions probe how an author comes to know or believe something to be true
- Experiential questions help the student review the text through the lens of his/her relevant personal experiences
- Communicative questions ask how the author conveys meaning and whether the forms clarify or confuse
- Political questions ask how the work serves to represent certain interests and challenge others

Preparatory assignments help students focus their reading and their thinking, thus facilitating a higher-quality discussion. It is important to note that assigning preparatory work does not necessarily add significant extra work for the instructor, who can collect student prep assignments, glance over them quickly to assess overall comprehension or to identify questions to address in class, and simply mark them Credit/No Credit.

Get to know your students.

Students are more likely to participate if they feel that they are recognized as individuals. If at all possible, learn your students' names and encourage them to learn and use one another's names. Some faculty members require individual students (or groups of students) to come to their office hours once early in the semester, to get to know them better; others use ice-breaking exercises <link to> early in the semester to lower inhibitions and encourage interaction.

Model exemplary discussion behavior.

Often, students must learn how to enter meaningfully into a discussion. One way to encourage students to engage in the style of intellectual exchange you desire is to model good discussion techniques in your own behavior, using language that demonstrates, among other things:

- how to build on another individual's contribution ("As Sunil pointed out…")
- how to ask for clarification ("I'm not sure what you mean, Allie. Can you give a concrete example from one of the readings we've had?")
- how to disagree politely ("I've got a different take on that issue…")
- how to marshal evidence to support a position ("There are three things in the book that led me to this conclusion. They are…")

In the interests of modeling a particular style of intellectual exchange, some instructors invite a colleague to their class and engage in a scholarly discussion or debate for the benefit of their students.

On its own, instructor modeling is not likely to affect student behavior, however. It is also important to explicitly point out the kinds of discussion skills illustrated above and to distinguish high-quality contributions (e.g. claims that are substantiated with evidence, comments which effectively build on other student comments) from lower-quality contributions (e.g. unsubstantiated claims, opinions based purely on personal taste, etc.)

Create ground rules.

Explicit ground rules or guidelines can help to ensure a respectful environment for discussion. The ground rules you use will depend on your class size and goals, but may include provisions such as these:

- speak respectfully to one another, even when disagreeing
- avoid using put-downs (even humorous ones)
- avoid disrupting the flow of thought by introducing new issues before the discussion of the previous issue has come to its natural end
- keep in confidence any information shared by a student in class

You can set these ground rules yourself and specify them in your syllabus, or have students help create them. Click on these links to see examples of ground rules and a template for creating student-generated ground rules.

Monitor group dynamics.

One of the instructor's responsibilities is to manage the personalities and dynamics within the discussion group, so that all students feel that their contributions (if thoughtful and appropriate) are welcome. Cultural <link to CV doc> as well as personality differences influence the ways in which students enter into (or hesitate to enter into) the discussion.

If a subset of students seems reluctant to speak up in class, you might consider ways for them to share their ideas and engage with the material in an alternative forum, such as via discussion board or e-mail. You can then bring these students' contributions to the attention of the class as a way of acknowledging their perspectives and encouraging further participation ("Felipe made an interesting observation in a post to the discussion board yesterday. He pointed out that…"). Giving students time to write down their thoughts before opening the floor to discussion can also help quiet students get more involved. So too can the use of pair-work and small-group discussions. While some faculty are reluctant to call on quiet students for fear of embarrassing them, it should be pointed out that calling on students can also liberate them: not all students who are quiet are shy; they may simply have trouble finding a way into the discussion.

Sometimes the problem is not shy students but overly domineering or aggressive students who monopolize discussion. Sometimes a subtle approach to reining in these students can be effective (for example: "Jake, I see your hand and want to hear your perspective, but I'd like to give some of the other students a chance to answer first."); other times it may be necessary to take a domineering student aside after class to discuss changing the behavior.

Handling strong emotions and disagreement that arise in a discussion can be a challenge for instructors. A certain amount of disagreement is desirable, yet if the conversation gets too heated or antagonistic, it can inhibit participation and squelch a productive exchange of ideas. When emotions are high, remind students to focus on ideas and refrain from personal comments (this stipulation can be included in your ground rules as well). You might also consider asking students to take a minute to write about their reactions to what has been said so they can cool off, focus their thoughts, and consider one another's perspectives before re-entering the discussion.

Also, consider in advance how you will handle sensitive discussion topics. Certainly one of the goals of education is to challenge and unsettle students' assumptions and beliefs. Discussions that do so may not be comfortable for some participants yet still have the desired effect. On the other hand, done poorly such discussions can stifle rather than stimulate engagement and learning. Thus, it is important to anticipate where the "hot spots" will be and make sure you accord them the time and sensitivity they deserve. Also, think about whether the discussion environment in your classroom is sufficiently inclusive of all your students, regardless of race, class, gender, sexual orientation, political persuasion, religion, etc. (link to principle about inclusivity).

Assign pair and small-group work.

As a prelude or addition to full-class discussion, consider giving pairs or small groups of students the task of discussing a question or problem. Group work tends to work best when the task is clearly defined and concrete. It can facilitate group work to assign roles within the group. For example, one member of the group could be charged with breaking the task down into steps and posing questions to the group; another could be charged with managing time and keeping the group on task; another could have the job of recording the group's thoughts or recommendations and reporting back to the full class. (Assigning this last task to a quiet student can help to draw him or her out.) Click on this link for more on group work.

Make high-quality participation count

While we all want students to participate in discussions for the sheer joy of intellectual exchange, not all students may be equally motivated to jump in – at least not initially. Providing extrinsic motivations can be helpful to establish the behavioral patterns that lead, ultimately, to intrinsic motivations. For this reason, many instructors include a participation grade as part of the reward structure of their courses.

In making participation "count", however, one runs the risk of encouraging talk for the sake of talk, rather than for the purpose of meaningful and thoughtful exchange. For this reason it can be helpful to define what you consider high-quality contributions to discussions and distinguish them from low-quality contributions by using a rubric for discussion that makes your expectations and grading criteria clear. One instructor, for example, defines high-quality participation as: "raising thoughtful questions, analyzing relevant issues, building on others' ideas, synthesizing across readings and discussions, expanding the class' perspective, and appropriately challenging assumptions and perspectives." She assesses student discussion performance on the basis of whether they make such contributions to discussion regularly, sometimes, rarely, or never.

3.5.4 Physical Factors

Try to arrange the physical set-up of your classroom so that it is conducive to discussion. Some instructors prefer that chairs be in a circle, others in a U-shape, while for small group discussions or debates chairs must be moved and assembled differently. Our intention here is not to recommend a "best way" of organizing the discussion space, but to raise some questions to consider when determining how to arrange your classroom.

First, what are your objectives? If one of your goals is for students to enter into a dialog with one another, then it is particularly important that they be able see and address each other directly. Obviously, the traditional classroom arrangement, with the instructor positioned before rows of student chairs does not serve this objective. On the other hand, if the style of discussion (or quasi-discussion) is Socratic, with the instructor asking questions and students answering, then a more traditional seating arrangement could be successful. In keeping with your objectives, you might also ask yourself what the arrangement of physical space communicates. Do you want to set yourself apart from other discussion participants, or position yourself as one of them? Do you want to make it difficult for students to avoid participation or do you believe they have the right to opt out? (Some authors, for example, have applied a Foucaultian analysis to discussions, arguing that the traditional circle-format is coercive in that students cannot hide from the instructor's disciplinary gaze! (citation).

Second, what discussion format(s) will you use? If you are engaging in a brainstorming session and plan to write on the board, you will need to have students sit where they can see the board. If you want students to work in small groups, you might consider how chairs and tables can be positioned so that you can walk from group to group, or have students do so if the task demands it. If your discussion is part of a group project that involves hands-on construction or manipulation (perhaps of a flow-chart or design), the physical space must be organized accordingly.

As a general rule, it is a good idea to set up the classroom so that students can (a) see each other and (b) see progress (e.g., to watch an evolving list of brainstormed ideas take shape, to focus their participation around a central question, to see several synthesizing points written on the board.) Clearly, the configuration of the room itself can limit your options, as can class size. If you are teaching a class of 120 in an auditorium with bolted-down seats and poor acoustics, the traditional circular discussion arrangement is untenable. However, you would be surprised how much discussion can be accomplished even in large classes (link to lament) and sub-optimal physical settings.

3.6 TIPS FOR FRAMING DISCUSSION QUESTIONS TO INCREASE HIGHER ORDER THINKING

Higher order thinking (HOT) is thinking on a level that is higher than memorizing facts or telling something back to someone exactly the way it was told to you. HOT takes thinking to higher levels than restating the facts and requires students to do something with the facts — understand them, infer from them, connect them to other facts and concepts, categorize them, manipulate them, put them together in new or novel ways, and apply them as we seek new solutions to new problems.

3.6.1 Answer children's questions in a way that promotes HOT

Parents and teachers can do a lot to encourage higher order thinking, even when they are answering children's questions. According to Robert Sternberg, answers to children's questions can be categorized into seven levels, from low to high, in terms of encouraging higher levels of thinking. While we wouldn't want to answer every question on level seven, we wouldn't want to answer every question on levels one and two, either. Here are the different levels and examples of each.

Level 1: Reject the question

Example:
"Why do I have to eat my vegetables?"
"Don't ask me any more questions." "Because I said so."

Level 2: Restate or almost restate the question as a response

Example:
"Why do I have to eat my vegetables?"
"Because you have to eat your vegetables."
"Why is that man acting so crazy?"
"Because he's insane."
"Why is it so cold?"
"Because it's 15° outside."

Level 3: Admit ignorance or present information

Example:

"I don't know, but that's a good question."

Or, give a factual answer to the question.

Level 4: Voice encouragement to seek response through authority

Example:

"Let's look that up on the internet."

"Let's look that up in the encyclopedia."

"Who do we know that might know the answer to that?"

Level 5: Encourage brainstorming, or consideration of alternative explanations

Example:

"Why are all the people in Holland so tall?"

"Let's brainstorm some possible answers."

"Maybe it's genetics, or maybe it's diet, or maybe everybody in Holland wears elevator shoes, or…" etc.

When brainstorming, it is important to remember all ideas are put out on the table. Which ones are "keepers" and which ones are tossed in the trashcan is decided later.

Level 6: Encourage consideration of alternative explanations and a means of evaluating them

Example:

"Now how are we going to evaluate the possible answer of genetics? Where would we find that information? Information on diet? The number of elevator shoes sold in Holland?"

Level 7: Encourage consideration of alternative explanations plus a means of evaluating them, and follow-through on evaluations

Example:

"Okay, let's go find the information for a few days — we'll search through the encyclopedia and the Internet, make telephone calls, conduct interviews, and other things. Then we will get back together next week and evaluate our findings."

This method can be equally effective with schoolwork and with everyday matters such as how late an adolescent can stay out on Saturday night or who is getting to go to a concert. For example, polling several families that are randomly or mutually chosen may produce more objective results than either parent or child "skewing" the results by picking persons whose answers will support their way of thinking.

3.6.2 Strategies for Enhancing Higher Order Thinking

These following strategies are offered for enhancing higher order thinking skills. This listing should not be seen as exhaustive, but rather as a place to begin.

Take the mystery away

Teach students about higher order thinking and higher order thinking strategies. Help students understand their own higher order thinking strengths and challenges.

Teach the concept of concepts

Explicitly teach the concept of concepts. Concepts in particular content areas should be identified and taught. Teachers should make sure students understand the critical features that define a particular concept and distinguish it from other concepts.

Name key concepts

In any subject area, students should be alerted when a key concept is being introduced. Students may need help and practice in highlighting key concepts. Further, students should be guided to identify which type(s) of concept each one is — concrete, abstract, verbal, nonverbal or process.

Categorize concepts

Students should be guided to identify important concepts and decide which type of concept each one is (concrete, abstract, verbal, nonverbal, or process).

Tell and show

Often students who perform poorly in math have difficulty with nonverbal concepts. When these students have adequate ability to form verbal concepts, particular attention should be given to providing them with verbal explanations of the math problems and procedures. Simply working problems again and again with no verbal explanation of the problem will do little to help these students. Conversely, students who have difficulty with verbal concept formation need multiple examples with relatively less language, which may confuse them. Some students are “tell me” while others are “show me.”

Move from concrete to abstract and back

It can be helpful to move from concrete to abstract and back to concrete. When teaching abstract concepts, the use of concrete materials can reinforce learning for both young and old alike. If a person is able to state an abstract concept in terms of everyday practical applications, then that person has gotten the concept.

Teach steps for learning concepts

A multi-step process for teaching and learning concepts may include (a) name the critical (main) features of the concept, (b) name some additional features of the concept, (c) name some false features of the concept, (d) give the best examples or prototypes of the concept (what it is), (e) give some non-examples or non-prototypes (what the concept isn't), and (f) identify other similar or connected concepts.

Go from basic to sophisticated

Teachers should be sure that students have mastered basic concepts before proceeding to more sophisticated concepts. If students have not mastered basic concepts, they may attempt to memorize rather than understand. This can lead to difficulty in content areas such as math and physics. A tenuous grasp of basic concepts can be the reason for misunderstanding and the inability to apply knowledge flexibly.

Expand discussions at home

Parents may include discussions based on concepts in everyday life at home. The subject matter need not relate directly to what she is studying at school. Ideas from reading or issues in local or national news can provide conceptual material (for example, "Do you think a dress code in school is a good idea?").

Connect concepts

Teachers should lead students through the process of connecting one concept to another, and also putting concepts into a hierarchy from small to large. For example, if the concept is "Thanksgiving," a larger concept to which Thanksgiving belongs may be "Holidays," and an even larger (more inclusive) concept could be "Celebrations." By doing this level of thinking, students learn to see how many connections are possible, to connect to what they already know, and to create a web of concepts that helps them gain more clarity and understanding.

Compare the new to the already known. Students should be asked to stop and compare and connect new information to things they already know. For example, if they are about to read a chapter on electricity, they might think about what they already know about electricity. They will then be in a better position to absorb new information on electricity.

Teach inference

Students should be explicitly taught at a young age how to infer or make inferences. Start with "real life" examples. For example, when a teacher or parent tells a child to put on his coat and mittens or to get the umbrella before going outside, the adult may ask the child what that might mean about the weather outside. When students are a little older, a teacher may use bumper stickers or well-known slogans and have the class brainstorm the inferences that can be drawn from them.

Teach Question-Answer Relationships (QARs)

The Question-Answer Relationships (QARs) technique teaches children to label the type of questions being asked and then to use this information to assist them in formulating the answers. Two major categories of question-answer relationships are taught: (1) whether the answer can be found in the text — "In the Book" questions, or (2) whether the reader must rely on his or her own knowledge — "In My Head" questions.

Clarify the difference between understanding and memorizing

When a student is studying, his parents can make sure that he is not just memorizing, but rather attempting to understand the conceptual content of the subject matter. Parents can encourage the student to talk about concepts in his own words. His parents can also play concept games with him. For example, they can list some critical features and let him try to name the concept.

Elaborate and explain

The student should be encouraged to engage in elaboration and explanation of facts and ideas rather than rote repetition. His teachers and parents could have him relate new information to prior experience, make use of analogies and talk about various future applications of what he is learning.

A picture is worth a thousand words

Students should be encouraged to make a visual representation of what they are learning. They should try to associate a simple picture with a single concept.

Make mind movies

When concepts are complex and detailed, such as those that may be found in a classic novel, students should be actively encouraged to picture the action like a "movie" in their minds.

Teach concept mapping and graphic organizers

A specific strategy for teaching concepts is conceptual mapping by drawing diagrams of the concept and its critical features as well as its relationships to other concepts. Graphic organizers may provide a nice beginning framework for conceptual mapping. Students should develop the habit of mapping all the key concepts after completing a passage or chapter. Some students may enjoy using the computer software Inspiration for this task.

Make methods and answers count

To develop problem-solving strategies, teachers should stress both the correct method of accomplishing a task and the correct answer. In this way, students can learn to identify whether they need to select an alternative method if the first method has proven unsuccessful.

Methods matter

To develop problem-solving strategies, teachers should give credit to students for using a step-wise method of accomplishing a task in addition to arriving at the correct answer. Teachers should also teach students different methods for solving a problem and encourage students to consider alternative problem-solving methods if a particular strategy proves unrewarding. It is helpful for teachers and parents to model different problem-solving methods for every day problems that arise from time to time.

Identify the problem

Psychologist Robert Sternberg states that precise problem identification is the first step in problem solving. According t o Sternberg, problem identification consists of (1) knowing a problem when you see a problem and (2) stating the problem in its entirety. Teachers should have students practice problem identification, and let them defend their responses. Using cooperative learning groups for this process will aid the student who is having difficulty with problem identification as he/she will have a heightened opportunity to listen and learn from the discussion of his/her group members.

Encourage questioning

Divergent questions asked by students should not be discounted. When students realize that they can ask about what they want to know without negative reactions from teachers, their creative behavior tends to generalize to other areas. If time will not allow discussion at that time, the teacher can incorporate the use of a "Parking Lot" board where ideas are "parked" on post-it notes until a later time that day or the following day.

Cooperative learning

Many students who exhibit language challenges may benefit from cooperative learning. Cooperative learning provides oral language and listening practice and results in increases in the pragmatic speaking and listening skills of group members. Additionally, the National Reading Panel reported that cooperative learning increases students' reading comprehension and the learning of reading strategies. Cooperative learning requires that teachers carefully plan, structure, monitor, and evaluate for positive interdependence, individual accountability, group processing, face to face interaction, and social skills.

Use collaborative strategic reading

Collaoborative Strategic Reading — CSR (Klinger, Vaughn, Dimino, Schumm & Bryant, 2001) is another way to engage students in reading and at the same time improve oral language skills. CSR is an ideal tactic for increasing reading comprehension of expository text in mixed-level classrooms across disciplines. Using this tactic, students are placed into cooperative learning groups of four to six students of mixed abilities. The students work together to accomplish four main tasks: (1) preview (skim over the material, determine what they know and what they want to learn), (2) identify clicks and clunks (clicks = we get it; clunks = we don't understand this concept, idea or word), (3) get the gist (main idea) and (4) wrap up (summarize important ideas and generate questions (think of questions the teacher might ask on a test). Each student in the group is assigned a role such as the leader/involver/taskmaster, the clunk expert, the gist expert, and the timekeeper/pacer (positive interdependence). Each student should be prepared to report the on the group's conclusions (individual accountability).

Think with analogies, similes, and metaphors

Teach students to use analogies, similes and metaphors to explain a concept. Start by modeling ("I do"), then by doing several as a whole class ("We do") before finally asking the students to try one on their own ("You do"). Model both verbal and nonverbal metaphors.

Reward creative thinking

Most students will benefit from ample opportunity to develop their creative tendencies and divergent thinking skills. They should be rewarded for original, even "out of the box" thinking.

Include analytical, practical, and creative thinking

Teachers should provide lesson plans that include analytical, practical and creative thinking activities. Psychologist Robert Sternberg has developed a framework of higher order thinking called "Successful Intelligence." After analyzing successful adults from many different occupations, Sternberg discovered that successful adults utilize three kinds of higher order thinking: (1) analytical (for example, compare and contrast, evaluate, analyze, critique), (2) practical (for example, show how to use something, demonstrate how in the real world, utilize, apply, implement), and (3) creative (for example, invent, imagine, design, show how, what would happen if). Data show that using all three increases student understanding.

Teach components of the learning process

To build metacognition, students need to become consciously aware of the learning process. This changes students from passive recipients of information to active, productive, creative, generators of information. It is important, then for teachers to talk about and teach the components of the learning process: attention, memory, language, graphomotor, processing and organization, and higher order thinking.

Actively teach metacognition

Actively teach metacognition to facilitate acquisition of skills and knowledge. It is important for students to know how they think and learn. Teach students about what Robert Sternberg calls successful intelligence or mental self-management. Successful intelligence is a great way to explain metacognition.

In his book entitled Successful Intelligence, Sternberg lists six components of successful intelligence:

- Know your strengths and weaknesses
- Capitalize on your strengths and compensate for your weaknesses
- Defy negative expectations
- Believe in yourself. This is called self-efficacy
- Seek out role models — people from whom you can learn
- Seek out an environment where you can make a difference

Consider individual evaluation

Many students with higher order thinking challenges benefit from individual evaluation and remediation by highly qualified professionals.

Make students your partners

A teacher should let the student with higher order thinking challenges know that they will work together as partners to achieve increases in the student's skills. With this type of relationship, often the student will bring very practical and effective strategies to the table that the teacher may not have otherwise considered.

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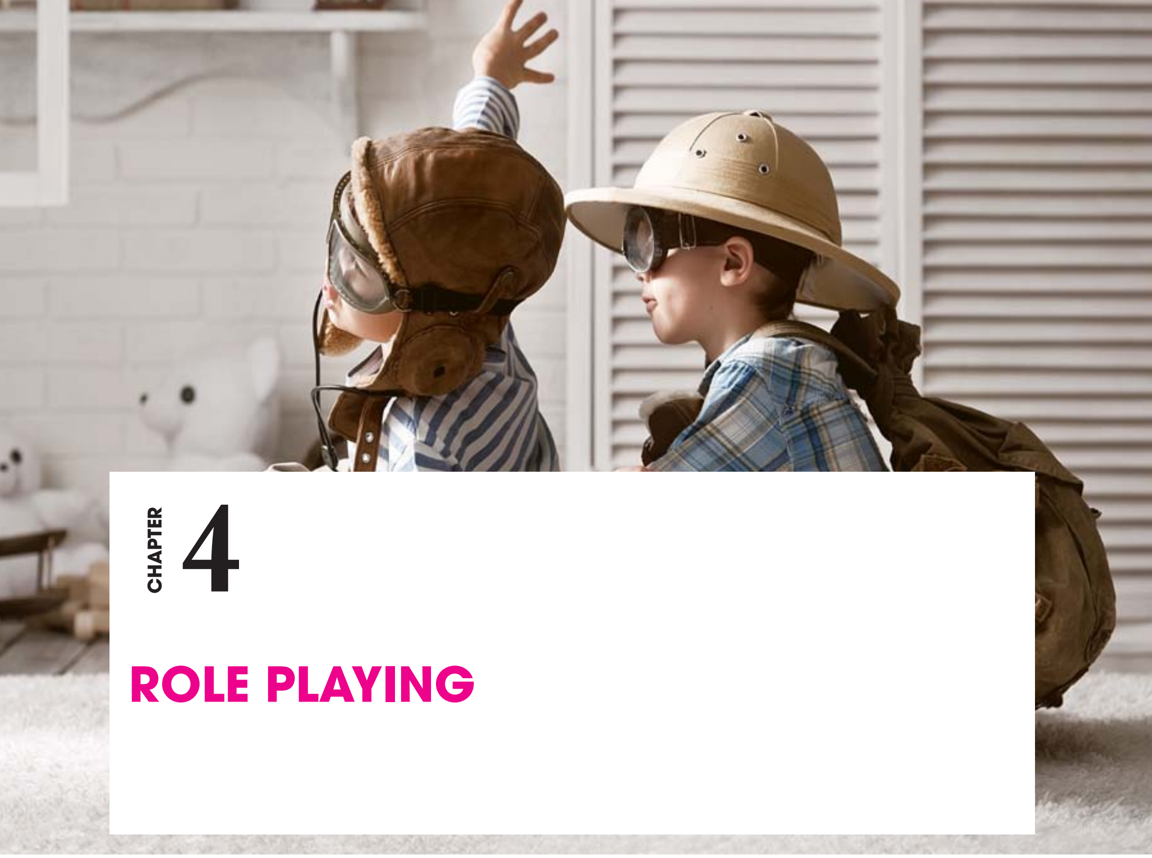


CHAPTER 4

ROLE PLAYING

INTRODUCTION

Role-play is a technique that allows students to explore realistic situations by interacting with other people in a managed way in order to develop experience and trial different strategies in a supported environment. Depending on the intention of the activity, participants might be playing a role similar to their own (or their likely one in the future) or could play the opposite part of the conversation or interaction. Both options provide the possibility of significant learning, with the former allowing experience to be gained and the latter encouraging the student to develop an understanding of the situation from the 'opposite' point of view.

4.1 FOCUS ON ROLE PLAYING

Role playing is a learning structure that allows students to immediately apply content as they are put in the role of a decision maker who must make a decision regarding a policy, resource allocation, or some other outcome. This technique is an excellent tool for engaging students and allowing them to interact with their peers as they try to complete the task assigned to them in their specific role. This work can be done in cooperative groups and/or students can maintain the persona of their role throughout the class period. Students are more engaged as they try to respond to the material from the perspective of their character. Role play exercises give students the opportunity to assume the role of a person or act out a given situation. These roles can be performed by individual students, in pairs, or in groups which can play out a more complex scenario. Role plays engage students in real-life situations or scenarios that can be "stressful, unfamiliar, complex, or controversial" which requires them to examine personal feelings toward others and their circumstances.

How it Works

Participants are given particular roles to play in a conversation or other interaction, such as an email exchange, typical of their discipline. They may be given specific instructions on how to act or what to say, as an aggressive client or patient in denial, for example, or required to act and react in their own way depending on the requirements of the exercise. The participants will then act out the scenario and afterwards there will be reflection and discussion about the interactions, such as alternative ways of dealing with the situation. The scenario can then be acted out again with changes based on the outcome of the reflection and discussion.

4.2 POSSIBLE TECHNOLOGIES TO SUPPORT THE APPROACH

Role-play is a very flexible teaching approach because it requires no special tools, technology or environments, for example student could work through a role-play exercise just as effectively in a lecture hall as in a seminar room. However, technology can provide significant advantages, and even new possibilities, for using the approach as a learning activity.

At the most simple level, technology such as voice recorders, video cameras and smartphones/tablets allow traditional face-to-face role-play exercises to be recorded and stored online for later reference, analysis and reflection, as in this example of negotiation skills from EduCon, Korea. This can allow an exercise to be revisited at a later date and re-evaluated based on subsequent learning and experience, which isn't generally possible when the exercise has not been recorded. Other tools that can be used with this traditional style of role-play are an electronic voting system or Twitter, both of which would allow a group of students to observe the role-play and evaluate the situation and conversation as it develops, such as by voting on whether a character was too aggressive or submissive during a particular interaction. This information could be retained and, coupled with a recording, provide another resource for later analysis and reflection.

However, technology can be used to create role-play exercises beyond what is possible in a face-to-face session. Asynchronous technologies, such as online forums and discussion boards, Social Networks, Twitter, etc., allow role-play to take place over longer periods of time and in a more considered way. This means that role-play can take place outside of timetabled sessions and in situations where students are unable to physical meet at the same time. In this situation students would post their part of the conversation, wait until the other participant(s) have responded, and then post their own reply, and so on. This method allows participants to engage when they are able and gives them time to consider their responses, and while it may seem quite artificial compared to a face-to-face exercise, it can reflect situations such as email discussions quite closely.

Another advantage of using technology is that it can enable external participants to take a part in the role-play. Tools such as Blackboard Collaborate, Skype and Google+ Hangouts all provide an online space where live conversations, including video, can take place. This means that a person with experience or expertise in the area being role-played can take one of the parts, producing a much more realistic experience for the student. For example, a clinical psychologist, drawing upon their own experience to make the interaction realistic, could play the part of a patient with students taking the part of the psychologist, or a chartered engineer could play the role of a project manager while students play the role of the engineers during a meeting. All of these tools can be accessed freely over the internet and only require a microphone and speakers/headphones, meaning the technical barriers are quite low. The tools typically have recording facilities that would allow the interaction to be permanently captured. These tools are also useful for role-playing among students where they are all available at the same time but can’t physically meet, such as on distance learning courses or during placement periods.

4.2.1 Getting Started

If you are interested in trying out role-play there are a few practical questions that you should answer:

- Where in the course/module would this approach work best?
- Are there situations and interactions that students would benefit from being able to explore?
- Would 'live' role-play be most appropriate or would it need to be staggered over a longer period of time?
- Should the students take on all of the roles, will the tutor take a role, or can people with direct experience be involved, e.g. having a genuine client or patient play their own part?
- How much technology should be involved? Which tools are most suited? What support would be needed?
- Are the students (and other tutors) ready for this?

Having thought about these questions, you should have worked out whether role-play is an approach that makes sense in your context and have some ideas about how to introduce it. If you are still unsure, you could try a small exercise in a single session and see how the students respond.

Advantages of Role Playing

- Students immediately apply content in a relevant, real world context.
- Students take on a decision making persona that might let them diverge from the confines of their normal self-imposed limitations or boundaries.
- Students can transcend and think beyond the confines of the classroom setting.
- Students see the relevance of the content for handling real world situations.
- The instructor and students receive immediate feedback with regard to student understanding of the content.
- Students engage in higher order thinking and learn content in a deeper way.
- Instructors can create useful scenarios when setting the parameters of the role play when real scenarios or contexts might not be readily available.
- Typically students claim to remember their role in these scenarios and the ensuing discussion long after the semester ends.

ROLE PLAYS

USES	ADVANTAGES	DIS-ADVANTAGES
• Exploring and improving interviewing techniques and examining complexities and potential conflicts of groups. • To consolidate different lessons in one setting.	• Good energizers. • Promotes empathy of trainees for other situation. • Encourages creativity in learning.	• Participants might be reluctant. • May not work with trainees who do not know each other well.

Steps and tips for using Role Playing

- **Offer a relevent scenario to students.** This scenario should include the role the student must play, the informational details relevant for decision making in this role, and a task to complete based on the information. This information might be provided on the screen through power point or by using a handout. It is highly recommended that the instructions be provided in writing so it is clear to students what they must do and how?
- **Give students five to ten minutes to complete the task.** The instructor might have students do this alone or in small groups or follow the think-pair-share format in which students work individual and then discuss their results with their partner.
- **Find a way to process student deliberations.** The instructor might ask students to write their replies to submit or this might be a very good lead in to a larger class discussion where students can justify their differing outcomes or opposing views.

4.2.2 Challenges of the Role Playing Technique

One of the biggest challenges of the role playing technique is to get all students to participate and be truly engaged. Instructors might want to consider ways of increasing the likelihood of strong student participation. The instructor might offer a participation grade somehow tied to a short product students produce from their perspective in their given role. It is a good idea to find ways to increase student awareness of the likelihood their group might being called upon to share their answer with the entire class if they are playing their roles in a group context. The instructor might also consider using some of the role playing tasks in questions on exams and make it clear to students that that is the case. The instructor could even tell them that they might have to answer a question from the perspective of any of the roles, not just the one they were assigned.

4.2.3 Specific Examples of Role Playing

For example, in economics we teach that changes in revenue generated by a change in the price of a product are related the price elasticity of demand for this product. Students are asked to imagine that they are members of a high school soccer team booster club. To make more money for the team, one parent has recommended an increase in ticket prices at the gate for games as a way to make more money. Another parent has suggested that the boosters would make more money if they actually cut ticket prices. While placed in the role of booster club member and parents of soccer players, students are asked to vote for either raising prices at games or lowering admission prices. After each student votes they are asked to convince their neighbor to vote the same way they voted. After a few minutes another vote is taken and then a fuller discussion takes place as students are asked to explain why they voted the way they did. The resulting discussion is usually a comprehensive list of reasons why attendance at high school soccer matches might be price-elastic or price-inelastic even though students might not yet be using those exact terms.

4.2.4 Benefits of Role Playing

Role playing can be effectively used in the classroom to:

- Motivate and engage students
- Enhance current teaching strategies
- Provide real-world scenarios to help students learn
- Learn skills used in real-world situations (negotiation, debate, teamwork, cooperation, persuasion)
- Provide opportunities for critical observation of peers

4.3 GUIDELINES IN DEVELOPING ROLE PLAYING EXERCISES

Using a set of guidelines can be helpful in planning role playing exercise.

- If you plan to use role playing as a graded exercise, introduce small, non-graded role plays early in and during the semester to help students prepare for a larger role play which will be assessed.
- Determine how the role play will be assessed: will observers be given an assessment rubric? Will observers' remarks and scores be shared with the role players? Will the observers' scores be included with the instructor's scores? Will the role players be given the opportunity to revise and present the role play again? Will observers be taught how to properly assess the performance (include meaningful feedback that is not purely judgmental but rather justify all remarks that are practical and unbiased)?
- Instruct students that the purpose of the role play is to communicate a message about the topic and not focus as much on the actual person acting the role.

- Tie role plays to learning objectives so students see their relevance to course content.
- Allow time for students to practice the role play, even if it is spontaneous, so they will be able to think deeply about the role and present it in a meaningful way.
- Reduce large chunks of content into smaller sections which can be more effectively presented as a role play.
- When assigning a role play, explain its purpose and answer questions so students are able to properly prepare the exercise. Provide guidelines about content to include: general presentation behavior (eye contact, gestures, voice projection); use of props; and specific language to be used (content-related vocabulary) and language not to be used (profanity, slang).
- Challenge all students equally when assigning role plays so everyone will be assessed on equal ground.

4.3.1 Examples of Role Play Exercises

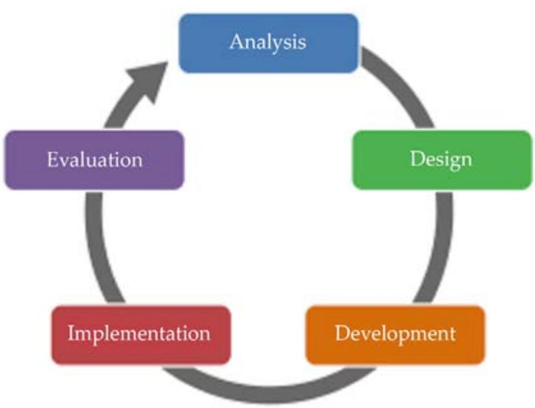
Students can gain additional (and alternative) meaning from the context of role playing than from non-context specific book learning and lectures. By means of guidance from clearly developed objectives and instructions, role plays can help students gain knowledge and skills from a variety of learning situations:

- **Interview practice**—In preparation for career interviews, students can assume the role of the interviewer and/or the interviewee.

- **Marketing—**In preparation for a class presentation, students can assume the position of a sales representative and sell a product.
- **Retailing—**To help prepare students for a guest speaker in merchandising course, students can play the role of sales manager and sales representative to gain better insight on the responsibilities of these positions.
- **Counseling—**In preparing for clinical practice, students can role play a family therapist whose client has revealed she has committed a criminal act.
- **Teaching—**In preparation for a job fair, students can role play the teacher and the student, or the administrator and the student, or the teacher and a parent.
- **Debates—**As a spontaneous exercise, the instructor has students briefly prepare arguments for and arguments against positions on a topic such as *Logging in the Northwest and the Spotted Owl, Arab-Israeli Conflict or Airline Flight Departure Delays*

4.3.2 The Learning Design Process

The learning design process, as its name suggests, is about creating an educational setting with sessions that are learner centered (rather than teacher centered). The goal is to implement authentic activities that can engage learners. The content and the resources should not be the organizing elements as they would be, for example, in many traditional lectures. Instead they are used to support the learning activities and the students' independent learning. The learning design process is very useful in providing teachers with an opportunity to create a constructive alignment between learning activities, assessments, and learning outcomes. The learning design process is also useful because it encourages important two way feedback between teachers and students through experiential learning and active dialogue where both parties can ask relevant questions to one another. Systems Analysis and Design is core course for the Information Technology (IT) Bachelor's degree, and helps prepare students for jobs such as IT project manager, business analyst, and systems analyst. Students learn to examine information systems, collect requirements, and design solutions. The course also teaches diagramming for development and documentation. Graduates will collaborate and communicate with various stakeholders during a project within a company, and are expected to bridge the gaps between different groups of people.



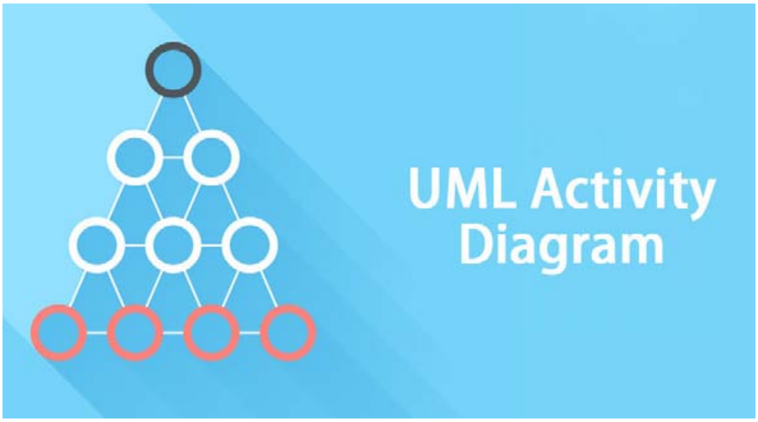
During the learning design process and in preparation for the lessons, it is important for teachers to consider the numerous factors on which successful student learning depends: for example, needing/wanting, doing, digesting, and feedback. Therefore, teachers need to organize engaging activities, instead of delivering pure lectures that keep the students in a passive state. Role play, as an active teaching strategy, can incorporate these positive elements of enjoying learning and digesting knowledge, when designed accordingly and implemented successfully. For teachers who are interested in this strategy, a relatively broad paper written by McSharry and Jones explains various types of role play with interesting examples from science education and suggestions to consider for all teachers.

According to McSharry and Jones, although role play may not be difficult for many learners, it is advisable to start with short role plays and move gradually to longer role plays after both the teachers and the students gain some initial experience and confidence. The role play activity also should not come immediately before or right after an exam because the exam can cause stress for the students and negatively influence the effectiveness of this activity.

Furthermore, a small number of teachers have recently started using role play in systems analysis and design courses, in particular. In a broader context, Green and Blaszczynski suggested that role play is suited for teaching soft (personal and social) skills to students and professionals. The systems analysis and design course itself offers many opportunities for role play. The obvious scenarios include client interviews, proposal presentations, and team meetings. This paper is about a more novel, original and recent role play approach: using analytical IT diagrams as scenarios or scripts for the role play sessions.

For example, in 2011, Costain and McKenna from the University of Auckland in New Zealand reported on their implementation of a role play activity coupled with Use Case Diagrams, which are part of the Unified Modeling Language (UML). The use case diagram method is so far the most common one in the literature, as opposed to other IT diagrams. This is due to the pictorial and often simpler nature of this specific type of diagram. However, role play should not be limited to use case diagrams. Other examples of IT documentation and diagram artefacts that have been used as a basis for role play by Borstler (2010) at Umea University in Sweden are class-responsibility-collaboration cards and so-called role play diagrams (derived from the UML Class and Object Diagrams).

Choosing which type of diagrams to use is important and interesting for IT lecturers. Although UML diagrams may often be preferred in industry and IT curricula, students also like Data Flow Diagrams (DFD), which are also still taught in systems analysis and design courses. In comparison, DFDs may also provide rich stories and have good role play potential, as they are often less sequential, have a greater scope, and more open to interpretation. As a process oriented diagram, a similar UML counterpart to the DFD is the UML Activity Diagram. In this New Zealand institution, where this paper has been written, both DFDs and Activity Diagrams have been used to stimulate role play activities in recent years (from 2013 through 2015) during the systems analysis and design course. The lessons plans were first written for DFDs (as described in the next section); the same instructions were also used for role play activities based on Activity Diagrams.



4.3.3 Implementation in Courses

The two class sessions discussed in this paper were on Data Flow Diagrams (DFD) and Activity Diagrams. The first session involved students in using the software in the computer lab. The learning outcome was to demonstrate their analysis of a case by drawing these diagrams. The second session had students reviewing and critiquing completed diagrams. Students did this through a role play activity about library systems. The learning outcome included explaining the diagram to others, i.e. non-technical people as well as technical IT staff. It is unnecessary to reproduce all of the diagrams involved in these class activities. One example (a UML Activity Diagram showing just one segment of the library environment) is in Figure 1 below:

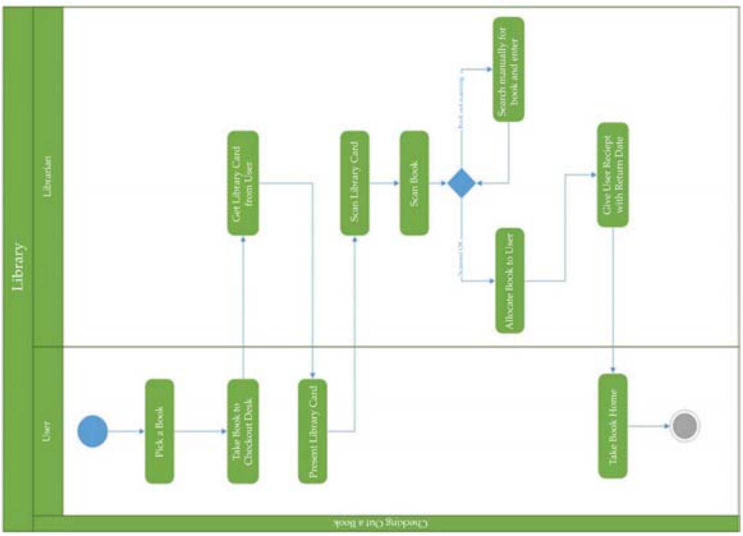


Figure 1: A sample UML Activity Diagram related to a school library.

Catering for Learner Needs In the beginning of the sessions, it needs to be emphasized that diagrams are used in business and systems analysis jobs. This includes reminding students that DFDs and similar diagrams can also be found in other subjects and classes. This increases their awareness of the wider context for this learning topic. The second session is to begin with a picture of a small computer game flowchart, telling the students how modeling and planning are important for creating any kind of software, not just business related software but also games. This helps relate the learning content to something they enjoy in their free time. In summary, these are plausible ideas to try to create a connection with the students' learning needs and career goals. Throughout these explanations, some references to their previous classes and sessions will also help provide a continuum of learning.

4.3.4 Active Learning Approaches

The first session involves learning by doing where each student has a computer to work hands on using software in the lab to draw data flow diagrams individually as well as helping each other. They gradually work in groups like a pyramid – first in pairs exchanging ideas and assistance with the person sitting next to him/her, and then in groups of four to come up with a complete and ideal group diagram. In the second session, the students are to discuss a sample DFD and 'role-play' the case, with peer feedback from observing students. The next step is to go around the class, and let the students identify and explain possible areas on the diagram that may have IT impact. Overall, both sessions feature different and interesting activities but they use the same case; this helps to build knowledge by covering different aspects of the same topic.

4.3.5 Feedback to Learners

In addition to the teacher's feedback to learners, it is also important to explore ways that they can give feedback to one another. For example, they discuss the case with each other in the first session as they draw the diagrams. In the second session, there is to be some discussion with peer feedback, between the role players and the observers (during and after the role play activity). The teacher also collects the diagrams submitted by each group for the purposes of feedback. During the sessions, the teacher regularly invites and questions the students in order to understand their level of learning. Each of the sessions has formative assessment activities that help them review and measure their knowledge of systems analysis and design terminology. The students are encouraged to take the formative assessment seriously, and advised to study more and supplement their learning if necessary.

As a side note for IT lecturers, the students use two computer applications for drawing the underlying diagrams, Microsoft Visio and Dia. Although not as frequently used as Visio, Dia is free and open source, as opposed to proprietary and commercial software. Teachers and students interested in diagram based role play do not need to be limited by financial concerns as free and open source software plays an important role within education in general.

4.4 EVALUATION OF TEACHING

After the conclusion of the above sessions, the teaching was reflected upon and evaluated from the perspective of the three strategies that are part of the learning design process. In addition, a peer evaluation was done by an experienced colleague. The findings from these evaluations are as follows:

4.4.1 Catering for Learner Needs

Using a ball and throwing it between the students as they took turns energized the dialogue, and everyone got a chance to say something based on their interpretation during the second lesson. As a future improvement, a pre-prepared white board or a projected slide with a session outline can give the students a welcome and a compass for each session. Although the introduction and agenda were done verbally this time, this can be done at the beginning of every future session in writing without much effort.

4.4.2 Active Learning Approaches

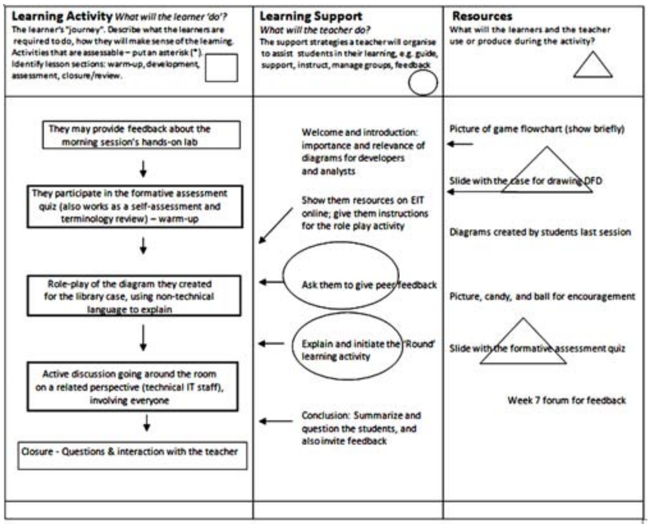
Asking students to do pair discussions every now and then was effective in keeping students active within the classroom and associating with each other as learners. The crossword in the first session was interesting and different for the learners, and served well as an assessment and feedback resource while being puzzling and enjoyable at the same time. The quiz/lottery in the second session (which was also for the purpose of assessment and feedback) was also effective because it built anticipation and engagement among the students. Next, the students also participated enthusiastically and effectively in the role play activity. As the peer observer suggested, the role play activities can be made even more effective. This requires, for example, preparing the students ahead of time, spending more time getting people into their roles, and slowing and fine tuning the learning process.

4.4.3 Feedback to Learners

During the sessions, a strong amount of positive feedback and acknowledgement was given to students and their responses. This even included a funny component by presenting an Academy Award to the role players, and joking with the observers about

Wellywood and Hollywood. The teacher selected student diagrams to base the role play session on, for critiquing and explaining the case. This was done after reviewing the diagrams they created in the computer lab in the previous session, also for the purpose of giving them individual feedback about their work with the software. According to the peer observer, this was a very validating move (using students' diagrams instead of textbook diagrams) and helped build the students' confidence. This was fair feedback as the work was good enough; but the potential impact on them as learners was also significant. One of the diagrams came from one of the groups that had been catching up with the other groups and had been somewhat withdrawn. Within two weeks after this, that particular group had become more confident and productive.

These are a result of the self-evaluation done by the teacher, while reviewing the success of the learning design plans. After reflecting on the question of catering for learner needs, it is possible to use a computer game related case study next time for practice with the future cohort (instead of the library). This might draw them closer toward the learning activities. In turn, they can become even more enthusiastic about this type of work, and will still do more serious Data Flow Diagrams or Activity Diagrams for their course assignment anyway. Next it is important for teachers to improve their questioning skills, to help stimulate the learners during role play and afterwards to help them reflect. Although it is important to complete the lesson on time, it would be beneficial to give learners more time to ponder and formulate answers. It will be useful to put the questions in writing on the board or the screen. Alternatively, the questions can be given to the students in advance of a session (if possible or appropriate). Providing time for discussion and digestion is important for teaching practice in general. This is true both for the LBKO (learning is building knowledge with others) approach and for the LIS (learning is individual sense making) approach. The students' self-directed learning time can also be used better for digestion and application of knowledge and skills. It is interesting to consider the students' learning styles, not just in the classroom but also outside. In order to understand a specific group of learners better, it is important to have deeper learning conversations with them about how they are studying and making progress outside of the class meetings. This would help the teachers get to know them better, provide more innovative or authentic feedback and support, and better prepare for role play and other active learning strategies. Role play as an active learning strategy can be used, not just in face-to-face classes, but also in blended or distance learning. This type of learning activity can be implemented more often in the context of business and computing courses. Teachers, who have already used this strategy before, can continue to experiment with role play by thinking of new scenarios for their courses.



4.5 ROLE-PLAYING AS A TOOL TO FACILITATE LEARNING, SELF-REFLECTION AND SOCIAL AWARENESS IN TEACHER EDUCATION

Good quality learning and teaching in the tertiary sector relies on a combination of several components that have been documented over the last three decades. Together, these components create an environment of motivation and inquiry, having the students active in their learning activity, facilitating interaction between learners, and building on a knowledge base at levels appropriate to the learners.

While a great deal of tertiary learning and teaching revolves around the traditional models of listening, reading, talking and writing, there is much to be gained by expanding the learning environment to include such activities as debates, open-ended assessments, panel discussions, and many other types of learning experiences that cater for higher order thinking and collaboration or contrived conflict between learners. This is where role-plays can fit.

In an educational environment that is standards or outcomes driven where teachers and students tick off the outcomes as they are achieved and education authorities assess programs by finding evidence that a specified standard has been met, it is all the more important that teachers honour their profession by finding ways to facilitate 'deep learning'. Deep learning is where the objective of the learning sequence is student learning as opposed to surface learning where the objective is student retention and recall of facts.

'Active learning' is one way for students to achieve deep learning not only in the retention of facts but by remembering and conceptualizing experiences. "Students must participate mentally, as opposed to passively listening to a lecture or unthinkingly following directions". Active learning is not just classroom activities for the purpose of making class interesting. It includes techniques designed to have students experience and remember facts, concepts and feelings.

A teacher would not consider using anything but active learning for new entrants at school level. Whether it be learning to count from one to ten or learning to tie shoe laces, it is difficult to imagine a kindergarten teacher achieving either of those objectives by lecturing the five year olds or writing notes on the board describing how to do these tasks. Teachers would commonly use techniques such as: ". . . use an analogy, sing a song, trace letters, or other active strategies". It is also considered to be a useful strategy in teacher education. Neuendorf and O'Connell (2011) describe the value of role-plays in teacher education: "Pedagogically sound scenario-based role-plays are activities with a specific learning outcome designed to create a realistic learning experience for participants". The use of role-plays also has the potential to facilitate a more comprehensive learning experience for teacher education students compared to the more traditional cognitive focused approach.

4.5.1 Role-playing in Multicultural Education Class

A pretext for students learning teaching skills for multicultural and Indigenous subjects is that they have developed some sort of reality as to what being part of a minority group is like. This activity lasted only fifty minutes and no demeaning activities were planned or anticipated. The objective was to create a microcosm of society in a controlled space where students would experience differentials of power, injustices of society and something of the depths of anxiety their fellow humans may feel because of the social situations they find themselves in. In so doing, it was hoped that teacher trainees would be more open to understanding their students and learning appropriate teaching methods to help minority groups.

Students entered the hall and were presented with an envelope that randomly assigned them a role. Roles included 'workers' with varying amounts of money to buy materials to make a collage, 'shopkeepers to sell the materials to workers, policemen, social workers, politicians, and reporters. The follow up to the activity was a lecture for debriefing and a survey that was administered to all the participants in the role-play.

War-gaming in history class Teaching the World Wars is complicated by two characteristic kinds of students: those who think they know everything about the wars and have nothing more to learn and those who have virtually no knowledge and, often, interest in those events. Tabletop war gaming has proved to be a way to engage and challenge both categories of students. The teaching method in this class begins with two lectures per week on the wars, including coverage of the various campaigns and in some cases, particular battles. Also addressed are political, economic and social aspects of the wars. A two-hour wargame is run each week, with every student commanding a course on one side or the other, based on a battle or campaign already covered in lectures. The simulations use a commercially-available tabletop wargame, whose rules have been slightly adapted to suit pedagogical ends. The tabletop game uses miniatures of soldiers and military equipment played on a mat with model buildings and terrain features such as roads, rivers, forests and mountains. It uses the common tabletop gaming system of you-go-I-go moves measured by tape and shooting outcomes determined by dice rolls with the numbers required determined by historically-based data on the efficacy of the course or weapons involved.

The games do not try to literally recreate a specific battle, but rather represent it through the ratio of forces and the nature of the terrain. Students rotate through the roles of overall commander, and of assistants. Up to 20 students at a time can play with about four at a time 'commanding' and the others helping with the game play, such as moving courses, rolling dice or checking rules and outcomes, and taking notes. Students select one game per semester to act as 'commander'. 'Commanders' submit a post-game journal, in which they reflect on the historical campaign, the game simulation and what lessons they learned from the interaction of game and history. At strategic points during the game, the lecturer intervenes to question tactical decisions, or to ask why a particular outcome occurred. Frequently games are not played literally to conclusion, but only until the learning objective is met. The game may be restarted to allow the 'commanders' to apply the lessons learnt, or alternatively, the next battle in the campaign is then played. With the speed of the learning experience varying from week to week, between one and three games may be played in two hours.

4.5.2 Role-playing in a Primary Mathematics Method Class

Typically pre-service teachers approach the study of mathematics education with some trepidation that is often traced back to their own negative experiences of the way they were taught mathematics. Subsequently, the approach taken in a first year mathematics education course of study is one that promotes the use of authentic, hands-on and enjoyable mathematics activities. The course enables students to uncover the interconnectedness and relevance of mathematical themes and topics, facilitating a better understanding of how to teach mathematics in a motivating and effective manner.

During these classes, the pre-service teachers experienced a number of role-play situations in on campus lectures and tutorials, and in online activities. Because teachers' attitudes about mathematics strongly influence their teaching practices the purpose of the role-play activities was to provide opportunities for students to revise their past attitudes about teaching and learning mathematics to incorporate a more positive and informed view of how mathematics can be taught.

To understand the perspective of a student in a primary school mathematics classroom, the pre-service teachers engaged in role-play activities in which they completed hands-on activities using mathematics manipulatives (such as number frames, counters and place-value blocks) as children would experience these activities. They had opportunities to play board games, physical activity games, online games and team games. Also, mathematics problem solving tasks that could be solved with multiple solutions were presented to them and assisted their understanding about mathematics as a discipline in which all "answers" were not necessarily right or wrong. Conversely, they also took part in role-plays in which they experienced feelings of uneasiness, even dread, to help them understand the point of view of a learner who may experience difficulties in or fear of mathematics. For example, the pre-service teachers participated in an activity in which they were directed to respond to a set of verbally provided mathematics questions by recording their answers on a printed answer sheet. The lecturer also took part in this role-play by presenting as an autocratic content-focused teacher who over emphasized the importance of "correct answers" and "good marks" which, she explained, would later be publicized to all students in the class. Of course she did not follow through with this "threat" in this simulated context.

To experience the perspective of a parent, the students participated in role-plays in which they engaged in conversations with teachers, also role-played, and about the value of mathematical games when teaching primary school aged children. This enabled the pre-service teachers to justify their pedagogical choices in a way that could be communicated to parents about using hands-on materials in their mathematics lessons.

4.6 ROLE-PLAY AS AN ASSESSMENT IN LEADERSHIP DEVELOPMENT

However, Spillane and Lee investigated 'problems of practice' for beginning principals and found that dealing with unsatisfactory performance from resistant staff members was a serious difficulty for these novice leaders. Given that developing leadership skills are so important for leaders, especially beginning leaders, the development of these skills is an important part of the content of the course which aims to prepare final year pre-service teachers for possible, future leadership responsibilities. In fact, Callahan, Whitener and Sandlin (2007) stated that "leadership development is arguably one of the most important activities undertaken by HRD [Human Resource Development] professionals".

One module of the course addresses the issue of managing unsatisfactory performance. Following this module of lectures and discussions, learning and implementation are brought together in an assessment which is a role-play simulation of the management of unsatisfactory performance by an employee within an educational setting. The student is required to select a typical example of unsatisfactory performance, write a script to simulate an example of a second interview where the staff member has only partially complied with the required improvements in his/ her performance, agreed on previously. The task is to organise a meeting with the non-compliant staff member, discuss the matter, reiterate the expectations, provide evidence of non-compliance, negotiate a solution and timeline, including support and professional development if needed, and complete the necessary documentation. Legal, industrial and policy requirements must be met as well as ensuring natural justice. Other students are co-opted to play the roles of staff member and witness/ support person. The rest of the group are required to observe and assess the role-play according to a rubric which lists demonstrated knowledge of relevant legal and industrial expectations together with demonstrated skills of communication, negotiation and professionalism. The student is then provided with detailed feedback.

4.6.1 Role-playing in Multicultural Education Class

The students were very keen to share their comments and give feedback about the role-play activity. This is true for their verbal comments in the lecture debrief of the role-play as well as in written form on the survey. During the lecture students commented on how real the experience had become for them. Comments were made about how, in some cases, they felt ashamed of what they had become in order to survive the experience and achieve the desired outcomes.

On the survey students were asked to circle words from a list that best described how they felt during the activity. Table 1 gives a snapshot of how they felt.

Table 1: Descriptors of students' feelings during the role-play

Descriptor	Number of responses	Males	Females
Collaborative	28	11 (40%)	17 (35%)
Amused	28	13 (45%)	15 (30%)
Excited	23	7 (25%)	16 (32%)
Frustrated	24	9 (30%)	15 (30%)
Competitive	24	9 (30%)	15 (30%)
Anxious	18	6 (20%)	12 (24%)
Bored	15	6 (20%)	9 (18%)
Confused	15	6 (20%)	9 (18%)
Enlightened	10	4 (15%)	6 (12%)
Bemused	5	3 (10%)	2 (4%)
Stressed	2	0	2 (4%)
Angry	2	1 (3.5%)	1 (2%)
Intimidated	1	0	1 (2%)
Guilty	1	0	1 (2%)
Nervous	1	0	1 (2%)
Indignant	1	0	1 (2%)

When students were asked whether they would recommend that the role-play be repeated with the next class, 61 agreed that the exercises should be run again, 10 said that the exercise should not be run again and six said that it should be run again but with a few modifications.

Table 2: Qualitative comments categorized and aligned to learning outcomes

Desired Learning Outcome	Student comment
That students experience what society is like being part of a minority group	• "I never felt left out in the process apart from being in jail for stealing. I discovered I'm quite the criminal. Looking back maybe this occurred because I found it hard to survive in that type of commcoursey." (worker with little money) • "People's selfishness did come out." (worker with little money) • "It felt frustrating because we were told to make something but had no money to start anything."(worker with no money) • "It was interesting to see how quickly people changed and adapted to survive."(worker with no money) • "I felt discriminated against but still managed to survive. I resented the workers with money getting all the goods" (worker with no money) • "I caught somebody stealing and I felt frustrated, annoyed and stressed because it was unfair." (shopkeeper) • "I learnt that it's pretty annoying to not have the same equality as everyone else." (worker with a disability) • "It was interesting to watch and see what the other groups were doing and how they conducted themselves. The police became corrupt very quickly." (reporter)
Model the benefits of innovative learning and	• "I enjoy these activities very much because I learn by doing. I adapted to the process very quickly and understood what had to

having students participate in their learning	be done. Not long into the activity I knew what it was illustrating and felt it was a fantastic way to show society today." (worker with little money) • "This was a great representation of society." (worker with no money) • "It made learning real. We all got very enthused by our roles. It was a great activity and very practical." (shopkeeper) • "What a brilliant version of a small society. All the anger, frustration, collaboration were fantastic examples of real world experiences." (social worker)

4.6.2 War-gaming in History Class

This study used a qualitative approach to determine what types of learning occurred during the wargaming sessions. Student reflective diaries captured some data, while end-of-semester written interviews and the lecturer's observations gave additional data. The study showed three main outcomes: an improved understanding of history, an increased engagement with history and personal development as a result of gaming.

Student responses on how the games affected their understanding of history showed diversity and depth. Some recorded their enhanced understanding using visual language ('helped me visualise', 'gave a new perspective, 'opened my eyes'). Others expressed that the games transformed their understanding of written histories, which had seemed flat and distant before, helping them grasp concepts such as logistics from a practical rather than merely theoretical point-of-view. 'No books that I have read could have given me the full understanding of how hard some of the decisions & successes would have been,' one said while another wrote: 'The emphasis on details, such as numbers, weapons, logistics make history more real, rather than just the general "what was the result" aspect of history that I have learnt before.' In effect, their understanding had shifted from a theoretical and distant perspective to one which is intimate, experiential, better grounded in detail and yet conceptually more complex, balanced and complete. There is a much stronger sense of genuine insight that transcends the merely intellectual, encompassing a more holistic view of the wars.

The capacity for the games to engage students was a major outcome. One student new to history commented: 'This was the best possible introduction for me into history study…. This course has reassured me that history is living, immiscible and relevant.' The words 'enjoy,' 'fun,' 'eager' and 'enthusiastic' were commonly used to describe their engagement, capturing even unwilling students who had voiced reservations about a class on the wars.

Students reported gaining a better appreciation of the roles of the people involved and the dilemmas of commanding: 'I was impressed with the emotions and decisions of history. I felt the generals' frustrations, pressures, the lack of information, the scrambling to make sense of results (or lack of). I therefore was impacted by how much more history is about humanity-decisions made, understand why they were made (rather than judging) and the consequences of those decisions.' One student reflected on a lost game with, 'One can only imagine how the French Generals felt.'

The learning impact of the games went beyond the boundaries of this particular course. Most students reported a higher passion for history due to their experience in gaming, and stated that they saw the profession of a history teacher in a new, more dynamic light. They commented on how the experience.

4.6.3 Role-playing in a Primary Mathematics Class

Throughout the semester, students were provided with three opportunities to write a narrative about how they experienced mathematics and mathematics teaching in the past, how they were experiencing mathematics and mathematics teaching in their current university studies and how they expected to experience mathematics and mathematics teaching in the future. These narratives were written in tutorial teaching sessions during which the pre-service teachers engaged in a number of role-play activities. The role-play activities formed much of the backdrop of the course of study and influenced the students' narrative reports.

Negative and positive role-plays were facilitated throughout the semester, enabling the students to experience the perspectives of:

- primary school aged children engaging in enjoyable mathematics activities using hands-on materials (that is, manipulatives);
- primary school aged children engaging in a pressured test-like situation;
- parents making inquiries about their children's education, especially in relation to the use of mathematics games;
- teachers planning mathematics activities for young children; and
- teachers justifying their selection of mathematical teaching strategies to parents.

A total of 59 students were enrolled in the mathematics education course. Of these enrolled students, 46 students volunteered to contribute a narrative report of their experiences early in the semester, 25 students in the middle of the semester and 33 students at the end of the semester. The variation in the number of students who contributed their narrative accounts was dependent on attendance at oncampus and online classes at each of the three data collection points. Although students who volunteered their narratives were not asked to indicate their gender, 38 of the 59 students enrolled in the course were female and 21 were male.

Students' narratives were analysed to track their attitudes about mathematics and mathematics teaching, and the changes, if any, that occurred throughout the semester as the students engaged in the course's activities which incorporated regular role-plays. Emerging from this analysis were three thematic categories that outlined students' reflections on how activity-based mathematics can be enjoyable, how their attitudes changed and how they planned to act as a future mathematics teacher (a role-play projected into the future). Table 3 outlines examples of the students' comments that formed each of these themes.

Table 3: Three themes linked to students' comments

Theme	Students' comments
Reflections about how the students perceived activity-based mathematics to be enjoyable	"Manipulatives (hands on material) are a great way to engage kids in maths without them thinking they are learning maths." "Maths can be fun. It does not have to cause anxiety or fear." I find myself laughing and enjoying myself. In a lot of classes I hate having to sit down writing notes (I know it's necessary though) and I love classes that at some stage we get up and do something in small groups or as the whole class. It's what I look forward to every time."
Reflections about how the students experienced attitudinal change	"Whenever I thought about having to teach maths I would get nervous but now I am really excited." "It [maths course, with role-plays] served to show me that simple maths can be something everyone can be involved in and enjoy." "... took the fear away. I had bought a red folder (scary red!) for my maths notes but as I progressed I bought a blue (I can do this, calm colour) lecture notebook. My perception of maths changed in just a few short weeks."
Reflections about how the students envisioned themselves as mathematics teachers in the future	"In the future I would teach maths using lots of hands-on resources and manipulatives. It would be very beneficial for the students I teach as it will make maths fun and enjoyable for them." "Every time I'm reading or researching tools to teach math I can see how important is to enjoy mathematics. I'm enjoying it, I'm learning concepts and my view is changing. I'm not scared of it anymore. I want to be a good mathematic teacher for my students, make the learning more fun."

Verbal comments offered by students at the close of each role-play activity were not always incorporated into their narrative accounts. However, the lecturer recorded these comments as observations after each role-play activity and included them in the data set analyzed in this study. These additional verbal comments indicated that students could be easily debriefed after positive role-play experiences but they required additional debriefing after negative experiences. Interestingly, even though the students knew beforehand that they would be placed into an uncomfortable position during a role-play in which they were directed to record written answers in a pressured test-like role-play activity, they still reported feelings of extreme unease and physical discomfort (such as sweaty palms). Some even reported feeling emotionally shut down. Similarly, debriefing discussions about their concerns regarding how to justify their pedagogical choices to parents typically extended longer than expected. They appeared to be unnerved by the atmosphere of the more negatively focused simulations but less emotionally influenced as a result of participating in the positive role-plays.

4.6.4 Role – plays in School Leadership Classes

Initially, students perceived this assessment task as an 'easy option'; one which did not require academic writing or detailed referencing. However, it was designed to address one of the most difficult tasks educational leaders have to undertake and be able to manage successfully. The stressful issue of dealing with non-compliant staff in as close to a real situation as possible may be perceived as 'only a simulation' however, the necessary steps in the process are understood, taken and documented. Further, issues of industrial relations, appropriate and direct communication, conflict management, negotiation and documentation are practiced. As Hess comments, the challenge is to provide the student with "an opportunity to practice skills that is of complexity and duration sufficient to elicit a substantial portion of the skill set". In this instance the preparation, writing, delivery and subsequent detailed feedback provided a very useful experience in a dynamic and stimulating manner. On the anonymous student feedback sheets, students commented on the relevance of this learning and assessment task: "I liked the hands on approach of the assessments and that there was a strong link between my assessments and the learning outcomes; It was relevant; Assessments related to real life circumstances; Very practical & real & useful! Valuable information.

Finding innovative ways of engaging tertiary students in learning that will genuinely impact their future practice in their chosen career is a challenging task for the teacher. Once discovered however, these methods can bring great satisfaction to both students and teachers. The era lecturers are dealing with today includes issues such as: greater student voice in the perceived quality of lectures; more students opting for the online learning environment; and students 'getting through' lectures to move on to their part-time work situations. Learning must be seen to be meaningful for students to engage.

Learning in educational institutions should be about changing the ways in which learners understand, or experience, or conceptualize the world around them. The 'world around them' includes the concepts and methods that are characteristic of the field of learning in which they are studying.

It would appear that the multicultural role-play exercise allowed for students to be immersed in a social scenario that has caused many of them to experience feelings and realities that they may not otherwise be exposed to. The learning outcome of students experiencing and understanding how minority groups feel in society is vital for them to be able to go on and diligently seek out methods of aiding the learning of these minority groups.

The debriefing that occurred in the lecture theatre after the role-play shed light on some of the results in the survey. The most compelling discussion revolved around the comments from students that in many cases they did not like what they had become during the role-play in order to survive. Indeed they were surprised at some of their own actions that they had undertaken in order to achieve the required objectives. The large number of students who listed frustration levels as a feeling they experienced was also discussed.

The conclusion was reached that what they experienced closely simulated the types of frustrations that may be experienced by these roles in real life. The feeling of frustration therefore added to the success in making the role-play a realistic simulation.

The findings of the wargaming study indicate that student learning outcomes in tertiary level history education course were enhanced by a teaching approach which facilitated active learning strategies in conjunction with students being involved in simulated historical events, with associated hands-on materials. The students' sustained involvement in reflection, discussion and game participation enabled an experiential approach to understanding complex historical events and characters. Across a series of tabletop gaming sessions, students were scaffolded in the process of making mistakes which led to enlightened understanding, enhanced by interactions with each other, with the lecturer and with the conventional tools of history education: lectures, readings and written reports. The results show that exciting new methods are not a substitute for sound teaching, but that properly harnessed, will take conventional methods to new standards. The three-dimensional learning activity of wargaming has been demonstrated to produce three-dimensional learning outcomes, heightening, and broadening and deepening student awareness. Their contextual understanding has broadened, their level of knowledge and engagement has grown, and the deep learning they have experienced has ensured that they will retain the learned outcomes for a long time.

The role-plays that the mathematics education students participated in enabled them to revise and in, some cases, dramatically change their attitudes about mathematics and mathematics teaching. For many students, their attitudes had previously been very negative, caused by a legacy of less than ideal mathematics experiences.

By engaging students in discussion-based, activity-based and material-based role-plays, they were able to experience mathematics and mathematics teaching from the varied perspectives of teachers, students and parents. These experiences enabled the pre-service teachers to engage in active learning and then to reflect on their mathematical views.

While some role-plays were focused on the positive side of mathematics (enjoyment, engaging activities, informed pedagogical choices), some of them were based on conflict (fear and anxiety about mathematics, doubt induced by having to justify pedagogical choices to parents), as outlined by Filene.

The outcomes of the positive role-plays appeared to directly impact both students' attitudes and understanding of mathematics. However, the negative role-plays affected students' personal emotions in a deeper way. In some cases, although being fully aware they were engaged in a role-play situation, the students experienced genuine forms of fear and anxiety. Although the use of role-play in mathematics education has already been explored to some extent.

The use of role-play in the education of mathematics teachers is a less researched area. This small study has revealed that the use of role-play in mathematics education can develop pre-service teacher's attitudes about mathematics and mathematics teaching. Role-play can also provide a platform through which pre-service teachers can come to a greater understanding of mathematics in the curriculum and how to teach mathematics by experiencing multiple perspectives of those involved in mathematics education of primary school children.

With the leadership simulation, in reality the students found that considerable work was required to write the script for themselves and the non-compliant staff member; to source the relevant industrial agreements and awards; to comply with a step by step format; to include all the relevant details, statements and actions that matched the marking rubric and to remember all of the necessary details while performing this role-play before peers and lecturer. The relevant factor was that they found this role-play assessment to be an effective, practical and appropriate learning experience.

Role-plays are one type of active learning. The role-plays discussed in this paper served to familiarize the students with each other and to open their minds to the issues faced by minority groups, professionals, children and parents. The results indicate that these activities achieved the stated objectives. By engaging in role-play activities, higher education students are provided with opportunities to view situations from multiple perspectives, in the spirit of constructivist learning theories. The research reported in this paper has demonstrated that role-play learning activities have the capacity to address emotional as well as cognitive dimensions of adult learning. Good quality learning and teaching in the tertiary sector needs to include activities other than lectures and Power point presentations in order to create a learning environment that ignites inquiry and motivation.

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CHAPTER 5

PROBLEM SOLVING

INTRODUCTION

Problem solving consists of using generic or ad hoc methods in an orderly manner to find solutions to problems. Some of the problem-solving techniques developed and used in philosophy, artificial intelligence, computer science, engineering, mathematics, medicine and societies in general are related to mental problem-solving techniques studied in psychology and cognitive sciences.

5.1 PROBLEM SOLVING METHOD

Problem-solving skills are necessary in all areas of life, and classroom problem solving activities can be a great way to get students prepped and ready to solve real problems in real life scenarios. Whether in school, work or in their social relationships, the ability to critically analyze a problem, map out all its elements and then prepare a workable solution is one of the most valuable skills one can acquire in life.

Educating your students about problem solving skills from an early age in school can be facilitated through classroom problem solving activities. Such endeavors encourage cognitive as well as social development, and can equip students with the tools they'll need to address and solve problems throughout the rest of their lives.

5.1.1 Meaning of Problem Solving

A problem is a task for which Problem–solving may be a purely mental difficulty or it may be physical and involve manipulation of data. , the person confronting it wants or needs to find a solution because the person has no readily available procedure for finding the solution. The person must make an attempt to find a solution. Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing and selecting alternatives for a solution; and implementing a solution.

In a problem solving method, children learn by working on problems. This enables the students to learn new knowledge by facing the problems to be solved. The students are expected to observe, understand, analyze, interpret find solutions, and perform applications that lead to a holistic understanding of the concept. This method develops scientific process skills. This method helps in developing brainstorming approach to learning concepts.

Problem-solving is a process—an ongoing activity in which we take what we know to discover what we don't know. It involves overcoming obstacles by generating hypo-theses, testing those predictions, and arriving at satisfactory solutions.

Problem-solving involves three basic functions:

- Seeking information
- Generating new knowledge
- Making decisions

5.1.2 Objectives of Problem-Solving

- Willingness to try problems and improve their perseverance when solving problems.
- Improve pupils' self-concepts with respect to the abilities to solve problems.
- Make pupils aware of the problem-solving strategies.
- Make pupils aware of the value of approaching problems in a systematic manner.
- Make pupils aware that many problems can be solved in more than one way.
- Improve pupils' abilities to select appropriate solution strategies.
- Improve pupils' abilities to implement solution strategies accurately.
- Improve pupils' abilities to get more correct answers to problems
- The appreciation of the existence of a problems and a desire to solve it
- The accumulation of the facts and data which are pertinent to the problem.
- Logical interpretation of the data supported by adequate valid experience.

5.1.3 What Is Problem?

A problem is a situation preventing something from being achieved. The word comes from a Greek word meaning an "obstacle" (something that is in your way). Someone who has a problem must find a way of solving it. The means of solving a problem is called a "solution".

5.1.4 How to Define a Problem

You may encounter problems often in your personal life, in your professional life, and in your community. Any sort of problem can be daunting, but taking time to define a problem may help make it easier to find solutions. Start by gathering information about the problem. Then, work on putting the problem into words. After that, analyze what you have written to look for possible solutions to the problem.

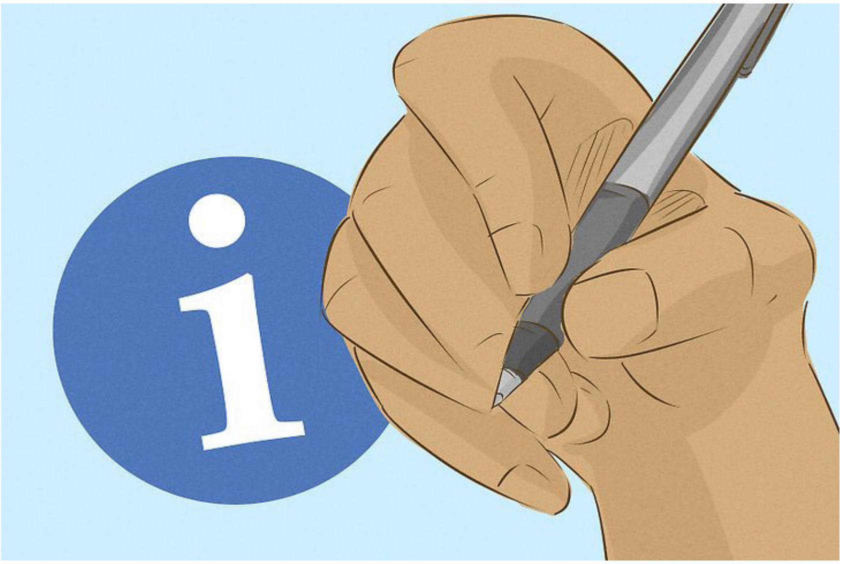
Gathering Information about the Problem

- **Ask "why" to get to the heart of the problem.** Asking "why" is a good way to delve deeper into the problem. Keep asking "why" until you can't think of anything else to say about the problem. This works well in a group setting, but you can ask "why" on your own as well.

For example, if you are searching for a new apartment, then you could start by asking, "Why do I need a new apartment? Because my roommate is leaving, I can't find a new roommate, and I can't afford this apartment on my own."

To gather more information on child hunger in your community, you might follow this line of questioning, "Why are children in this community going hungry? Because their parents are running out of money towards the end of the month. Why are they running out of money? Because their food benefits renew at the beginning of the month."

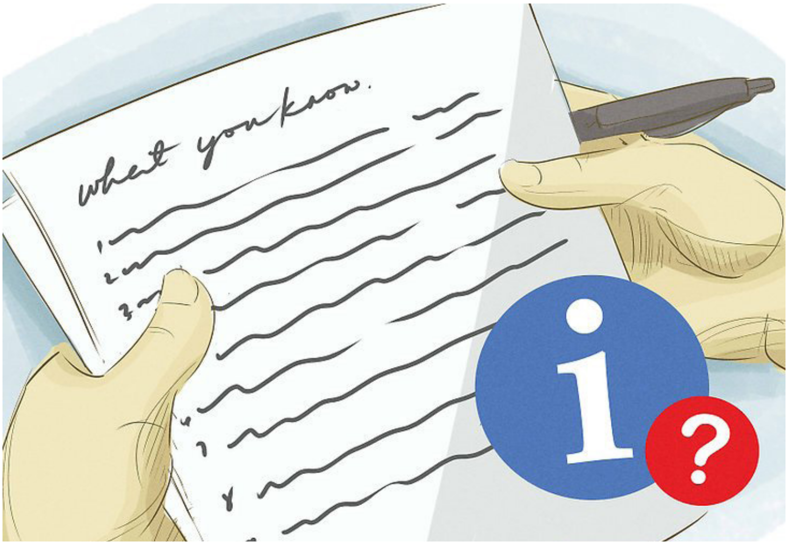
- **Identify what you already know about the problem.** Write down as much as you know about the problem. If you are working with a group of people to define a problem, then have everyone in your group do the same. You can list the information you know or write it in full sentences.



For example, if you are in need of a new apartment, write down the specifics of the new apartment you need, such as when you need to move in, how much you can pay in rent each month, and where the apartment needs to be located.

If you are trying to define the problem of child hunger in your community, then you might make a list that includes the estimated number of children affected, the areas where these children live, and where the children attend school.

- **Figure out what other information you need.** After you list what you know, think about what you do not know. This is crucial for developing a comprehensive definition of the problem and also for working towards a solution. If you are working in a group to define the problem, talking about what information you need may be helpful.



For example, if you are looking for a new apartment, then some of the information you might need could include your maximum rent per month, local apartment complexes, and the cost of utilities without a roommate.

If you are trying to define the problem of child hunger in your area, then you might need to know how much extra food each family needs, what the shortage is in their benefit checks, and if they have any other sources of food.

- **Do research to fill in the gaps.** Try searching online for the information you need. If that does not turn up the results, then you may need to make phone calls, design a survey, or consult an expert to get the information you need.

For example, if you are trying to find an apartment within a specific area and price range, visit the apartment complex's website, check your local newspaper for apartment listings, or call a local complex and ask questions.

If you are trying to find out why the children in your community are dealing with hunger, talk with someone from the local food bank or create a survey for parents to complete.

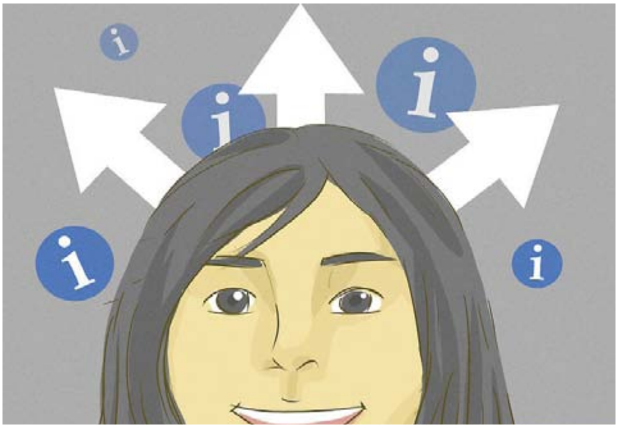
Putting the Problem into Words

- **Describe the problem in your own words.** Start by writing down the problem in your own words using as much detail as possible. Be as specific as possible in your description.

For example, if the problem is that you need to find a new apartment because your roommate is moving out, then you might write it as, "I need to find a new apartment because I cannot afford to live in a 2 bedroom apartment on my own and I haven't been able to find a new roommate."

Another example might be, "Children in our community are going hungry towards the end of the month."

- **Expand your initial statement with more details.** Add to your initial description of the problem using the information you have gathered. Include as many details about the problem as you can in your description.



For example, if you are seeking a new apartment, then your tentative statement might be, "I need to find a new apartment by the end of the month because I can no longer afford this one. I need to find a 1 bedroom or studio apartment in the same neighborhood I live in now that costs no more than $700 per month."

If you are trying to define the problem of child hunger in your community, then you might write, "Children in this community are going hungry towards the end of the month because their parents are running out of money and food benefits."

- **Discuss the statement to determine if it could be stronger.** Talking through the problem statement in a group is a great way to determine if you have missed anything. Have an open discussion of the statement. Look for ways you could strengthen the statement and define the problem more clearly.

If you are working with a group, ask your group members something like, "What else is missing from this statement? How could we make it stronger?" Work together to integrate the missing details.

- **Define key terms used in the problem statement.** If you will be presenting your problem statement to a group of people, include the definitions of any key terms you use. Do this even if it seems like the terms are things that your audience will understand.

For example, you might need to explain what is meant by "food benefits" in a problem statement on child hunger in your community.

Finding a Solution to the Problem

- **Look for patterns in the way people describe the problem.** Talk to people who are affected by the problem. Read what other people have written about the problem. This may lead you towards a better understanding of what is causing the problem and possibly even a solution.

For example, if you are looking for a new apartment because of the cost, you might notice that other people have run into a similar issue. This could help you to see that the high cost of living in that neighborhood is central to your problem.

If you are trying to determine why children in your community are going hungry, read what other people have written about it. If a common theme is the distribution of food benefits, then this is likely central to the problem.

- **Check for possible causes of the problem.** You may or may not know what has caused the problem. Either way, take some time to figure it out and write it down. There may be multiple causes that you should be aware of before you try to solve the problem.

For example, if the high cost of a neighborhood is driven by the location and safety of the area, then these might be worth paying a little extra money for. Consider if you can find a way to work it into your budget, such as by cutting back on entertainment or another expense.

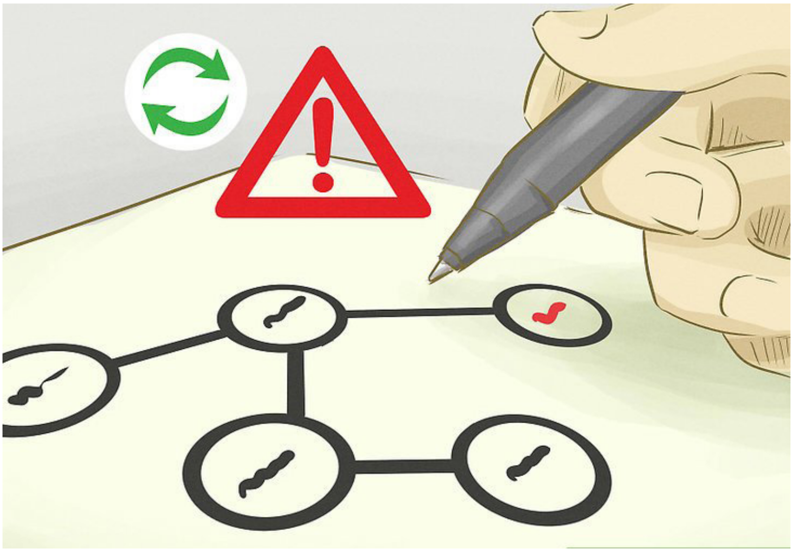
If you are trying to define the problem of child hunger, then a possible cause might be a lack of access to affordable food in the community.

- **Determine what the consequences of the problem might be.** Not working towards a solution to the problem could lead to far worse problems in the future. Take the time to consider the potential consequences of this problem continuing. Make a list of the pros and cons of the problem continuing to determine how you might tweak the negative aspects of it. In some cases, there may be more negative aspects of solving the problem than allowing it to continue.

For example, if you try to stay in an apartment you cannot afford, then you may struggle from month to month and end up in an even worse financial situation later on.

If the problem of child hunger is not solved, then children may suffer from malnutrition and psychological trauma, which could affect them for the rest of their lives.

- **Identify areas of the problem that you can change.** You may not be able to solve the problem fully since many of its factors may be out of your control. Think about what aspects of the problem you are actually capable of changing.



For example, if you cannot afford the rent for your apartment, you are not in control of the cost of rent. However, you may be able to find some ways to save or earn more money to stay in the same neighborhood.

If you are trying to solve child hunger in your community, you may not be able to change the way families use their food benefits. But you can provide resources to help them or supplement their food supply when they run out.

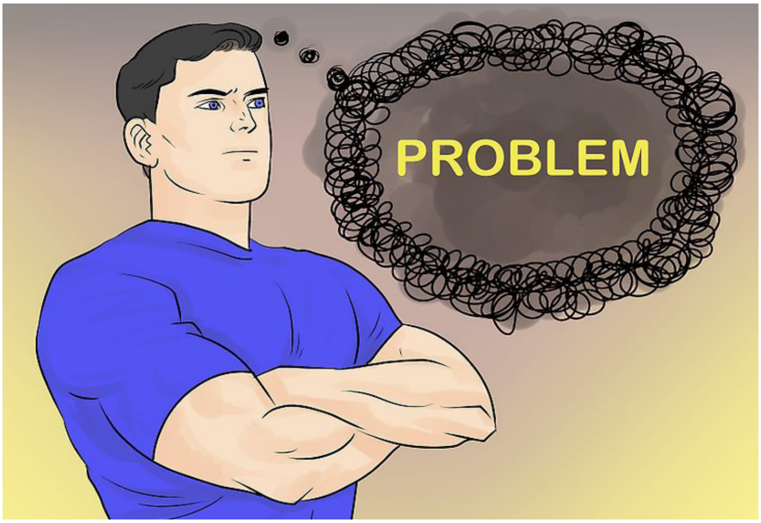
5.1.5 How to Face Problems in Your Life

Having problems in your life can feel overwhelming and it may be that the last thing you want to do is face them. Fortunately though, dealing and coping with problems is a well-studied area and there are many cognitive, emotional, and behavioral steps that can be taken to effectively face your problems head on.

Accepting and Understanding the Problem

- **Acknowledge the problem.** It can be tempting to stay away from the issue that is causing you problems.

However, avoiding the problem does not help solve it. Instead, accept that the problem exists and ask yourself some questions about it. What are the consequences of this problem? Who does it involve?



- If you don't think you have a problem, but everyone tells you there is a problem, try to see if there is truth to it.
- If you are having trouble admitting you have a problem, you might be in denial. For example, if you don't want to accept that a close family member is involved with drugs, you might come up with other excuses for her behavior.
- While denial can be useful at times by protecting your mental health, it can in other cases lead you away from dealing with the problem head on.
- In fact, avoidance often exacerbates the problem and doesn't provide any lasting relief. Avoiding your problem will continue to create a cycle of stress for you as it will always be weighing on the back of your mind.
- That said, sometimes a little escapism can be healthy. If you find yourself overwhelmed and stressed out, take a break! Watch a TV show or read a book, or engage in

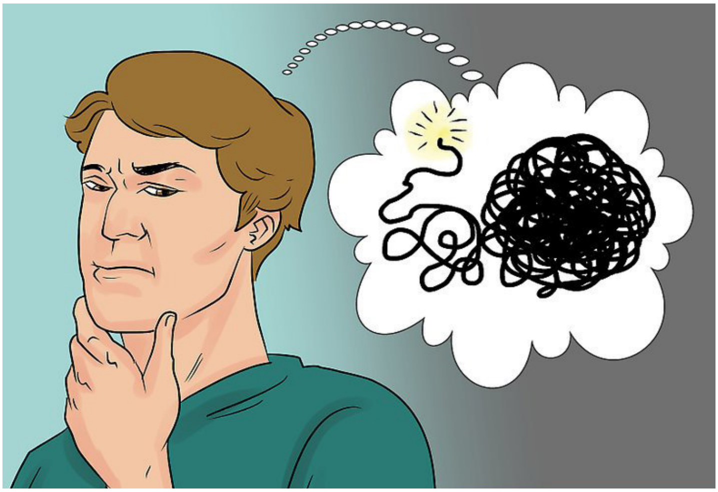
some other hobby you enjoy. You could even just zone out and let your mind wander!

- **Avoid catastrophizing.** Catastrophizing means to have irrational thoughts, such as exaggerating your problem by blowing it out of proportion. For example, you might think that because you failed one class it means that you will never get a good job. Catastrophizing can also mean engaging in all or none thinking (e.g., I'm either going to solve this problem or my life is over).

You can avoid catastrophizing by being cognizant of when you are doing it. This requires that you monitor your own thoughts and try to check them for accuracy.

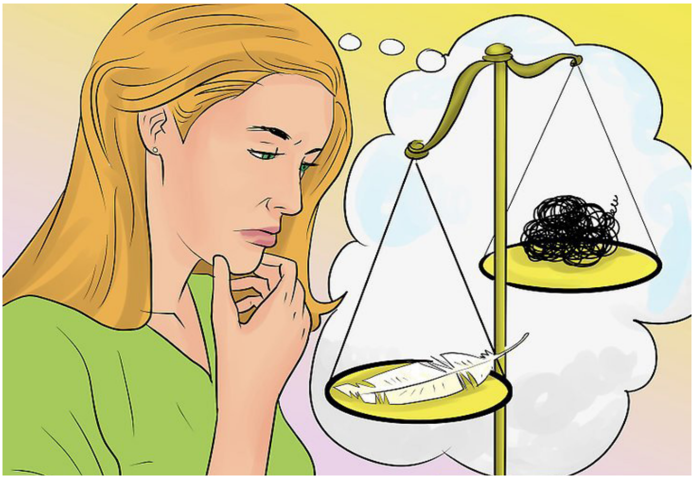
You can monitor your thoughts by remembering to think about them and by asking yourself if someone else had that thought, would you think they were being accurate?

- **Think of the origin of the problem.** When did you first notice this problem? Sometimes you may not notice something until it has been going on for a long time. This might especially be true if your problem involves other people (e.g. your sister may have been involved with drugs for a long time before you noticed).



If you think you know when the problem started, think about events that happened at that time. The root cause might be related to it. For example, if your grades started slipping in school after your father moved away, maybe you're having a hard time adjusting to this change.

- **Put things into perspective.** Most likely, your problem is not the end of the world: you can still carry on despite it. Every problem either has a solution or can be looked at in a different way that shows it's not really such a problem at all.

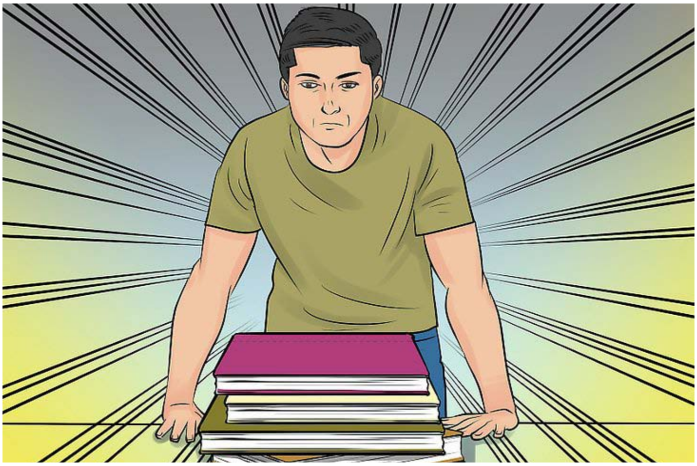


For example, your problem might be that you don't manage to make it to school on time. By changing a few habits or making different transportation arrangements, this can be changed.

Some things can't be changed, such as a permanent disability or the death of a loved one, but you can learn to live with it and thrive in the wake of it. Also keep in mind that people often think negative events will make them feel worse and worse for longer than they actually do.

Telling yourself this isn't the end of the world doesn't mean your problem is not really a problem or is insignificant. It just helps you internalize that your problems are not insurmountable.

- **Embrace the challenge.** Your problem can be thought of as a negative thing or a thing in which you have the opportunity to rise to the occasion. For example, if you are a failing a class, you could view this as a major problem and become depressed about it. Or, you could embrace the challenge it offers. Your failing suggests you need to work harder or learn new studying and organizational strategies to succeed. You could use this problem as an opportunity to learn such skills.



Dealing with problems and solving them can make you more competent and also more empathetic toward others who have their own problems.

Expressing That You Have a Problem

- **Write your problem down.** Put your problem on paper with pen. This will help the problem seem more tangible and will make you more likely to try to solve it when it is written down and staring you in the face.

For example, if your problem is that you don't have enough money, you could write that down. You could also write down the implications of that problem to drive home the point and motivate you to solve it. An implication of not having enough money might be that you are stressed out and that you can't enjoy the kinds of things that you would like to.

If the problem isn't something private, put the list somewhere you see it so you don't forget to act on it. For example, you might put it on your fridge.

- **Talk about the problem.** Share all the relevant details of your problem with someone that you trust with the information, such as a friend, family member, teacher, or parent. At the least it can help to reduce stress. In addition, she or he may be able to offer you advice that you hadn't thought of before.

If you're going to talk to someone else who has the same problem, you will need to be tactful. Let her know that you just want to learn so you can solve it, too.

- **Embrace your feelings.** Your feelings can act as guides that let you know how your problem solving is going. Feelings are important, even the negative ones. If you feel very frustrated or angry, for example, rather than trying to brush those feelings under the rug, acknowledge them and assess their cause. By finding the source, you may also find solutions to your problem.

It's okay to feel upset, angry, worried so long as you know that being upset, angry or worried won't help solve the problem. You will have to take action to solve the problem. Still, these emotions can help you realize you have a problem, as well as suggest its source.

Some ways to calm down when you're feeling upset include: focusing on your breathing, count to 10 (or higher if you need to), gently talk yourself down (tell yourself "it's going to be alright," or "take it easy."). Try going for a walk or run or listening to calming music.

- **See a counselor.** If your problem involves your mental health or well-being, or is impacting either, consider looking up a mental health professional and booking an appointment. These professionals can help you cope with and solve your problems.

Finding Solutions

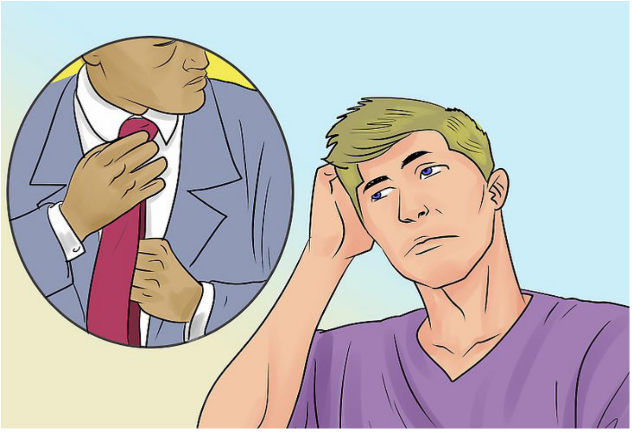
- **Research the problem.** Many problems are common enough to have plenty of details online. Your research can include journals or discussion forums. Behavioral, financial, academic or any other issue you may have, will most likely have been written about online.

Consider talking to people who have been through something similar or are professionals in the subject related to your problem.

For example, if your problem is academic related, talk to your teacher about it or another student who has already done the subject or course you're having difficulty with.

Understanding how problems come to be might help you face them better. Refocusing your attention on solving the problem will help decrease unproductive emotional tendencies such as guilt and anxiety, which can stymie problem solving skills and capabilities.

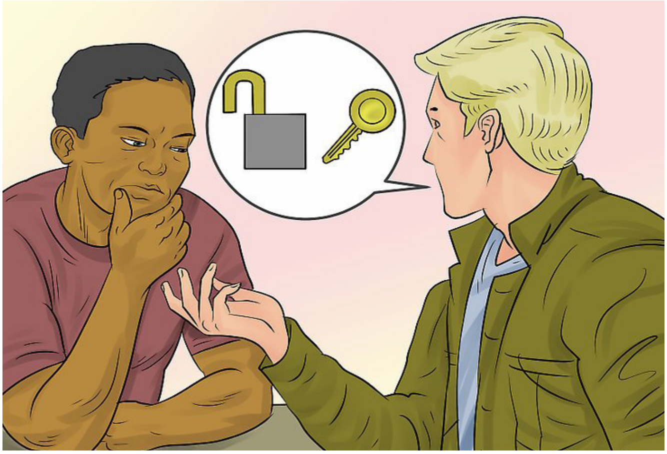
- **Seek out an expert.** If your problem involves something that an expert can help with, be sure to seek one out. For example, if your problem is that you consider yourself to be overweight and want to lose some pounds, you could try the help of a nutritionist or physical trainer.



Make sure that when you seek out advice, it's from a licensed professional in their field, which proves they have the skills needed to help you with your particular problem.

There are people who might claim to be an expert. If they are lacking the right credentials, chances are they aren't.

- **Look to others who solved your problem.** Think of other people who have been in a similar situation and how they resolved it. Could the same way work for you? For example, if you are struggling with addiction to alcohol, you could attend an Alcoholics Anonymous meeting and get a sense of the strategies successfully sober people used to remain that way.



Try asking them how they coped with and solved the problem you share. You may find yourself so wrapped up in your problem that an obvious solution evades you, but it may not evade others.

- **Brainstorm solutions.** Make a list of possible solutions to your problem. Think of where you can start, whom you can ask for help and what resources you will need. Be sure to think of lots of solutions and not to judge them as you are thinking of them. Just write down everything that comes to mind and evaluate whether it is a good or bad solution later on.

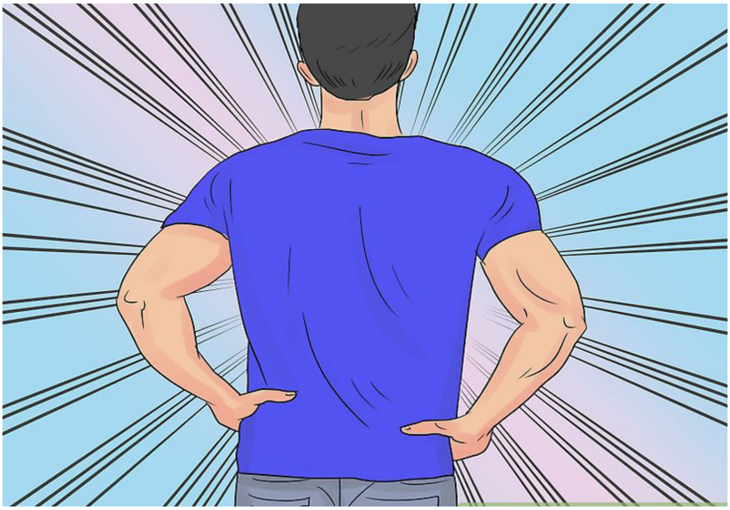
Consider the anatomy of the problem. Usually a problem is not just one problem alone - it has consequences and affects other areas of your life. Which part of the problem do you think you should address first?

For example, if your problem is that you never get to go on vacation, sub-problems may be that it is difficult for you to get time off of work, and it is difficult for you to save money to be able to afford a vacation.

You could address these sub-problems separately: You could cut back on eating out while simultaneously talking to your boss about how you are burnt out and could use a week off, and make a case that you would ultimately be more productive in the long run if allowed to recuperate.

- **Evaluate your solutions.** Ask yourself some questions that may help you decide whether to pursue one approach versus another. Ask yourself:
  - Whether the solution will, in fact, solve your problem.
  - How efficient the solution is in terms of the time and other resources it will require.
  - How you might feel it you choose that solution relative to another solution.
  - What the costs and benefits of the solution are.
  - Whether this solution has worked for others in the past.

- **Put your plan into action.** Once you know what you want to do and you've gathered your resources, implement your solution and face your problem head on. If the first solution doesn't work, try your plan B or go back to the drawing board and make one. The important thing is to keep going until you've successfully conquered the problem.



As you engage in your plan, reward yourself for your small successes so you are more likely to stick with it when the going gets tough!

Resist the temptation to avoid your problems if your plans don't work. Remember not to catastrophize –just because one solution didn't solve the problem, that doesn't mean there isn't another method to solve your problem.

5.1.6 Steps of Problem Solving Method

Here is a five-stage model that most students can easily memorize and put into action and which has direct applications to many areas of the curriculum as well as everyday life:

- **Understand the problem**. It's important that students understand the nature of a problem and its related goals. Encourage students to frame a problem in their own words.
- **Describe any barriers**. Students need to be aware of any barriers or constraints that may be preventing them from achieving their goal. In short, what is creating the problem? Encouraging students to verbalize these impediments is always an important step.

- **Identify various solutions**. After the nature and parameters of a problem are understood, students will need to select one or more appropriate strategies to help resolve the problem. Students need to understand that they have many strategies available to them and that no single strategy will work for all problems. Here are some problem-solving possibilities:
- **Create visual images**. Many problem-solvers find it useful to create "mind pictures" of a problem and its potential solutions prior to working on the problem. Mental imaging allows the problem-solvers to map out many dimensions of a problem and "see" it clearly.
- **Guesstimate**. Give students opportunities to engage in some trial-and-error approaches to problem-solving. It should be understood, however, that this is not a singular approach to problem-solving but rather an attempt to gather some preliminary data.
- **Create a table**. A table is an orderly arrangement of data. When students have opportunities to design and create tables of information, they begin to understand that they can group and organize most data relative to a problem.
- **Use manipulatives**. By moving objects around on a table or desk, students can develop patterns and organize elements of a problem into recognizable and visually satisfying components.
- **Work backward**. It's frequently helpful for students to take the data presented at the end of a problem and use a series of computations to arrive at the data presented at the beginning of the problem.
- **Look for a pattern**. Looking for patterns is an important problem-solving strategy because many problems are similar and fall into predictable patterns. A pattern, by definition, is a regular, systematic repetition and may be numerical, visual, or behavioral.
- **Create a systematic list**. Recording information in list form is a process used quite frequently to map out a plan

of attack for defining and solving problems. Encourage students to record their ideas in lists to determine regularities, patterns, or similarities between problem elements.

- **Try out a solution**. When working through a strategy or combination of strategies, it will be important for students to …
  - Keep accurate and up-to-date records of their thoughts, proceedings, and procedures. Recording the data collected, the predictions made, and the strategies used is an important part of the problem solving process.
  - Try to work through a selected strategy or combination of strategies until it becomes evident that it's not working, it needs to be modified, or it is yielding inappropriate data. As students become more proficient problem solvers, they should feel comfortable rejecting potential strategies at any time during their quest for solutions.
  - Monitor with great care the steps undertaken as part of a solution. Although it might be a natural tendency for students to "rush" through a strategy to arrive at a quick answer, encourage them to carefully assess and monitor their progress.
  - Feel comfortable putting a problem aside for a period of time and tackling it at a later time. For example, scientists rarely come up with a solution the first time they approach a problem. Students should also feel comfortable letting a problem rest for a while and returning to it later.
- **Evaluate the results**. It's vitally important that students have multiple opportunities to assess their own problem-solving skills and the solutions they generate from using those skills. Frequently, students are overly dependent upon teachers to evaluate their performance in the classroom. The process of self-assessment is not easy,

however. It involves risk-taking, self-assurance, and a certain level of independence. But it can be effectively promoted by asking students questions such as "How do you feel about your progress so far?" "Are you satisfied with the results you obtained?" and "Why do you believe this is an appropriate response to the problem?"

5.1.7 Teacher's Role in Problem Solving

Teacher's has a very important role in Teaching Learning Process. He or She has the duty to provide proper guideline to the students in the completion of their work. Some important roles are given below:

- Give suggestions not answers
- Offer a problem solving heuristic
- Teach a variety of problem solving strategies
- Allow time for the students to struggle with the problem
- Choose problems that require time to think through a solution
- Provide a variety of problems
- Allow students time to practice a heuristic and strategies
- Give similar or the same problem in different ways
- Ask questions that encourage students to:
    - think divergently
    - explain how they are thinking.
    - to share strategies
    - think of other ways that the same problem could be asked
    - think of real life problems that are or relate to the problem
    - discover different problems that can be solved with the same strategy
    - discover multiple ways to solve the problem
    - reflect or check their solutions

  - reflect and discuss how they imagined a certain strategy might be possible
  - explain why they have confidence in their solutions
- Provide encouragement and appreciation:
  - appreciate different solutions and strategies
  - encourage students to find multiple solutions to a problem
  - encourage students to take time to solve problems
  - compliment students on good problem solving strategies whether they reach a solution or not
  - make sure students know what a compliment or praise specifically relates to about the problem and problem solving
  - encourage students to keep trying and to learn by correcting mistakes
  - let students know that problem solving is difficult and rewarding
  - share and discuss attitudes and dispositions that are conducive to problem solving

5.1.8 Advantages of Problem Solving Method

- **Development of Long-Term Knowledge Retention** - Students who participate in PBL activities can improve their abilities to retain and recall information. This is because, while learning about something, open discussion between peers reinforces understanding of subject matter.
- **Use of Diverse Instruction Types** - Grouping students together for PBL allows them to tackle tangible problems and enjoy team-based learning. You can also provide content such as videos, news articles and more.
- **Continuous Engagement** - It's not hard to see the potential for engagement, as students collaborate to

solve real-world problems that directly affect or heavily interest them.

- **Development of Transferable Skills** - Using PBL to present tangible contexts and consequences can allow learning to become more profound and durable, helping students apply skills they develop to other real-world scenarios.
- **Improvement of Teamwork and Interpersonal Skills** - Completing a PBL challenge hinges on interaction and communication, meaning students should also build skills related to teamwork and collaboration.

5.1.9 Disadvantages of Problem Solving Method

- **Potentially Poorer Performance on Tests** - Because standardized tests typically reward fact-based learning with multiple choice and short answer questions, PBL activities may not effectively prepare students.
- **Student Unpreparedness** - Many students may not be prepared to participate in a PBL exercise due to immaturity, unfamiliarity with broad questions and lack of prerequisite knowledge.
- **Teacher Unpreparedness** - You may have to adjust some habits, such as overtly correcting students and teaching to promote the fast recall of facts. Instead, give hints and ask questions to encourage independent thought.
- **Time-Consuming Assessment** - If you choose to give marks, assessing a student's performance throughout a problem-based learning exercise demands constant monitoring and note-taking.
- **Varying Degrees of Relevancy and Applicability** - It can be easy for students to divert from the challenge's objectives, possibly missing pertinent information. Running into unanticipated obstacles when solving the problem is another possibility.

Thus the problem solving method is based on the principles of active learning. The student gets totally involved in the activity which helps in enhancing his/her knowledge, understanding and skills in real life situation and ultimately in developing a holistic personality. Since all the activities are related to the real life experiences, each of such activities is meaningful to the student. Therefore, meaningful learning is always associated with this method.

5.2 PROBLEM-SOLVING SKILLS

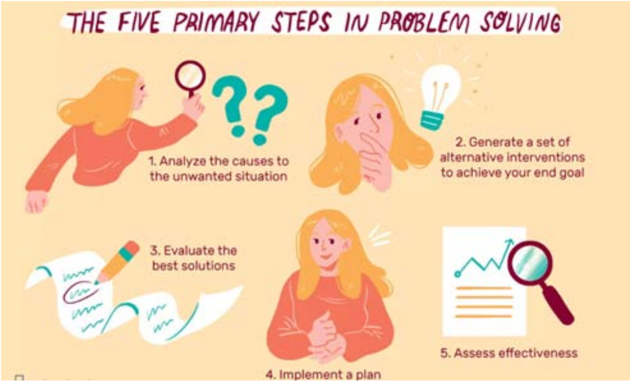
Problem-solving skills help you solve issues quickly and effectively. It's one of the key skills that employers seek in job applicants, as employees with these skills tend to be self-reliant. Problem-solving skills require quickly identifying the underlying issue and implementing a solution.

Problem-solving is considered a soft skill (a personal strength) rather than a hard skill that's learned through education or training. You can improve your problem-solving skills by familiarizing yourself with common issues in your industry and learning from more experienced employees.

5.2.1 How Problem-Solving Skills Work

Problem-solving starts with identifying the issue. For example, a teacher might need to figure out how to improve student performance on a writing proficiency test. To do that, the teacher will review the writing tests looking for areas of improvement. They might see that students can construct simple sentences, but they're struggling with writing paragraphs and organizing those paragraphs into an essay.

To solve the problem, the teacher would work with students on how and when to write compound sentences, how to write paragraphs, and ways to organize an essay.



There are five steps typically used in problem-solving.

1. Analyze Contributing Factors

To solve a problem, you must find out what caused it. This requires you to gather and evaluate data, isolate possible contributing circumstances, and pinpoint what needs to be addressed for a resolution.

To do this, you'll use skills like:

- Data gathering
- Data analysis
- Fact-finding
- Historical analysis

2. Generate Interventions

Once you've determined the cause, brainstorm possible solutions. Sometimes this involves teamwork since two (or more) minds are often better than one. A single strategy is rarely the obvious route to solving a complex problem; devising a set of alternatives helps you cover your bases and reduces your risk of exposure should the first strategy you implement fail.

This involves skills like:

- Brainstorming
- Creative thinking
- Prediction
- Forecasting
- Project design
- Project planning

3. Evaluate Solutions

Depending on the nature of the problem and your chain of command, evaluating best solutions may be performed by assigned teams, team leads, or forwarded to corporate decision-makers. Whoever makes the decision must evaluate potential costs, required resources, and possible barriers to successful solution implementation.

This requires several skills, including:

- Analysis
- Discussion
- Corroboration
- Teamwork
- Test development
- Mediation
- Prioritizing

4. Implement a Plan

Once a course of action has been decided, it must be implemented along with benchmarks that can quickly and accurately determine whether it's working. Plan implementation also involves letting personnel know about changes in standard operating procedures.

This requires skills like:

- Project management
- Project implementation
- Collaboration
- Time management
- Benchmark development

5. Assess the Solution's Effectiveness

Once a solution is implemented, the best problem-solvers have systems in place to evaluate if and how quickly it's working. This way, they know as soon as possible whether the issue has been resolved or whether they'll have to change their response to the problem mid-stream.

This requires:

- Communication
- Data analysis
- Surveys
- Customer feedback
- Follow-through
- Troubleshooting

5.2.2 How to Improve Problem Solving Skills

The ability to solve problems applies to more than just mathematics homework. Analytical thinking and problem-solving skills are a part of many jobs, ranging from accounting and computer programming to detective work and even creative occupations like art, acting, and writing. While individual problems vary, there are certain general approaches to problem-solving like the one first proposed by mathematician George Polya in 1945. Following his four principles – Understanding the Problem, Devising a Plan, Carrying out the Plan, and Looking Back – you can improve your problem-solving and tackle any issue systematically.

Understanding the Problem

- **Define the problem clearly.** This is an outwardly simple but vital step. If you don't properly understand the problem, your solutions may be ineffective or fail entirely. To define the problem you will have to ask questions and look at different angles. For example, is there one problem or actually several? Can you restate the problem in your own words? By spending time with the problem you will better understand it and be equipped to generate solutions.

Try to formulate questions. Say that as a student you have very little money and want to find an effective solution. What is at issue? Is it one of income – are you not making enough money? Is it one of over-spending? Or perhaps you have run into unexpected expenses or your financial situation has changed?

- **Define your objective.** State your aim as another means to reach the nature of the problem. What is it that you want to achieve? What is it that you want to discover? Keep in mind that you will have to account for the problem's knowns and unknowns and figure out where to find data that will help you reach your goal.

Say that your problem is still money. What is your goal? Perhaps you never have enough to go out on the weekend and have fun at the movies or a club. You decide that your goal is to have more spending cash. Good! With a clear goal, you have better defined the problem.

- **Gather information systematically.** Along with defining your problem and goal, you should gather as many facts as you can about the problem in order to get a clear picture of it. Collect data, ask people or experts connected to the problem, look for resources online, in print, or elsewhere. Once you have data, organize it. Try to do this by rewording, condensing, or summarize it. Perhaps you could even map it out in a chart. You may not need to bother with this step for simple problems, but it will be essential for those of a more complex nature.

To solve your money shortage, for example, you would want to get as detailed a picture of your financial situation as possible. Collect data through your latest bank statements and to talk to a bank teller. Track your earnings and spending habits in a notebook, and then create a spreadsheet or chart to show your income alongside your expenditures.

Devising a Plan

- **Analyze information.** The first step in finding a solution is to look at data that you have gathered about the problem and to analyze its importance. When you analyze, you will look for links and relationships in the hope of better understanding the overall situation. Start with the raw data. Sometimes, information will need to be broken into smaller, more manageable parts or to be ranked for its importance or relevance. Things like charts, graphs, or cause-and-effect models are helpful tools to do this.

Say you have now collected all your bank statements. Look at them. When, how, and from where is your money coming? Where, when, and how are you spending it? What is the overall pattern of your finances? Do you have a net surplus or deficit? Are there any unexplained items?

- **Generate possible solutions.** Say you have looked at your data and found that you have a net deficit of funds – that is, you are spending more than you are taking in. The next step is to generate a range of potential solutions. You do not need to assess them now. Try brainstorming, for example, or reverse brainstorming. This involved asking yourself, “how could I possibly cause the problem?” and then reversing the answers that you generate. You might also ask others what they would do.

Your problem is a lack of money. Your goal is to have more spending cash. What are your options? Without evaluating them, come up with possible options. Perhaps you can acquire more money by getting a part-time job or by taking out a student loan. On the other hand, you might try to save by cutting your spending or by lowering other costs.

Use some strategies to help you come up with solutions:

- Divide and conquer. Break the problem into smaller problems and brainstorm solutions for them separately, one by one.
- Use analogies and similarities. Try to find a resemblance with a previously solved or common problem. If you can find commonalities between your situation and one you've dealt with before, you may be able to adapt some of the solutions for use now.
- **Evaluate the solutions and choose.** Just as you had to analyze the problem's raw data, you will also have to analyze all prospective for their suitability. In some cases, this could mean testing a scenario or running an experiment; in other cases, it may mean using a simulation or "thought experiment" to see the consequences a given solution. Choose a solution that best suits your needs, seems likely to work, and does not creating further problems.

How can you raise money? Look at expenditures – you aren't spending much outside of basic needs like tuition, food, and housing. Can you cut costs in other ways like finding a roommate to split rent? Can you afford to take a student loan just to have fun on the weekend? Can you spare time from your studies to work part-time?

Each solution will produce its own set of circumstances that need evaluation. Run projections. Your money problem will require you to draw up budgets. But it will also take personal consideration. For example, can you cut back on basic things like food or housing? Are you willing to prioritize money over school or to take on debt?

Implementing and Assessing the Plan

- **Implement a solution.** Once you have chosen the best solution, put it into practice. You might do this on a limited, trial scale at first to test the results. Or, you might go all in. Keep in mind that unforeseen problems can arise at this stage, things which you did not plan on during your initial analysis and evaluation, especially if you did not structure the problem correctly.

You decide to cut costs, because you were unwilling to take on debt, to divert time away from school, or to live with a roommate. You draw up a detailed budget, cutting a few dollars here and there, and commit to a month-long trial.

- **Review and evaluate the outcome.** Now that you have implemented a solution, you will have to monitor and review the results. Ask yourself if the solution is working. Does it allow you to achieve your goal? Are there any unforeseen new problems? Review the problem and your problem-solving process.

The results of your trial are mixed. On one hand, you have saved enough during the month for fun weekend activities. But there are new problems. You find that you must choose between spending cash and buying basics like food. You also need a new pair of shoes but can't afford it, according to your budget. You may need to a different solution.

- **Adjust if necessary.** Keep in mind that problem-solving works in a cycle. It will generate a number of different potential solutions that each must be evaluated. If you fix the problem, you have found a suitable solution. If not, then you must look for an alternative solution and start the process over again. Reconsider your initial solution and adjust if it is not working. Try another solution, implement it, and review the outcome. Repeat this process until you finally solve the problem.

After a month, you decide to abandon your first budget and to look for part-time work. You find a work-study job on campus.

Making a new budget, you now have extra money without taking too much time away from your studies. You may have an effective solution.

Honing your Skills Further

- **Do regular mental exercise.** Like a muscle in your body, you will need to work on problem solving if you want to improve its strength and functioning over time. In other words, you will need to "exercise" regularly. Studies show that things like brain games can make you more mentally limber. There are any number of games or activities you can try.

Word games work great. In a game like "Split Words," for example, you have to match word fragments to form words under a given theme like "philosophy." In the game, "Tower of Babel," you will need to memorize and then match words in a foreign language to the proper picture.

Mathematical games will also put your problem solving to the test. Whether it be number or word problems, you will have to activate the parts of your brain that analyze information. For instance: "James is half as old now as he will be when he is 60 years older than he was six years before he was half as old as he is now. How old will James be when his age is twice what it was 10 years after he was half his current age?"

- **Play video games.** Video games have been portrayed as "intellectually lazy" for a long time. However, new research shows that playing video games can improve parts of thinking like spatial perception, reasoning, and memory. Not all games are created equal, however. While first-person shooter games can improve your spatial reasoning, they are not as effective as others at developing problem solving skills.

Play something that will force you to think strategically or analytically. Try a puzzle game like Tetris. Or, perhaps you would rather prefer a role-playing or strategy game. In that case, something like "Civilization" or "Sim-City" might suit you better.

- **Take up a hobby.** A hobby is another way that you can continue to improve your problem solving skills. Pick something that either involves active problem solving or activates appropriate parts of your brain. For example, start to learn a foreign language. Language functions in both hemispheres of the brain, so learning one will activate areas that control analysis as well as reasoning and problem solving. This is where problem solving

Web design, software programming, jigsaw puzzles, Sudoku, and chess are also hobbies that will force you to think strategically and systematically. Any of these will help you improve your overall problem solving.

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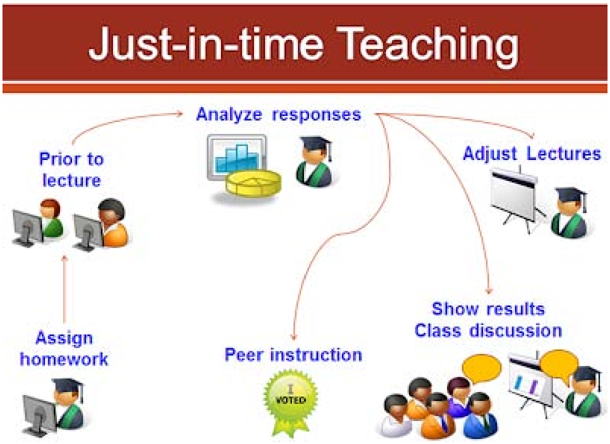
CHAPTER 6

JUST-IN-TIME TEACHING

INTRODUCTION

Just-in-time teaching is a pedagogical strategy that uses feedback between classroom activities and work that students do at home, in preparation for the classroom meeting. The goals are to increase learning during classroom time, to enhance student motivation, to encourage students to prepare for class, and to allow the instructor to fine-tune the classroom activities to best meet students' needs. This should not be confused with just-in-time learning, which itself focuses on immediate connections between learners and the content that is needed at that moment.

Just-in-time teaching actively involves students in the learning process through a two-step series of learning activities. In the first step, students complete a focused set of activities outside of class (usually via interactive Web documents) and submit their work to the instructor. In the second step, the instructor (often just hours before the next lecture) collects the students' responses and identifies areas of understanding and misunderstanding to adjust the next lesson so that students can receive specific "just-in-time" feedback on those particular areas.



The purposes of just-in-time teaching are to encourage more student responsibility for learning the content outside of class, maximize the efficiency of class-time to allow for more focused and more meaningful explication of the content, and have more time for interaction and discussion. Instructors who use just-in-time teaching also find that their students are more active and more interested than they would be in a more traditional lecture.

Since many students will not read a textbook, but they will watch a video or listen to an mp3, many instructors have elected to use short video lectures (via YouTube) or podcasts (via ITunes U) as the starting point of the learning process in just-in-time teaching.

6.1 OVERVIEW OF JUST-IN-TIME TEACHING (JITT)

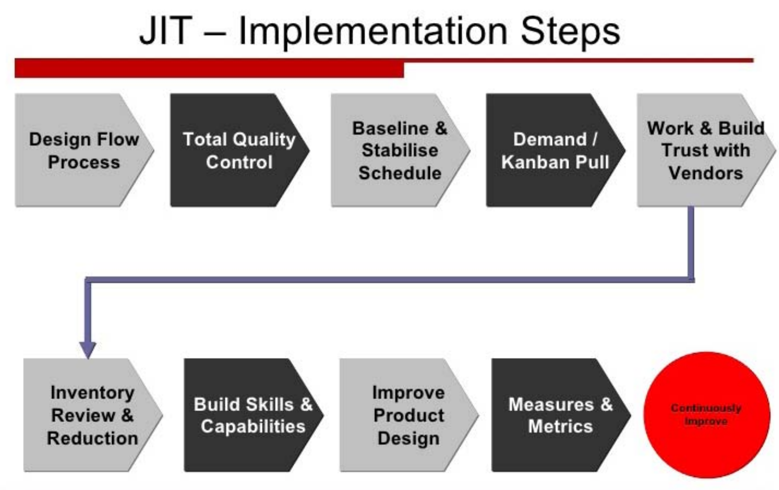
Just-in-Time Teaching (JiTT) is an innovative approach to education that integrates real-life and virtual instruction to maximize the efficacy of both. This teaching method is created by a team led by university professor Gregor Novak. This model involves a two-step series of learning activities:

- Students complete a focused set of activities (e.g., reading from the textbook or using other resources etc.) online (through a course website, or through a learning management system) before coming to the class. These pre-instruction assignments called warmups. These activities often require complex answers even though they are open to interpretation. Then, students submit their assigned work to the instructor a few hours before class starts.
- The instructor collects students' responses and identifies the areas of understanding and misunderstanding to adjust teaching activities in a meaningful way. This will let the instructor to focus class time on cooperative problem solving activities.

This method lets the instructor to maximize the efficiency of class-time to allow for more focused and more meaningful exploration of the teaching materials. According to Novak (2011), "successful implementation of the JiTT strategy depends critically on the teacher and students' total buy-in. If students see the on-line assignments merely as an add-on to the course, to be completed perfunctorily in the shortest time possible and then discussed briefly at the beginning of class, before the "real" lecture, they will resent the extra work and will not get any additional benefit from JiTT. "

6.1.1 Implementing JiTT

The process begins, as always in education, by asking questions. These are posted online for students to consider well before any class meeting. The questions do not have predigested multiple-choice answers, or blanks to fill in. Rather, they require the student to be thoughtful and take action: consult a reference, perform an experiment, analyze a video or interact with an outside source. Thus, the JiTT approach begins on the students' own terms, organically familiarizing them with the material at hand and putting them in the headspace for stimulating class participation. Teachers also have time to review the responses so that they can be categorized and addressed during the class session. Learning disparities can also be more quickly identified and targeted. By structuring their first interaction this way, students and their instructors can start out on the same page, which advances the learning process.



STEP 1: Considerations for JiTT Success

JiTT is applicable to every subject, but is not a "one size fits all" methodology. Specifics are paramount to using the approach effectively, as are setting goals for the coursework and tailoring it to the students themselves. As an instructor, you should reflect on questions of your own before implementing JiTT in the classroom. Factors to consider include:

- Class size
- Student level/aptitude: How advanced are the students expected to be with the subject?
- Spectrum of progress: How will you define success for the average student in your class?
- Dominant pedagogy: How can JiTT best complement the favored approach to teaching this course
- What share will JiTT represent of the grading process?
- How much time (in and outside of class) can be dedicated to discussions and exercises?
- How will you and your students make use of the results generated by JiTT?

The JiTT approach you develop in this step cannot be underestimated, as it will affect the subsequent stages of the entire process as outlined below.

STEP 2: Crafting the Right Questions

JiTT questions are designed to help learn more about the student, not determine what the student has learned about the subject. Therefore, they are very different from traditional assignments, tests, and quizzes. They should provide much more robust and detailed information illustrating how the student thinks and processes information. This allows the instructor to mold the curriculum in response, fostering better communication and a sharper evaluation of the pupil's ongoing progress. Good JiTT questions are not conclusive, and do not point to predetermined responses. They are jumping off points that reveal multiple "landing areas." To allow yourself sufficient opportunity to read the replies before class, student answers should be relevant to the subject and precise in their thinking, but not tethered. The opening questions must complement the determinations you made in Step 1, and give you the insight to encourage students to elaborate on their ideas in class.

STEP 3: Assessing the Responses

JiTT Steps 1 and 2 have direct bearing on the next phase, as the work you and your students put into the questions and responses will be of limited value if you lack the time to review them before class. So it is important to keep in mind that JiTT is an ongoing process that builds upon realistic benchmarks determined at the outset. You will base the course approach on this initial interaction with your students, so you'll want to ensure the results are compatible with the time available to read their responses. In most cases, depending on sample size, they will fall into place along a spectrum that can be broken up into groups or "response clusters," with more than one student comprising each category. Arranging them this way will be very helpful in crafting the exercises and activities that will enrich the course experience. It makes the work load more manageable and encourages a cooperative environment while at the same time promoting individual achievement.

STEP 4: Keeping JiTT Active

Step 4 can follow many avenues. The simplest use of the student results is to share a sample response from each "response cluster" to facilitate group discussion. This should of course be done without compromising anyone's identity, as the sample response will ideally be dissected to reveal strengths and weaknesses, and further expound upon the subject matter. But to get the most out of JiTT, these results will be employed to address any disparities revealed in the spectrum of responses. This will take the form of generating high levels of engagement within the class, requiring students to learn from one another and figure out solutions within a group. JiTT activities will be cultivated both inside and outside of the classroom, which will keep students enthusiastic about the course and allow the instructor a sturdy framework to evaluate their progress.

6.1.2 Methods of JITT

Just-in-Time Teaching relies on a combination of high-tech and low-tech methods. On the hightech side, the WWW is used as a flexible, high-speed communications tool linking students and faculty. On the low-tech side, students participate in several classroom activities that stress active learning and interaction among students and faculty. Student teams work on problems under the guidance of faculty and peer mentors. We have also developed an interactive lecture unique to JiTT. Several web-based tools and assignments used at IUPUI. One of these, the WarmUp exercise is a crucial element in the interactive lecture method.

WarmUp Exercises are the single most important element of the Just-in-Time Teaching strategy. These are brief, conceptual exercises that are due before lecture periods. Students must read assigned materials, then answer several questions via an online form. In the introductory physics courses at IUPUI, the WarmUps are due two hours before each lecture session. Although this period can be varied substantially, it should be short enough that the subject is fresh in the students minds (12 hours or less) yet long enough that the instructor has time to review a representative sample of the students responses (at least 1 hour). Grading of the WarmUp exercises is also subject to the instructors discretion. At IUPUI, most instructors grade the WarmUps on effort, rather than for technical accuracy. This encourages students to participate fully, and is especially helpful when the WarmUp focuses on subjects that are difficult or confusing. This also helps maintain student motivation. Students resent being graded on material that has not yet been discussed in class.

In the period between the submission deadline and the class period, faculty adjust and organize the classroom lesson in response to the students submissions Just-in-Time. Thus, a feedback loop between the classroom and the Web is established. The WarmUps encourage students to keep up in the textbook, and are designed to challenge students preconceptions about the subject. To use the WarmUps, we read the students submissions and select excerpts that will be used in class.

Interactive lecture, we present the excerpts selected from the students work, weaving them into the presentation as appropriate. Instead of passively listening to a lecture, students participate in a guided discussion that begins with their own preliminary understanding of the material. We do not simply go over the questions in an isolated section of the lecture; rather, we frame our lecture in terms of an analysis of various student responses. It is noteworthy that the instructor need not read all of the students responses for this purpose. Reading a few dozen responses generally provides adequate material for the lecture, and grading may be done later, possibly by a teaching assistant or student mentor.

Building the lecture around students responses has numerous benefits. It is far easier to elicit students thoughts on a subject if the discussion is grounded in their own work. The WarmUps encourage students to prepare for the lecture, and help them develop a need to know. If many of the students have not understood a particular point in the reading, the faculty member is forewarned, and can give more attention to that point. If a point has clearly been understood by most of the class, then that issue can receive less emphasis.

This method does not lead to sacrificing content. The instructor designs the questions and selects which student responses to use in class. With a little practice, the instructor can easily elicit responses that are good talking points for the material he wants to cover.

A key aspect of the interactive lecture is to use the WarmUp responses to promote active learning during the lecture, a particularly difficult task in large, theater-style rooms. However, using the WarmUps carefully, it is possible to engage students even in classes of several hundred students. There are many ways to accomplish this goal. Most involve brief periods in which students discuss the subject with their neighbors in the classroom. For instance, students can be shown two responses to the same question which are clearly mutually exclusive. The instructor asks the class for a show of hands on which (or neither) of the answers is correct. After noting the result, she then gives the students two minutes to discuss the two answers with their neighbors before asking for a new vote.

We have also found that using the WarmUps helps students to improve their study habits. Because WarmUps are due on lecture days (and homework on recitation days) our students have assignments due on every day of class. This encourages them to organize their studying around manageable sessions, through which they can remain alert and effective.

Puzzles act as the opposite bookends to the WarmUp exercises. Like WarmUps, puzzles are delivered and answered via the WWW. However, where we use WarmUps to introduce individual topics and subtopics, we use Puzzles to tie a group of topics together, and to connect those topics to prior parts of the course. Puzzles are intended to be difficult even for the best students in the class. They often ask students to integrate course content with knowledge from other courses, and they are usually graded much more harshly. Most instructors use puzzles less frequently: once each week or less. In the classroom, we treat the puzzles in much the same way that we do the WarmUps. Faculty take excerpts from students responses and bring them to class for use during the discussion of the puzzle. Unlike WarmUps, however, puzzles are usually discussed in isolation, at the beginning of class. Once the discussion of the puzzle is ended, we move on to introduce new material.

Intra-class communications are aided by several online tools including an anonymous suggestion box, a course bulletin board, and an announcements feature on the course home page. The first of Astins three factors is student-student interaction. At residential colleges and universities, this interaction is facilitated by students living arrangements. Dormitories and other student housing often have common study areas in which students can find peers who are taking or have taken the courses that they are struggling with. They often learn more while working with such colleagues than they do during class time. Unfortunately, this type of interaction is unavailable to part time or commuting students. We use an online bulletin board for each course in an effort to at least partially obviate this lack. In addition to the bulletin board. The course web sites also each contain an anonymous electronic suggestion box through which they can communicate concerns to the instructors without fear of reprisal. This gives us the opportunity to receive valuable feedback throughout the semester rather than waiting for the official course evaluations which are not available until the semester ends.

The recitation section has been substantially changed as well. In the traditional format, an instructor (often a graduate student) would present detailed solutions to the homework problems. The class size was smaller, but student participation was as limited as in the traditional lecture. We have replaced this session with one in which the instructor spends only the first ten to fifteen minutes of class discussing the homework, often focusing on a single difficult problem. For the remainder of the class, students stand at whiteboards (which cover much of the available wall space) and work on problems in teams of two to four. The instructor, a graduate student, and several peer mentors circulate throughout the room during this time, providing help as needed.

6.1.3 JITT in Higher Education

Over the past two decades, instructors from several academic disciplines in postsecondary education have incorporated the JiTT strategy. Even though the majority of JiTT practitioners are housed in the sciences (e.g., physics, biology, chemistry), JiTT has been implemented in a wide array of classes, such as psychology, anthropology, education, computer science, accounting, economics, history, and more, due to its flexible nature and its design based on seminal theories in educational research. JiTT adopters have reported many benefits of using the strategy, such as increased student participation and preparation, deeper learning of material, improved motivation, improved critical thinking skills, improved grades, frequent formative feedback before major assessments, and decreased student anxiety. Since JiTT has been successfully integrated in a variety of academic subjects, we believe that FL instructors can also reap the same benefits by including JiTT in their classes, especially at the advanced level.

While there are several convincing arguments that support the integration of JiTT in higher education courses, it is important to stress that JiTT is not a panacea for all instructors facing significant classroom challenges, nor does its implementation come without its own share of difficulties. When using the strategy for the first time, many JiTT instructors have confronted a sizable learning curve; frustrations are to be expected, especially during the first few iterations of a course that implements JiTT pedagogy. Specifically, instructors have observed student resistance to the JiTT exercises, considering them too time-consuming and demanding. Students also have been known to wait until the last minute to complete the JiTTs or to find out the answers from other students in earlier sections before completing an assignment; both of these behaviors defeat the purpose of implementing the JiTT strategy. However, after fine-tuning JiTT questions, incorporating student feedback on the JiTT practice, and explicitly explaining to students the purpose of JiTTs and how to study using the strategy, instructors have been able to successfully utilize the technique to enhance student learning in their classes.

6.1.4 JiTT in Foreign Language Instruction

We believe that JiTT can be particularly advantageous in advanced-level FL classes: JiTT is flexible, facilitates an engaged, learner-centered classroom, and stimulates student participation and motivation. Though upper-level FL classes range in content from the humanities, as in a FL literature class, to the social sciences, as in a FL linguistics course, what these advanced classes have in common is that they focus on simultaneously teaching concepts to students and leading them to communicate about those concepts in the FL. The implementation of the strategy in a FL classroom. JiTT was highly effective when teaching English as a Foreign Language (EFL) in Japan. Specifically, students were less anxious, and they came to class more prepared, asked more questions, and learned more from classmates, because JiTT helped lower their affective filters. The effectiveness of JiTT in EFL classrooms, previous work that has been done with JiTTs in FLs appears to consist solely of various activities submitted by Franklin to the Multimedia Educational Resource for Learning and Online Teaching (MERLOT), where she is a founding editor. These include materials for teaching mostly French, though there is one activity for heritage speakers of Spanish to work through a module on identity and bilingualism in America. The four activities for French include videos on culture in the Francophone world, a newspaper reading assignment, and a postcard creation exercise, all intended as warmups and designed for learners at various levels of proficiency. The activities seem to require that the instructor be familiar with JiTT pedagogy in order to understand how to fit them into the JiTT model. With the exception of one of the activities, “Cartes Postales de TV5 Monde,” and possibly one of the videos, “Learn French through Gastronomy,” there does not appear to be a way for the instructor to assess comprehension prior to class, which is the fundamental element of JiTT pedagogy.

6.1.5 JITT to Hispanic Linguistics

We demonstrate how JiTT may be incorporated into an advanced FL class taught at many postsecondary institutions, Introduction to Hispanic Linguistics (IHL), although the technique is easily adaptable for any content-based FL course. IHL has become a frequent offering at many universities in the U.S. and includes an introduction to the major fields of linguistics of the Spanish language: the sound system (phonetics and phonology), word and sentence structure (morphology and syntax), meaning (semantics and pragmatics), and history and variation of the language (dialectology and sociolinguistics). Since this class is conducted in Spanish, students are expected to communicate in the language in order to participate and complete assignments and assessments, which can prove difficult for those students with lower linguistic proficiency. Students are also challenged by the heavy terminology of the course, as well as the fact that they may never have considered language as an object of academic study. As such, JiTT pedagogy can be an appropriate technique for the IHL classroom, especially since the strategy has been successfully employed in many other introductory courses to engage students that initially show little motivation or background knowledge in a topic. In addition, even though IHL covers content-specific material, it remains a FL course; JiTT can not only assist students with complex content, but it can also facilitate more opportunities for FL production in both written and oral forms at more advanced levels. In fact, presenting students’ answers anonymously to the class without correcting non target-like forms could give students more incentive to pay closer attention to the linguistic structures they employ as they work with the FL.

6.1.6 Promoting Active Learning

Consider the main features of the JiTT exercise.

- Students are presented with a slightly provocative and memorable statement that is open to a considerable amount of interpretation.
- Students rephrase the question in their own words. The responses tell the instructor how students interpreted the assignment.
- Students must take a stand and justify their position. They must examine prior knowledge, consult the course resources, and perhaps discuss the issue with classmates.

The essence of the JiTT pedagogy is timely pre-instruction assignments, usually called warm-ups, that inform the upcoming lesson by encouraging the students to examine their prior knowledge and seek information about the upcoming topic before coming to class.

6.1.7 Adjusting the Lesson Flow

There is room for flexibility as long as two crucial criteria are met. The assignments must be thoughtfully constructed and constitute an integral part of the lesson. Expanding on these two criteria, a good JiTT question:

- Is informed by education research, both cognitive and discipline-specific.
- Yields a rich set of student responses for classroom discussion.
- Requires an answer that cannot easily be looked up.
- Encourages the student to examine his/her prior knowledge and experience.
- Requires that the student formulate the response, including the underlying concepts, in his/her own words.
- Contains enough ambiguity to require the student to supply some additional information not explicitly given in the question. (This feature enriches the subsequent classroom discussion.)
- Targets a conceptual bottleneck.
- Is just outside the comfort zone.

- Is extendable and memorable.
- Is sufficiently captivating so that even struggling students may be interested in the answer.

Encouraging students to examine the status of their knowledge, metacognition is usually accomplished by including on the response page a free-form "comments" field.

Before going to class, the instructor looks at the responses and decides how to adjust the lesson flow. Student responses typically fall into a set of categories. The instructor selects representative examples to show in class, not ignoring the comments.

The instructor is now ready to adjust the classroom activities or lesson flow, and improvise if necessary. The flow is pretty much predetermined, but the words used in class will arise from the student responses and, most importantly, will be influenced by the feedback from the live class. Typically, the live class is shown a representative set of responses, and the authors of the responses are invited to comment and elaborate. The rest of the class is encouraged to challenge and suggest alternatives. Properly handled, this can be a teaching opportunity that goes beyond the course content. Students have an opportunity to practice critical thinking and communication skills. The course content is enriched because the wording actually comes from the live class, which makes the lesson fresh and interesting to the students.

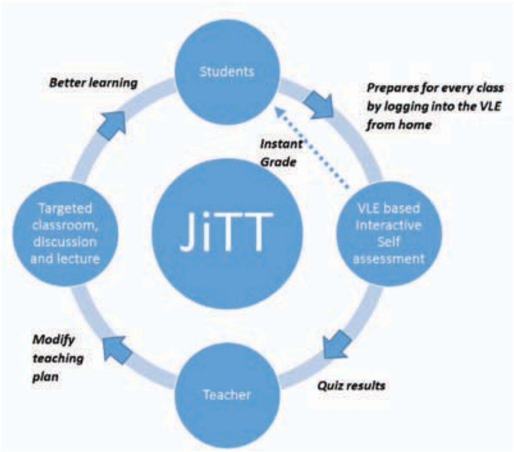
6.1.8 Effective Uses of JITT

There is a variety of ways to respond to the issues raised in the student responses to the pre-class JiTT assignment:

- Mini-lecture
- Group activities
- Clicker activities
- Demos

Here is checklist of recommendations to make the JiTT pedagogy effective:

- Let students know that JiTT will be used, why, and how it works. Make clear what a quality response looks like.
- Use JiTT regularly, but keep it short and manageable.
- Use JITT questions on exams, and use responses in distractors. Also, let JiTT count toward the final grade. Grade for effort.
- Include climate questions, and ask students how they reached their answers.
- Look for patterns in responses, and link responses to in-class activities.
- Make responses easy to submit and manage. Provide personal feedback as much as possible.



6.2 PEER INSTRUCTION AND JUST-IN-TIME TEACHING

In comparison, PI structures time during class around short, conceptual multiple-choice questions, known as ConcepTests, an example of which is shown in Figure 1. These questions are targeted to address student difficulties and promote student thinking about challenging concepts

The ConcepTest procedure is depicted in Figure 2. After a brief presentation by the instructor, the focus shifts from the instructor to the student, as the instructor encourages the students to think about the material by posing a ConcepTest.

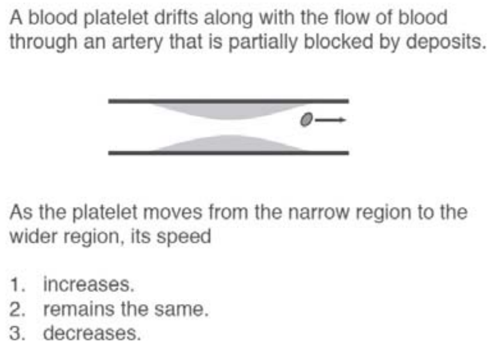


Figure 1: A Sample ConcepTest

After 1–2 minutes of thinking, students commit to an individual answer. If an appropriate percentage of students answer the ConcepTest correctly, the instructor asks students to turn to their neighbors and discuss their answers. Students talk in pairs or small groups and are encouraged to find someone with a different answer. The teaching staff circulates throughout the room to encourage productive discussions and guide student thinking. After several minutes students answer the same ConcepTest again. The instructor then explains the correct answer and, depending on the student answers, may pose another related ConcepTest or move on to a different topic.

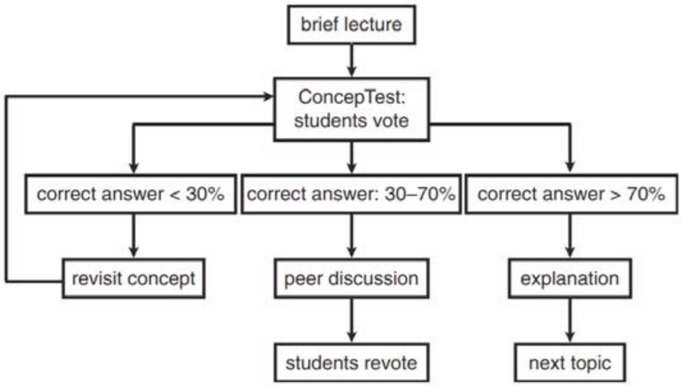


Figure 2: The ConcepTest-Peer Instruction Implementation Process.

PI has been shown to be a useful way to engage students in classroom demonstrations, much like interactive lecture demonstrations. Before showing students what happens when you mix two chemicals or flip a switch on a given circuit, instructors can ask students to predict the outcomes. Research shows that asking students to predict the outcome of an experiment results in greater conceptual understanding and instructors report increased student engagement. In social science or humanities courses PI can be used to involve the students as participants in experiments with human responses.

A variety of question-types can be used with PI, including questions about general theories and definitions, questions asking students to apply concepts in different contexts, and questions that illustrate how different ideas are related. PI is not only useful for questions with "correct" answers, but also for promoting discussion among students with questions that lack a clear-cut answer. For example, a ConcepTest may ask students to consider the relative importance of different assumptions in a scientific hypothesis or the relative value of different interpretations of a literary passage. The structure of PI provides opportunities for students to hone their skills in critical listening and developing solid arguments. PI enables students to create knowledge through discussion and become active participants in the discipline they are studying.

PI and JiTT: The quality of student discussion and learning in a PI classroom depends on the quality of the ConcepTests. Several databases of class-tested questions exist in physics chemistry, astronomy, mathematics, geoscience, philosophy, and psychology. For a ConcepTest to be most effective, the question must require higher-level thinking about a concept so students aren't simply recalling something they read or using "plug-and-chug" with equations. Questions must also be at an appropriate difficulty level so students are challenged but can reason to the answer with their existing knowledge.

To choose the best ConcepTests, instructors need to gauge what concepts are causing student difficulties and what level of question is appropriate for their class. By assigning JiTT assignments before class, instructors receive important feedback on their students' knowledge and understanding of the material, enabling them to better prepare for a PI lecture. Reading student responses helps instructors learn what difficulties students have, what topics students are most apprehensive about, and what concepts students understand well. Combining JiTT with PI makes preparation for class especially efficient, as it becomes much easier to choose effective ConcepTests. Often, reading student problems or misconceptions even leads to ideas for new questions.

JiTT is not only useful for instructor preparation; it also helps students prepare for class. As Figure 3 shows, students get the most benefit from peer discussion when about 30–70% of the class answers the ConcepTest correctly before discussion.

Too few correct answers may indicate that students do not have enough understanding or knowledge to engage productive discussions. Therefore, students must come to class with some knowledge and ideas about the material. Often instructors administer reading quizzes at the start of class to promote pre-class reading; however, this assignment often relies solely on student memorization of facts, definitions, or equations. JiTT also encourages students to read the material, but the questions ask for more than memorization of key words and definitions and push students to start thinking more deeply about the concepts. In addition, most JiTT exercises include a question of the type, “After completing this exercise, what concepts are still unclear to you?,” which promotes reflective thinking by students and provides formative feedback on students’ thinking processes for instructors.

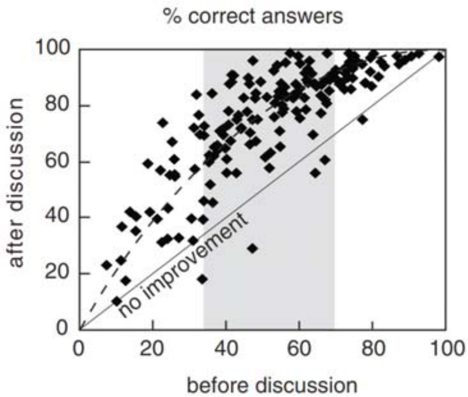


Figure 3. Percentage of correct answers before discussion versus after discussion.

6.2.1 Using JITT and PI: An Example

This class met twice a week and students submitted JiTT assignments online by midnight the evening before each lecture. For this assignment students typically read a half chapter from the textbook and answered two conceptual JiTT questions and one additional question: “Please tell us briefly what single point of the reading you found most difficult or confusing. If you did not find any part of it difficult or confusing, please tell us what part you found most interesting.” Students were graded for effort, not correctness, on these reading assignments. After the submission deadline, students could log into their accounts to see the correct answers for the first two questions as well as common questions (plus answers) from their peers. The instructor reviewed student answers before lecture, responded by email to student issues, and designed the next lecture, choosing which ConcepTests were appropriate. During the 1.5-hour-long lecture, students answered several ConcepTests, using either a wireless infrared device or their own personal wireless device, such as a cell phone, PDA, or laptop. Students' answers were recorded and students received participation credit for their responses. After lecture students could log in to review the ConcepTests as well as correct answer explanations, and the instructor could see statistics on students' answers before and after discussion.

To further illustrate how JiTT and PI complement each other, we detail one reading assignment and lecture from a one-semester course covering electricity and magnetism. We have selected a topic that was more likely to be covered in high school science courses—and therefore does not need a great deal of background knowledge—to help make this sample lecture more accessible to instructors in a variety of disciplines.

To prepare for lecture students were required to read four sections of a physics textbook covering ray optics, including topics such as transmission, reflection, absorption, refraction, dispersion, and image formation. They were then asked to answer three questions as part of their JiTT assignment:

- Several of the figures show the paths of three so-called "principal" rays (1, 2, and 3) emitted from a light bulb and focused by a converging lens. How would you trace the path of a fourth ray emitted by the light bulb that bisects rays 1 and 2? (See Figure 4 for an example figure from the text.)
- You are looking at a fish swimming in a pond. Compared to the actual depth at which the fish swims, the depth at which it appears to swim is greater, smaller, or the same?
- Please tell us briefly what single point of the reading you found most difficult or confusing. If you did not find any part of it difficult or confusing, please tell us what parts you found most interesting.

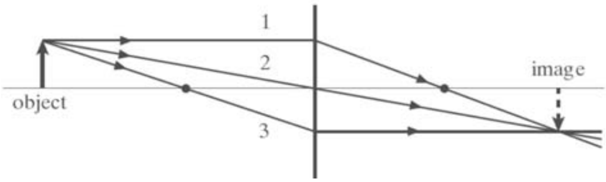


Figure 4: Sample Figure of Light Rays with a Converging Lens from the Text.

The correct answers were posted on the website for the first two questions after the assignment was due.

- From the bulb to the lens: bisect rays 1 and 2 to find the point P where the ray strikes the lens. Then, draw a line from point P to the point where the principal rays intersect on the image of the light bulb.
- Smaller, because at the water/air interface the light bends; the rays from the fish travel less steeply in air than in water. Therefore, the light appears to have come from a more shallow source.

Most students were able to correctly answer the first JiTT question by describing the path of a fourth ray. Students who had problems with this question often had issues with terminology or did not explicitly state how all rays would converge at the same point. Below is a sample of student JiTT responses.

- If you had a fourth ray that bisects rays 1 and 2 you would have it emerging at an angle after passing through the lens that didn't allow it to pass through the focus point. This is because it would not be paraxial and would be displaced away from the focus point.
- A fourth ray emitted by the light bulb and bisecting the angle between rays 1 and 2 should be directed through the focal point after reaching the center of the lens (so it makes a smaller angle upon reaching the center of the lens than ray 1 does, but a larger one than ray 2 makes, because ray 2 does not bend upon reaching the center of the lens).

- Well, I would probably draw it following a path that continued half way in between the other the paths followed by rays 1 and 2, but beyond that the sketch would not be very precise.

Many students answered the second JiTT question correctly, but often with sparse or incomplete explanations. Students who answered incorrectly didn't seem to grasp the concept of refraction in different mediums, especially with a flat interface. The sample student responses illustrate this point.

- The depth would be smaller due to the way the light is refracted by the water.
- The depth is the same. The water will act as a sort of lens, but because it will be a flat lens, the image size will not be changed so the fish will appear to be at the same depth.
- It obviously depends on whether the pond resembles a smooth clear lens, or a convex lens (concave doesn't really make sense here). Assuming clear/flat, the depth is the actual depth, however if the pond serves as a convex lens, no matter where the fish is it will appear as a smaller fish swimming less deep than actuality

In addition, students wrote about their difficulties in their answer to the third JiTT reading question:

- I don't understand what a virtual image actually is. Is it literally just a trick our mind plays on us when processing visual information?
- It is difficult to conceptualize Fermat's principle in terms of the amount of time it takes light to travel. How are we supposed to know which path this is?

- I don't understand how it's possible not to see an image (as in when the object is at the focal point). Where do the light rays go? It just seems so counter-intuitive.

Students expressed difficulty or confusion on a number of different concepts. Some of these questions were best addressed by posting an answer on the website or talking about the question in class. Other student questions provided good opportunities for students to think about these concepts in class and discuss them with their neighbor.

To prepare for lecture the instructor spent a couple hours reading the student responses and reviewing the textbook and ConcepTest database to determine what additional concepts should be covered. In this particular lecture the first few ConcepTests were related to concepts about reflection, concepts that were not explicitly covered in the JiTT questions.

At the start of the lecture the instructor went over some basic logistics, including upcoming assignments and lab meetings. He then quickly summarized student responses to the JiTT assignment. As student problems were varied—spread out over many different concepts—the instructor went straight to ConcepTests to find out where students were in their understanding about the propagation of light.

The first ConcepTest (see Figure 5) asked about basic reflection and most students were able to answer this question correctly before discussion, indicating that they understood the idea of a virtual image formed with a mirror. The instructor gave a short explanation and moved quickly to the next question without asking the students to discuss their answers or repolling. The second and third ConcepTests (see Figures 6 and 7) asked students to think about ray paths with reflection, which was aimed at helping students with more complex ray drawings later.

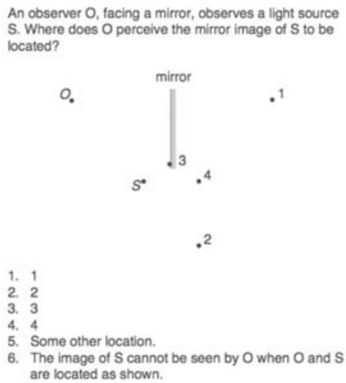


Figure 5: First ConcepTest from Sample Lecture.

About 40% of students answered these ConcepTests correctly before discussion, while 60% of students were able to answer correctly after discussion. To help students better understand the ray paths that light takes when reflected, the instructor took some additional time to explain the concept and described examples in everyday life that might help struggling students understand. After encouraging students to review these ConcepTests again on their own online, the instructor moved on to talk about the speed of light through different materials. Students had additional opportunities to work with ray drawings with mirrors in the next lecture and on the homework assignment.

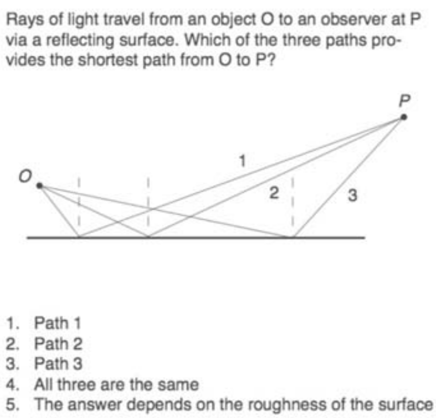


Figure 6: Second ConcepTest from Sample Lecture.

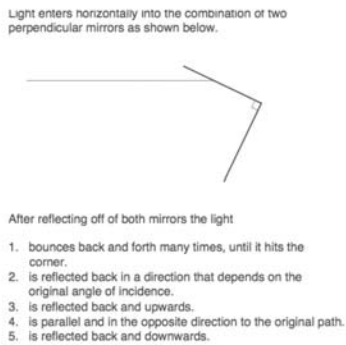


Figure 7: Third ConcepTest from Sample Lecture.

In their answers to the third JiTT question several students expressed confusion about Fermat's principle. After a brief reintroduction to the concept and talking about how light changes speed in different materials, the instructor posed a ConcepTest that used this principle in a more relatable context to help clear up some confusion about "least time" (see Figure 8).

Less than half of the students answered the ConcepTest correctly initially, but after discussing the concept with their peers, more than threequarters of the class had a correct answer. As many students demonstrated understanding of this concept, the instructor began discussing a related concept: refraction.

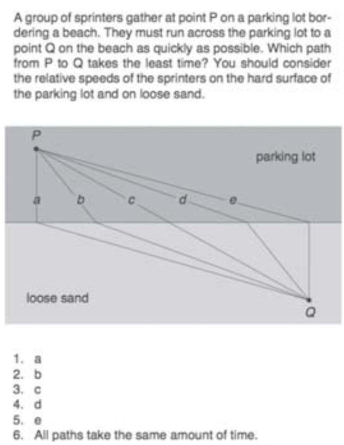


Figure 8: Fourth ConcepTest from Sample Lecture.

Based on the pre-class reading, the instructor could not be sure that students really understood the concept of refraction of light into different mediums, as many students did not give good explanations to the fish-in-water JiTT question. Therefore, the fifth ConcepTest asked students to think again about the perceived depth of the fish in the water (see Figure 9).

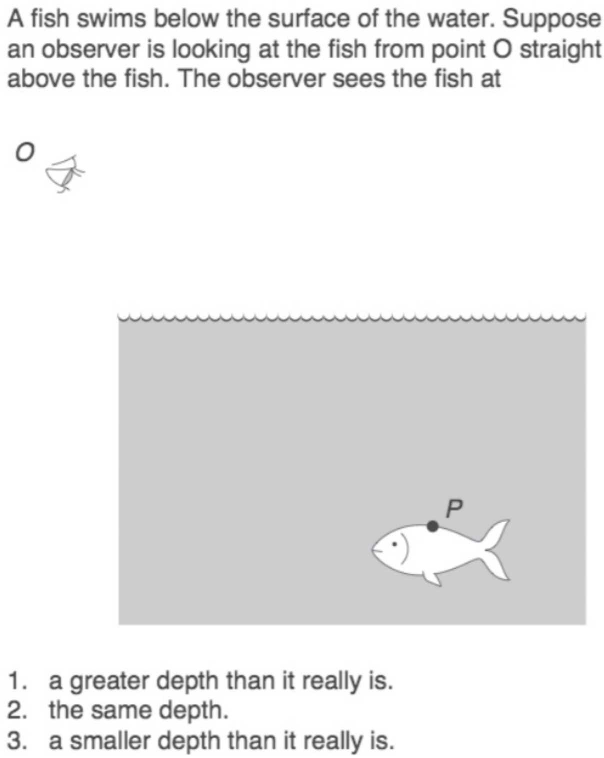


Figure 9: Fifth ConcepTest from Sample Lecture.

The instructor also posted a ConcepTest on the course website that phrases the question in a slightly different way, so the observer is directly over the fish. This question addresses a misconception a few students had on the reading assignment.

Looking at student answers to the pre-class reading, most students understood the basics about ray drawing with lenses. However, students needed to use these concepts for the problem set, so a series of ConcepTests were developed to probe student knowledge and advance their understanding. Due to time constraints, this lecture included only one of these ConcepTests (see Figure 10).

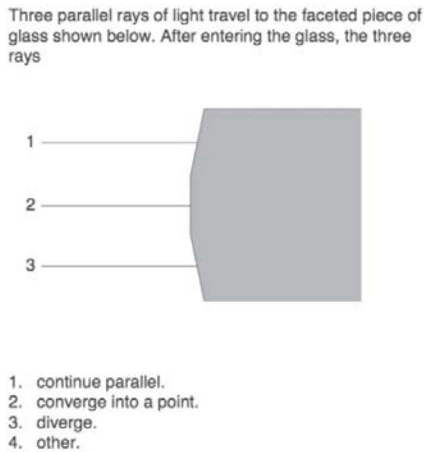


Figure 10: Sixth ConcepTest from Sample Lecture.

This particular ConcepTest helped bridge the principles of refraction to lens concepts. With the many resources available, the instructor was able to gauge student understanding before class, target specific areas or concepts during class, and post additional information and questions online for students to review after class. The interaction of technology and pedagogy helped streamline the work for both the instructor and students, maximizing the benefit of class time and making the classroom more personalized.

6.2.2 Using PI and JITT with the Interactive Learning Toolkit (ILT)

JiTT and PI are particularly advantageous in providing formative feedback to the instructor about students' understanding. Figure 11 shows a schematic on how these methods work together, emphasizing the role of technology in providing structure and feedback throughout the learning process.

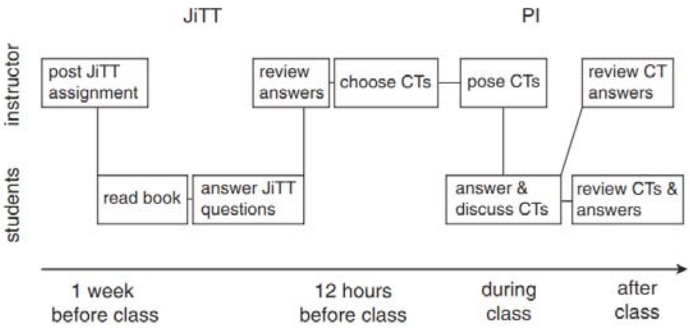


Figure 11: Timeline of JiTT and PI for a Given Class.

For JiTT, the reading module provides features to help create and announce reading assignments. Students complete the assignment online by a given due date. Instructors and teaching assistants are able to quickly review all student responses to a given question, revealing common weaknesses in the class's understanding. The ILT also permits instructors to respond to questions or difficulties expressed in student responses via a laborsaving web interface, increasing students' sense of individual connection to the instructor.

With PI, use of electronic devices such as "personal response systems" (clickers) is helpful, although not necessary, for successful implementations. Many instructors use simple hand-raising or flashcards to poll their students. However, hand-raising allows students to see how their peers vote, which may bias their responses. Flashcards keep students' responses private from their peers and results show that flashcards work just as well as technological polling methods (i.e., handheld devices) in improving student learning. Although it is not necessary for implementation of PI, technology can be very useful to instructors, as students can submit their answers to ConcepTests electronically, giving precise, real-time feedback. In addition, students can use wireless handheld devices, clickers, or more recently, personal wireless devices such as cell phones, PDAs, or laptops. With these devices instructors can collect data on student performance in class and longitudinal data on individual students. Additionally, advances in technology have allowed for the creation of seating maps with students' responses, enabling instructors to focus their attention on groups of struggling students during their discussions.

In addition to helping coordinate the JiTT reading assignments, the ILT contains a searchable ConcepTest database, with over 800 physics questions, many developed at other institutions for either algebra- or calculus-based introductory physics, and some developed for non-introductory courses. Users can generate class-ready materials, such as pages for a course website or overheads for class, directly from the database. Links to separate databases of ConcepTests for astronomy and chemistry are also available. Lectures can be used to design PI classes and are linked by dates and times. With the database of ready-to-use ConcepTests the instructor can choose which conceptual questions best probe students' understanding. Additionally, the ILT provides an easy way to create additional ConcepTests in .pdf format, which can also be shared and added to the database. The instructor can easily generate a set of ConcepTests for a given lecture topic and post these for students to access after class.

If the instructor uses an electronic response system to poll students for answers to in-class ConcepTests, the lecture module of the ILT contains a feature to record student responses and statistics for each question.

The ILT also links student answers with other aspects of the course, such as performance on pre-class reading, assignments, and exams. Additionally, we have integrated the technology of the ILT with Beyond Question, which allows students to use wireless-enabled devices, such as cell phones, laptops, or PDAs to respond to in-class ConcepTests. With many students already using these devices in class, this feature alleviates the need for students to purchase an additional device and reduces the technical infrastructure needed in the classroom. Standardized tests, including those mentioned in this article, are also available on the ILT and can be provided to students as online assignments. These tests are designed to assess students' conceptual understanding, quantitative problem-solving skills, or attitudes about undergraduate science courses, and can be taken pre- and post-course to provide information on the effectiveness of the instruction in these specific areas.

The database of these tests is growing, and currently includes the Force Concept Inventory, Mechanics Baseline Test, Astronomy Diagnostic Test, Conceptual Survey on Electricity and Magnetism, Lawson's Test of Scientific Reasoning, and the Maryland Physics Expectations Survey. Other standardized tests can be easily added to the database.

6.3 CONTEXTS

6.3.1 On PBL

During the past 30 years by project- and problem-based learning (PBL) has been praised as the future of education, with arguments that working with projects leads to much more motivated students, hence higher learning outcome. It involves the solution of a problem, though not necessarily set by the student himself/herself; it involves initiative by the student or group of students, and necessitates a variety of educational activities. The result is usually an end product (e.g., report, computer program, a model). The process often goes on for a considerable period of time. Teaching staff assume advisory rather than directive roles. However, claims for PBL have been challenged in terms of problems in comparing research results, due to the many ways to run PBL and even that results ,for instance physics tests, provided very small differences in achievements for those having followed lectures and those carrying out PBL activities. In many higher educational institutions that have typically had a lecture-centred approach, we now see attempts to shift more broadly to a project-based one. Conversely, universities based on a PBL approach see the need to mix in lectures in their pedagogical philosophy (also seen in a shift from Content Management Systems (CMS) to Massive Open Online Courses (MOOCs). The lecture-based teaching method still holds its ground in many settings.

Success criteria concerning PBL are very often solely placed on the teacher/lecturer to contextualise the topic and narrate a 'story'. There is rather broad consensus on key elements for successful learning, such as good physical environment, feelings of acceptance, ability to master the task, good dialogue etc. One major element is that of motivation. Motivating for and in learning has been thoroughly investigated concerning online learning, student centred methods, issues of ownership etc. In this regard a distinction has been made between problem- and project-based learning. In contrast to the former, the latter refers to longer and more open-ended projects. One angle to explore in project-based learning is to look at interest and value, two key elements in that approach. Drawing on the findings of Malone and Leppers, Blumenfeld examined what factors might enhance student interest and perceived learning value. These factors were: that a) there be variety and novelty, where a learning activity should contain more than just reproducing known knowledge; b) a learning activity should be realistic and have meaning: c) there should be some kind of challenge; d) there be closure, with a natural end to the task; e) there be more than one way to solve the given task; and, f) there be included the possibility to work with others.

6.3.2 From Teaching to Learning

In "From Teaching to Learning - A New Paradigm in Higher Education" Barr and Tagg discuss a sea change in the conceptualisation and implementation of learning from providing instructions to produce learning. There are several reasons for this, including a more rapidly changing society, the ability to adapt but also the pedagogical methods used, and shifts in relations between lecture and discussion. These they frame within what they label The Learning Paradigm. These scholars do not anticipate the end of lecturing. They go on to identify one key challenge with the Learning Paradigm, namely that of incorporating knowledge transfer when and where it is necessary. Here too knowledge transfer should not be seen simply in an outdated transmission model of learning or communication.

In practice we see that learning, for instance a computer program, is strongly linked to context; following a tutorial is almost useless if it is not motivated towards solving a task.

Even then, however, a tutorial typically becomes a teaching platform not a learning platform. From a student's perspective, you do not find the solutions you seek, but are overwhelmed with skills-directed knowledge that is then often deemed useless and as yet impossible to relate to developmental design and work settings. These are the wider contexts of application that lie ahead in a learning trajectory.

6.3.3 Beyond Tacit Knowledge

In contrast, an additional challenge is that, even though we all live in a fast changing society in which knowledge may be made obsolete almost before its known, there are still important issues concerning tacit knowledge in design. Earlier Polanyi distinguished between internalised and unarticulated inner, or tacit, knowledge. This is knowledge that is characterised by being sensual and conceptual and may be discovered by acknowledging its emergence and connoisseurship. This contrasts sharply with the formalist and explicit ways of knowing in the natural sciences and methods that seek validation and replicability.

Although Nightingale likened tacit knowledge to physicists "dark matter", such a view explains away the empirical failures of existing theory because we relate to non-explicit knowledge all the time. In teaching processes, repeating and training have been a core part of everyday school life. Whether this is perceived as fun or a necessary evil is very often influenced by how we facilitate learning. The use of games and other activities has therefore often been employed to make tedious exercises more enjoyable and even fun, thereby sparking intrinsic motivation. Still, in the chase to motivate the learning of new explicit knowledge, the adequate allocation of time to enable and increase tacit knowledge is essential.

6.3.4 Different Types of Motivation

As all teachers know, motivated students are probably the single most important element for successful learning to occur in a group or class. Equally, individual motivation may propel single students onwards. With curiosity and a measure of ingenuity, deep learning may occur. However, there are several types of motivation, with the two main types being intrinsic (IM) and extrinsic (EM). IM is in short inner motivation: this is when you do something because it's fun, and refers to fulfilling interesting preoccupations, directions and needs. In this form of motivation, there are no rewards or penalties in play. Alternatively, EM is basically driven by rewards and/or penalties. In the context of work, these may include salaries; in the educational system, these may be grades.

There has been lengthy discussion on the impact and importance of these two types of motivation. Whether IM is the preferred type of motivation and whether EM could actually harm IM is still debated. As Lemos claim, there is a strong argument for a combination of the two, as compliments to one another. In PBL the pedagogical strength is very often explained by the intrinsic motivation it creates. There is, however, a transition between the two types of motivation, knowing when this transition happens. What it implies from a teacher's point of view is very valuable.

6.3.5 A matrix of Knowledge with Motivation

That explicit and tacit knowledge are not opposites along a continuum, but more like two sides of the same coin. Students may be motivated to acquire new, explicit knowledge, but also to increase their tacit knowledge during a project. Again, awareness of when it is that this happens is of great value. Figure 12 show a tentative description of the different knowledge motivations that is typically at play in a design project, but also in any typical project. The different types of learning motivations will be exemplified in the illustrative case. However, the wider making and learning activities in a design studio involve a mesh of actions that need to be understood in terms of time and need.

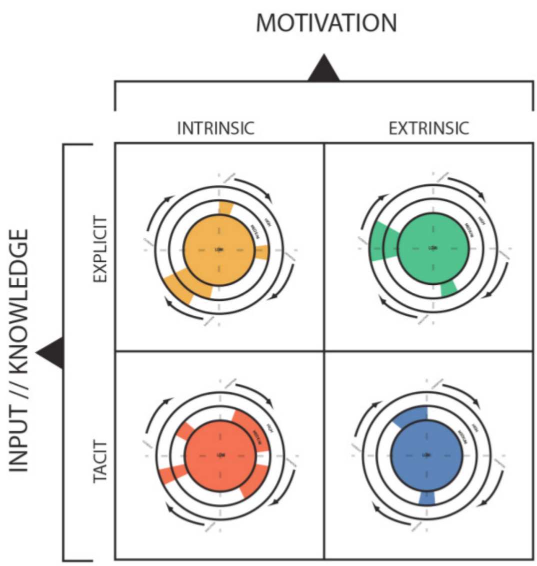


Figure 12: A matrix of knowledge with motivation.

6.3.6 Just-in-time and Just-in-need Learning

In contrast to the usual attention given to building constructive motivation and a form of 'progressive' problem solving, frustration combined with motivation may act as a powerful agent for learning. It might be conceptualised and positioned pedagogically so as to open up for actual teaching if delivered at the correct time, or as the adage goes "just-in-time". This would need to be done not too early so that the teacher solves the problem, but also not too late with the result that a student's frustration turns into aggression or disinterest. Based on this, one could claim that even a lecture could have high pedagogical outcome if delivered at the right time, that is when the students need it. There is a window of opportunity for teaching and learning; the task is to know when it appears and exploit it. Who requests and who decides when this should be done is a matter for further investigation.

This then leads to questions concerning how the term "just-in-need" may be framed and put into practice in design pedagogy.

6.3.7 Competing and Complementary Needs

There is a very real danger for students of design to become rather (too) quickly frustrated. This frustration may then be magnified unfruitfully, in reaction to not seeing the directions and potential uses of tools and technologies, material or processes. Their mismatch between procedural knowledge and conceptual and applied active knowing may result in disinterest or disengagement - not unalike the alienation experienced in a boring lecture. If, on the other hand, a specific task has to be solved and the tool to solve it needs to be taught, the ability to withstand frustration is almost proportional with the perception of the importance of the task. In other words, from a student's view the question becomes how motivated is one so as to be able to solve the task at hand. This is important when that task takes the form of a design brief that entails a mix of competencies over time. It also involves process of working with what may be indistinct problems and ways to finding routes to providing design solutions over time and in relation to options. These may need to be arrived at via trial and error, by the juxtaposition of options, through the exploration of alternatives and by way of studying complex decision-making across and between them.

For example, in over the past quarter century of design education we have observed how the students in the (industrial and later diversified) design department at AHO have learned and developed their Computer Aided Design (CAD) skills. From running tutorials and even teacher-led courses we have seen that the actual outcomes were often thin. However, when students were given a task to solve matters, preferably their own design, the frustration that developed when trying to figure out how to do things, led to an almost exponential positive learning curve in understanding and using the tool. Trying different ways to solve the task also meant students were touching on a number of areas that in effect did not solve their problem. Yet, they understood what the approach they arrived at could be applied in a later situation, such that they saw that they were actually adding to their wider tacit knowledge and understood the processes of their progression towards decisions and design choices and products.

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CHAPTER 7

GAME-BASED LEARNING

INTRODUCTION

Game based learning is where game characteristics and principles are embedded within learning activities. Here, learning activities promote student engagement and motivation to learn. Components of game-based learning include points systems, badges, leaderboards, discussion boards, quizzes and classroom response systems. Points may come with academic rewards such as having an extra week to submit an assignment once reaching a certain point threshold. Badges can be given if students reach a certain success level while classroom response systems like Kahoot or Top Hat encourage participation through points.

Game based learning is also an active learning technique where games are used to enhance student learning. Here, the learning comes from playing the game and promotes critical thinking and problem solving skills. Game based learning can be accomplished with digital or non-digital games and may include simulations that can allow students to experience the learning firsthand.

Games have been used as a learning tool for centuries. Chess was used to teach strategic thinking as far back as the middle Ages, and the game of Kreigsspiel was invented in 1812 specifically to teach Prussian officers strategy. Beyond military strategy, the genesis of Kindergarten in the mid-1800s was Friedrich Fröbel's ideas of learning through play.

The core concept behind game-based learning is teaching through repetition, failure and the accomplishment of goals. Video games are built on this principle. The player starts off slow and gains in skill until they're able to skillfully navigate the most difficult levels. Games that are planned and designed well will offer enough difficulty to keep it challenging while still being easy enough for the player to win.

Game-based learning takes this same concept and applies it to teaching a curriculum. Students work toward a goal, choosing actions and experiencing the consequences of those actions. They actively learn and practice the right way to do things. The result is active learning instead of passive learning.

Flight simulators are a perfect example of the effectiveness of game-based learning. Pilots commonly use flight simulators during their training. They are given very specific goals and practice until they can accomplish them. The result is much more effective than sitting through lectures and theory.

7.1 CONCEPT OF GAME-BASED LEARNING

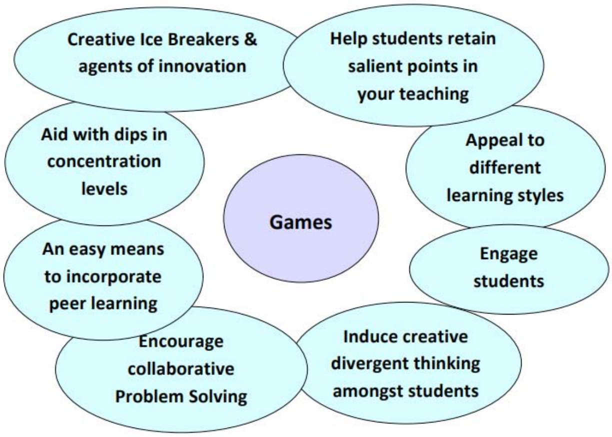
Definitions of game-based learning mostly emphasize that it is a type of game play with defined learning outcomes. Usually it is assumed that the game is a digital game, but this is not always the case. A corollary to this definition is that the design process of games for learning involves balancing the need to cover the subject matter with the desire to prioritize game play. This corollary points to the distinction of game-based learning and gamification. What exactly is meant by gamification varies widely, but one of its defining qualities is that it involves the use of game elements, such as incentive systems, to motivate players to engage in a task they otherwise would not find attractive. Similarly, there is an ongoing debate among scholars as to the exact definition of a game, and especially what is not a game. One definition defines a game as "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome". Consider as an example the gamification of math homework, which may involve giving learners points and stars for the completion of existing activities that they consider boring. Game-based learning of the same math topic, on the other hand, even though it may also include points and stars, would involve redesigning the homework activities, using artificial conflict and rules of play, to make them more interesting and engaging.

Even though the debate around how games are defined cannot be resolved here, this may not be a problem, as play—the essential activity in games—has long been thought of as a critical element in human development.

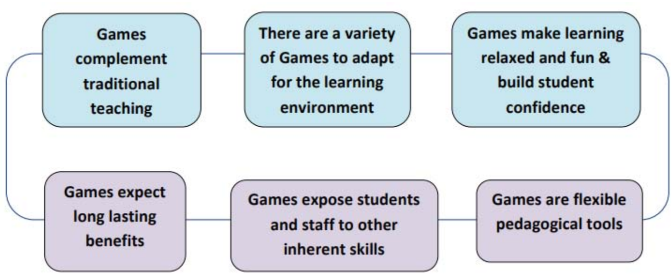
Games offer a unique structure to complement traditional teaching strategies and infuse teaching with energy, spark innovative thinking and provide diversity in teaching methods. Games make learning concepts more palatable for students and supply learners with a platform for their creative thoughts to bounce around. Games encourage creative behavior and divergent thought and are excellent ice breakers. Games will often act as learning triggers inducing lively discussion on learning concepts amongst students following game play.

Games as Pedagogical Devices

As pedagogical devices, games are extremely useful - they can enliven teaching topics and are especially effective for dealing with problem solving and key concepts. Research shows that "games have a special role in building students' self-confidence" and "they can reduce the gap between quicker and slower learners".



The highly adaptable, flexible nature of games means that they can be molded to suit a variety of learning settings and environments, even VLE's such as Blackboard, this can add another layer of interactivity and facilitate distance learning students. The number of game frames or models available is extensive, so no matter what discipline you teach in, there is a game model you can use. Apart from inviting students to learn curriculum content in a fun and relaxed manner, games also expose students to other skill development during game play via sequential, verbal, visual and kinetic and other game based activities.



7.2 PLAY AND COGNITIVE DEVELOPMENT

Psychologists have long acknowledged the importance of play in cognitive development and learning. Piaget, for example, described play as being integral to, and evolving with, children's stages of cognitive development. According to Piaget, play becomes more abstract, symbolic, and social as children mature through different developmental stages. One way that play is seen as contributing to children's cognitive development is by activating their schemas in ways that allow children to transcend their immediate reality. For example, a child can pretend, or "act as if," an eraser is a car while fully knowing that it is not a car. This type of play allows children to hold in mind multiple representations of the same object, a skill required for the development of symbolic thinking, one of the most significant developments of early childhood. Being able to hold in mind multiple, even conflicting, representations of reality underlies key later developments, such as the acquisition of a theory of mind and emergent literacy and numeracy. This understanding of the role of play in children's cognitive development has informed our understanding of educational games, but there has also been great interest in understanding how video games shape cognitive development and learning.

In one of the first books on the psychology of video games, Loftus and Loftus focused on players' motivations, exploring what makes video games "fun." Relying largely on behaviorist theories, Loftus and Loftus pointed out that in video games, rewards or successes typically happen only occasionally, which corresponds to an intermittent reinforcement schedule—the reinforcement schedule that produces the greatest response rate. Loftus and Loftus also cited work illustrating that good games are neither too easy, which results in the games being boring for players, who then quit playing, nor too difficult, which frustrates players, who then quit playing. Good games aim for the "sweet spot," where players can succeed but only with some struggle, inducing what has been described as a state of "flow". In the context of learning, good games aim to be within a player's zone of proximal development.

The notion of a zone of proximal development, of course, comes from Vygotsky, who also characterized play as being a "leading factor" in children's development and thought that a vital role of play is to create a zone of proximal development for the child.

Vygotsky argued that genuine play, which begins around age 3, is always a symbolic and social activity. In part because of its social nature, play—particularly play with an adult or more capable peer—enables a child to succeed at things that are a bit beyond his or her current ability. In Vygotsky's words, play allows the child to achieve "beyond his average age, above his daily behavior; in play it is as though he were a head taller". We believe this statement, made almost 40 years ago, applies to well-designed games of all types, including the digital games that are played by so many people today.

7.3 THE ARGUMENT FOR GAME-BASED LEARNING

There are a number of arguments being advanced for why games are effective learning environments. Some of these arguments have little or no empirical support, whereas others are deeply grounded in existing theory and research. We summarize some of the most important arguments and provide a deeper discussion of the empirical foundations of these.

Motivation

The motivational function of games is their most frequently cited characteristic. The argument is that games for entertainment have been shown to be able to motivate learners to stay engaged over long periods through a series of game features that are of a motivational nature. These features include incentive structures, such as stars, points, leaderboards, badges, and trophies, as well as game mechanics and activities that learners enjoy or find interesting. From a game design perspective, it is less desirable to use game features to "enhance" otherwise uninteresting mechanics and more desirable to make mechanics in themselves interesting, but little if any empirical evidence exists for the relative impact of each of these approaches on learning

Player Engagement

Related to motivation, one of the most frequently cited reasons to consider digital games for learning is that they allow for a wide range of ways to engage learners. Which types of engagement are implemented depends on design decisions that reflect the specific learning goal, learner characteristics, and setting. Because the concept of engagement is ill defined and underspecified, we base our discussion of engagement on the INTERACT model of learner activity, which distinguishes among cognitive engagement (i.e., mental processing and metacognition), affective engagement (i.e., emotion processing and regulation), and behavioral engagement (i.e., gestures, embodied actions, and movement). We add a fourth type, sociocultural engagement (i.e., social interactions embedded within a cultural context). For example, a game can engage the learner behaviorally by using gestures as input or inviting players to perform specific physical actions as part of play. Game characters engage the learner emotionally, and social features such as collaborative play support sociocultural engagement. The goal of all these types of engagement, however, is to foster cognitive engagement of the learner with the learning mechanic. Games that do not achieve cognitive engagement are not likely to be effective in helping the learner achieve their learning goal. All forms of play have the potential to result in all four types of engagement (affective, cognitive, behavioral, and sociocultural). However, the actual type of engagement will differ by game and within a game, as different games features elicit different types of engagement in different context and for different learners.

Adaptivity

Learner engagement is facilitated in part by the many ways of making a game adaptive, customizable by the player, or personalized. Adaptivity is the capability of the game to engage each learner in a way that reflects his or her specific situation. This can be related to the learners' current level of knowledge, to cognitive abilities, to the learners' emotions, or to a range of other variables. The first requirement of adaptive design is therefore to measure the variable the game is supposed to adapt for, such as prior knowledge or self-regulation skills. The next step is to provide an appropriate response to the learner. This may involve a modification of the type and complexity of the problems and guidance presented to the learner or the use of scaffolding, guidance, and feedback in a way that responds to the player's in game actions.

Graceful Failure

Another argument for game-based learning is that it allows for graceful failure: Rather than describing it as an undesirable outcome, failure is by design an expected and sometimes even necessary step in the learning process. The lowered consequences of failure in games encourage risk taking, trying new things, and exploration. They also provide opportunities for self-regulated learning during play, where the player executes strategies of goal setting, monitoring of goal achievement, and assessment of the effectiveness of the strategies used to achieve the intended goal. The ability to fail gracefully is connected to many of the previously discussed issues, such as motivation, engagement, and adaptivity. How can these various arguments for game-based learning be described in a more systematic, theory-based way?

7.4 THEORY OF GAME-BASED LEARNING

Few would dispute that games are learning environments with characteristics that differ to such an extent from those of other genres that they should be classified as a genre of their own. Some advocates go even further and make the case that game-based learning involves processes that differ to such an extent from learning in other forms (such as classroom instruction) that they should be described as a unique model or theory of learning.

A review of existing games quickly confirms, however, that the uniqueness of game-based learning can hardly be defined at an epistemological level. Game designers use behaviorist elements, cognitivist elements, and constructivist elements, and often various combinations of them, in the design of games for learning. For example, the game Angry Birds challenges the learner to fling birds at pigs that hide under different types of structures. In its essence, the game takes a behaviorist approach by posing a low-level task of maximizing the damage to the pigs. However, the player's response to this challenge involves the selection of a specific type of bird from a set of birds with different (destructive) abilities and allows for some flexibility in the vector (angle and force) in which the birds are flung. The game shows the trajectory of the bird and gives feedback on the damage caused in visual form, in the destruction of structures and bruising of pigs, in auditory form as sound effects, and in the form of points won for each destroyed object or pig. The task itself (directing an object to a target location) is tedious and uninteresting, but the game elements used to implement the task as game mechanic, and the feedback provided, make this a very engaging game that has been played by millions.

Another type of game, Crayon Physics (or its cousin Newton's Playground), poses different challenges for players. By choosing whether to attempt to solve a problem as elegant, innovative, minimalistic, and so on, players can set their own goals and respond accordingly by creating drawings that guide a ball into a target. The feedback in this game is tied to the task itself—the use of physics to move a ball from its original location to a target location. Few additional game elements are needed to make the task more interesting, and the points awarded are secondary to the satisfaction of having found a solution to the problem.

Finally, MMOs such as Eve Online or World of Warcraft are player-driven worlds with an almost infinite range of possibilities of play. Players control and customize characters and interact with the environment and with other players' characters in ways that develop an in-game culture and often economy. MMOs allow players to set and pursue their own challenges, develop different identities, and play different roles. These activities involve team collaboration and competition, communication, creation, systems thinking, and problem solving, and it has been argued that those activities can enhance players' socioemotional skills, or 21st-century skills.

These three examples represent three very different models of learning, from behaviorist to constructivist. One of the few characteristics they have in common is that playfulness serves as an enriching yet orthogonal dimension—a dimension that can be present no matter what model of learning a game is based on. Trying to develop a model of game-based learning would, therefore, require the construction of a general model of learning that incorporates each of the existing models into one meta-theoretical model. Such an attempt has been made; the resulting model is not specific to games but rather can be used to describe learning independent of the genre of the learning environment used for its implementation.

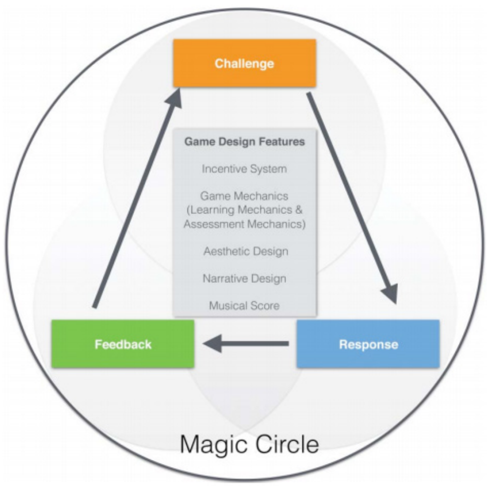


Figure 1. Model of game-based learning.

Instead of a comprehensive theory of learning, we may therefore consider a simple model that describes the basic structure virtually all games appear to have. This structure consists of three key elements: a challenge, a response, and feedback. A loop is generated when the feedback constitutes a new challenge or prompts the player to provide a different response to the original challenge.

The learning theory that informed the design of a specific game is reflected in the type of challenge the game provides, the type of responses it facilitates, and the kind of feedback it provides. For example, a behaviorist game would provide a challenge with a limited set of choices by which the player can respond, and the feedback received would be corrective, as a right/wrong message. In contrast, a game based on a constructivist approach may allow players to set their own challenges, make available tools with which to construct a response, and provide a system of peer feedback.

The model shows how game design features are at the center of the learning experience, permeating how challenge, response, and feedback are designed. The playful character of each of these three key elements transforms the learning experience in different ways. For example, challenges can be inspiring by using a strong narrative such as in Portal 2. Responses can be enjoyable through game mechanics such as slinging birds in Angry Birds. Feedback can be playful through game characters or a leaderboard such as in Little Big Planet.

Coming back to the observation that learning with and from games is clearly a unique experience, yet a comprehensive model of game-based learning appears to be not feasible, how else can this experience be described? We propose that a more promising method to capture the uniqueness of game-based or playful learning can be found by focusing on how these learning environments are designed. By the time games were adopted at scale for learning purposes, game design had developed into a refined art form with processes that differ from the design of traditional learning environments in a number of ways. One of these differences is that designers of game-based learning have a unique concern for the quality of the learning experience, which is refined and tested with great effort and care. This designed learning experience incorporates engagement on an affective, behavioral, cognitive, and sociocultural level, creating a Magic Circle of playful learning. This learning experience is often described as a flow experience, although we prefer to think of it as optimal engagement, that is, engagement optimized to facilitate learning. Taking multiple types of engagement into consideration is rare for most other learning environments. These different forms of engagement are facilitated through design features that result in a playful experience, as shown at the top of Figure 2. In this way, games are a unique genre to implement existing models of learning, and playfulness adds a dimension to these existing models. This creates a learning experience that can make games a preferable genre for implementing these models than other, more traditional genres.Similarly problematic is the attempt to formulate a general theory of game-based learning, as games can be designed based on virtually any model of learning. Instead, we have proposed a simplified model of game-based learning and have argued that one of the distinguishing characteristics of games is the unique concern of game designers for the quality of the learning experience and, in part because of this concern, the fact that digital games are able to engage learners on an affective, behavioral, cognitive, and sociocultural level in ways few other learning environments are able to.

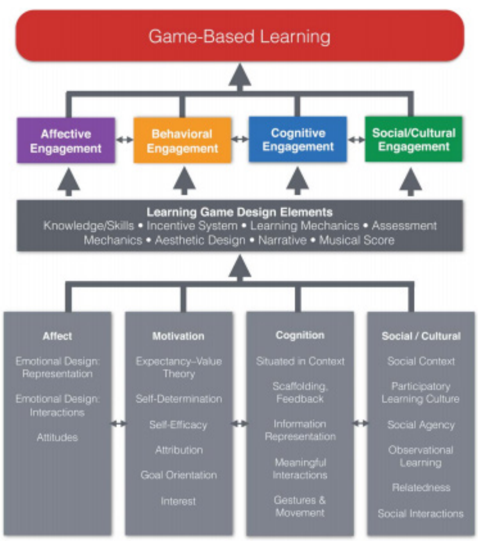


Figure 2. Integrated design framework of game-based and playful learning.

7.5 A GAME-BASED LEARNING SYSTEM FOR IMPROVING STUDENT'S LEARNING EFFECTIVENESS

The internet is a rich source of information, and more and more people make information available online. One day, the knowledge from the internet will be more than teachers alone can provide. Obviously, the traditional teaching and unilateral knowledge acquisition has not attracted the attention of young people, and cannot fulfill the needs of the information society. Because the convenience of network and interactivity results in increasing time and location flexibility, e-learning has become the development trend of education and learning. Due to its prevalence, the network provides quick information technology access to various industries. Information systems improve the effectiveness and save time, becoming an important tool for business management, decision-making, competition and development. Therefore, the system developer, who the business needs, must have some knowledge and skill, understand the concept of the system development. System analysis is the process of effective problem solving, which makes "system analysis" become an important task. But now most learning approaches of system analysis are in accordance with the traditional face-to-face way, and textbooks often seem esoteric with their many steps, theories and case studies, but lack practical exercise. The game-based learning has abundant characteristics, such as Representation, Fun, Play, Goals, Outcomes and feedback, Win states, Competition/Challenge, Problem solving, Task, Story and so on, to increase the learning motivation of student. Games are used to improve the dull and hard course, where course content corresponds to game levels, making the knowledge and skill of the course teaching available through game-based learning. In summary, People love the digital game-based learning system, that using system analysis course as activity content, lets students through "Learning by Doing" achieve personalized learning, bring the entertainment of game, fun, interactive into education, achieving the purpose of edutainment.

7.5.1 Theoretical background

Game-based learning

Computer games meet the actual needs and interests of children, and are becoming the most popular computer activity and provide a new mode of interaction. Some of the advantages of games are that they are attractive, novel, provide a better atmosphere and help keep the learner focused on the task, therefore suggesting games as valuable educational tools. Kids like all humans love to learn when it is not forced upon them. Modern computer and video games provide learning opportunities every second or fraction thereof. The real importance of good computer and video games is that they allow people to recreate themselves in new worlds and achieve recreation and deep learning at the same time. Some educators consider game-based learning to be a powerful instructional approach. The educational game makes the learner become the center of learning, which allows the learning process to be easier, more interesting and more effective.

ARCS model

The ARCS model is a problem solving approach to designing the motivational aspects of learning environments to stimulate and sustain students' motivation to learn. To accurately measure the change in learner motivation, Karoulis and Demetriadis indicated that the ARCS model can be the standard of how much the learning motivation is increased by the game. The four dimensions of ARCS are the following: Attention- attention which increases the learner's curiosity, Relevance- establishment of the relevance of the learning content to learners, Confidence- feedback to the learner, through the effort and the learning process of self-control, Satisfaction- the satisfaction or reward the learner can gain.

7.5.2 Methodology

Research concept

The related research in game-based learning such as applied in medicine, nature, language and some area has considerably progressed. There are some research applications developed to aid the teaching, but the teachers are unable to customize an appropriate game, and the game may not completely fit the course content and purpose of research. We analyze the experimental and control group achievements in the pre-test and post-test of the system analysis course, to check if there is significant difference between the learning achievements of two groups.

Quasi-experimental design

The experimental group uses "game-based learning", and the control group uses the "traditional face-to-face learning". Figure 3 to show the experiment design for comparing the Game-based learning and the traditional face to face learning approach. Both of two groups are taught the same system analysis course. Experimental group: There are 33 students playing the online learning game, and filling out the questionnaire and individual information afterwards. There are 30 students doing traditional learning in control group and 33 students doing game-based learning system in experimental group. After the different teaching strategies, In order to avoid influence from other factors, except from independent variance, the control variances of study are as following:

1. Teaching resources: The experimental group is given a lesson in a computer class, the control group in regular class, while the teachers are the same.
2. Teaching content: During the study experiment, the experimental and control group have the same teaching content.

3. Teaching hours: The experimental and control group have one lesson in 3 hours per week: The experimental and control group are given the same time to do the tests in pre-test and post-test phases.

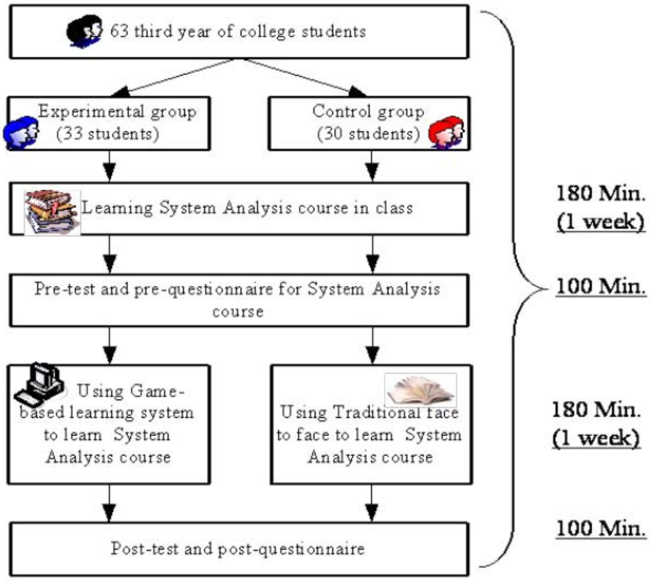


Figure 3. Experiment design for comparing the Game-based learning and the traditional face to face learning approach.

We develop a 3D game-based learning environment, with system analysis course as its basis, and cooperates with the teacher who has the teaching background of the information course. The students study the system analysis course, and all students have the same learning content and resource, one group uses game-based learning, the other takes the traditional face-to-face teaching. After the class ends, all students must take the test and fill in the questionnaire. We then compare the difference of the test results and questionnaire analysis of game-based learning, and look at the discrepancy of the learning results between the game-based learning and traditional face-to-face teaching approaches.

Content mapping to game

The course content is based on the procedure of system analysis, which allows students to gain real-world experience. The game story is set in a company office environment. As there are different staff who participate the process of system analysis, the learner can take on different roles and freely choose to act which character, such as project manager, system analyst and programming staff, where different roles corresponds to different scenes in the game. We use a 3D scenario game based on ARCS, and learning strategy to develop a game-based learning system for students to learn the “waterfall development model “.The game-based learning process is divided into two layers: the underlying layer is the process of the game learning; the course content layer is the content of game design course and the learning process layer is the game-based learning system with ARCS.

In the learning process layer, there are three processes stage.

(1) Input stage: By mapping teaching content into the game content, and through the game skill, task learning, reward institution and the interesting gameplay, the learners blend into the game situation.

(2) Process stage: Explanation with internal ARCS; Attention (A): through the characteristics of the game, such as challenge, diversification and uncertainty, to inspire the curious of players and catch their attention, which influence user intention; Relevance (R): allowing user to learn new skills in different ways , to define the learning goal and raise learning motivation and to relate to familiar things, which impact user behavior; Confidence (C): Using the feedback of the game, such as grades and treasure, to make the user believe that his/her effort will directly cause achievement, helping students understand the possibility of success and prevent him/her from thinking it is impossible to achieve the goal; Satisfaction (S): when the new skills which the user learned during the game are useful and can be applied to other game tasks, the player will want to solve

increasingly harder tasks which gives him a positive feeling of success. The various tasks and skills given by system attract the attention of student, and further raise the learning motivation, increase the abilities of student progressively, and keep cycling on user intention, user behavior, system feedback and ARCS and reach the ultimate learning goal.

(3) Output stage, which includes directed goal achievement evaluation and repeated practice, monitors the progress and performance of students and provides the results to teachers for improvement of their teaching.

System interface and system function

According to the system planning mentioned, we develop a role-play game which functions as follows:

(1) The game situation: The construction of the game, besides the design of the game screen, also includes the drama and character design. The story is set in a computer and internet service company whose clients and complicated equipment are getting more and more. This company therefore wants to develop systems that can answer questions of clients and increase the efficiency. The player must help the company evaluate and develop software, act as different roles in the developing process and complete different tasks as different roles to complete the software development.

(2) The interface design: The game study develops takes the story background, environment and age of players into consideration, in order to increase the authenticity of the game, uses the office model as scene, the office worker as people and the 3Ds Max to complete the actual interface that is interaction with players in the system.

The game provides five different roles to be chosen. The Figure 4 shows to select a role for the game task and Figure 5 show that every role corresponds to different situations and tasks, and the player can go through the different roles to learn all different tasks of various positions. In the requirements analysis, we use the maze game, which will show the problem sign and player position. When passing a problem sign, the character must stop, and the player must solve the current problem in order to keep going forward. In this task, the multiple choice questions are designed by the meeting record from the game. Besides solving all problems in the maze, The Figure 6 show that the player must find a way out in order to increase his interest and keep the player's attention on game based learning. In this task, the player must distinguish the requirements into functional and non-functional. The screen includes a countdown, health points and scores. If the answer is wrong the health points will decrease by one and the question will reappear and the countdown will be reset, in order to give the player the chance to correct the mistake. The player must answer in limited time, to increase the challenge of the game. At the end of the learning phase, show in Figure 7,the player have to take an evaluation then he will get the score which will provided to the teacher for reference.

Figure 4. Select a role in the game.

Figure 5. Role information in the game.

Figure 6. The players identify the requirements.

Figure 7. System evaluation test for a role.

7.6 ELEMENTS OF GAME DESIGN FOR LEARNING

Before we discuss the different approaches to learning from games, it may be useful to define some of the fundamental elements of game design. Although there is much discussion regarding the definition of what is a game, most agree on the following building blocks of games: game mechanics; visual aesthetics; narrative; incentives; musical score; and, because we are discussing games for learning, the learning objectives and related content and skills covered by the game.

Game Mechanics

Game mechanics describe the essential game play—the activity or sets of activities repeated by the learner throughout the game. These activities can primarily have a learning focus (learning mechanics) or an assessment focus (assessment mechanics); in many cases they focus on both. An example of a game mechanic in the middle school geometry game Noobs v. Leets is when the learner clicks on a missing angle, clicks on a given angle, and then selects the rule she wants to apply to solve for the missing angle (e.g., complementary angle rule). The game mechanic represents the essential behavior that is linked to learning or assessment activity in a game. It can be designed for single players or involve social features. Mechanics are often used to describe genres of games, such as platformers or first-person shooters.

Visual Aesthetic Design

The visual aesthetic design includes visual elements such as the overall look and feel of the game and the game characters, but also the form of representation of key information in the game. The visual design determines how tools and functions of the game mechanics are visualized, how cues are represented, and how feedback is displayed, which means it has a cognitive function and an aesthetic one. For example, in the game Light Lanes, in which players must avoid obstacles to redirect a laser beam to a specific target, obstacle blocks that cannot be penetrated by a laser beam are represented in red, whereas light reflecting blocks are represented in green. The visual aesthetic design constitutes the information representation of the multimedia learning aspects of the game. It is also linked to the narrative of the game by expressing its aesthetics.

Narrative Design

The narrative of a game is the storyline that is advanced via features such as cut scenes, in-game actions, dialogues, and voice-overs. Unlike most movies and books, games allow for nonlinear narratives that advance based on the choices made by the learner. Narratives provide contextual information for learning, connecting rules of play, characters, tasks, events, and incentives. They have a strong motivational function by contributing to a game's stickiness, that is, the desire it generates for people to return to play. For example, in the game Space Ranger Alien Quest, which was designed to enhance a player's executive functions, the narrative explains how different aliens like to eat different foods and why the player needs to help the aliens, and then later explains how the rules have changed and that different food preferences are in play.

Incentive System

The incentive system of a game includes the many motivational elements that aim to encourage players to continue their efforts and feedback that attempts to appropriately modify their behavior. Incentives can consist of scores (points), stars, badges, trophies, power-ups, and many other rewards. These rewards can be either an intrinsic part of the game play, such as a power-up that gives the player special abilities in the game, or an extrinsic nature, awarding stars or points that do not directly contribute to the game play but that may create a metagame when players compete with one another via leaderboards. For example, the game FactorReactor awards rings for each solved problem. These rings are intrinsic rewards because they are essential to the game play—they are needed to execute a step in solving the next problem. The game also awards points, which are a form of extrinsic rewards. Many game designers favor the use of multiple features as incentives in order to address the preferences of different players.

Musical Score

The musical score of a game provides background sounds that are often used to direct the player's attention to specific important events or moments in the game, signal the presence of danger or opportunity, induce positive or negative emotions, or acknowledge the success or failure of a specific task. A related design feature is the sound of any voice used in the game, for example, the tone or gender of the voice. In many cases, the musical score is accompanied by haptic information (such as vibration) of the game controller. For example, the game Space Ranger Alien Quest uses the musical score to provide feedback whenever a player successfully directs a food item to the right alien, or when the wrong food item is given to an alien.

Content and Skills

The final element of learning game design is the subject matter content and skills that the game is designed to teach. The content and skills that a game is supposed to cover will determine the learning mechanics to be used, the visual design to be adopted, the narrative design, the incentive system design, and the musical score. In other words, the content of a learning game has profound impact on all major game elements and their design.

It may be useful to consider a heuristics of four functions of games that describe to what extent and with what learning goal is covered.

Preparation of future learning: This type of game does not have its own learning objectives but instead provides students with shared experiences that can be used for later learning activities, for example, class discussions

Teach new knowledge and skills: This type of game introduces new knowledge and skills for the learner to acquire as part of the game play.

Practice and reinforce existing knowledge and skills: These games provide opportunities to practice existing knowledge or physical and basic cognitive skills in order to automate them.

Develop 21st-century skills: Provide opportunities to develop more complex socioemotional skills related to teamwork, collaboration, problem solving, creativity, communication, and so on.

It is difficult to describe learning goals for a genre as broad as games, as this term captures many different subgenres of games, from casual games and puzzle games to role-playing games (RPGs), real-time strategy games, and first-person shooters. Each of these genres will result in different choices of how the game elements are designed. In fact, not all learning needs require the use of all of these game design elements. In many cases, for example, an incentive system and musical score might be missing and the use of narrative might be minimal or absent.

What are the foundations of game-based learning that are expressed in game design elements that aim to generate different types of engagement? The design framework we propose describes what kinds of engagement game-based learning environments facilitate and lists the game design elements that create such engagement. We now turn to the theoretical foundations for these game design elements that make them suitable and potentially effective for games for learning.

7.7 COGNITIVE FOUNDATIONS OF GAME-BASED LEARNING

When game-based learning is viewed from a cognitive perspective, the goal of learners' engagement with a game is the construction of mental models. One cognitive theory describes, for example, that learners first select what is presented in the game, organize this information as visual and verbal representations in working memory, and then integrate these representations with one another and with prior knowledge. From a cognitive perspective, designers and researchers consider which game elements contribute to the cognitive processing of the learning content, that is, how the content should be represented and how learning mechanics should be designed to engage the learner in a way that facilitates reaching the intended cognitive outcomes. Designers also have to consider the cognitive demand of processing the meaning of the various game elements, that is, the cognitive load experienced by the learner during game play. In particular, Mayer 2014 suggested that designers of learning games should aim to reduce extraneous (i.e., unnecessary) processing, manage essential (i.e., necessary) processing, and foster generative processing (i.e., investment of mental effort by the learner).

Research based on the cognitive approach is inconclusive as to the effectiveness of games for learning. The preferred method of investigation is experimental lab studies, often comparing games with other media, such as PowerPoint slide shows that present the same content as the game. In fact, many studies on cognitive aspects of learning with games investigate brief durations of game play in which interest, motivation, and emotion are not essential factors.

A cognitive approach to game-based learning is primarily concerned with optimizing cognitive processing in the construction of mental models and with the cognitive demand of processing the meaning of the various game elements, that is, the cognitive load experienced by the learner during game play. We described a number of areas in which games can support this processing and described the empirical support that exists for the impact of these mechanisms.

Many of the findings from research on games for learning taking a cognitive perspective are specific to the content, function, and genre of the game under investigation. However, some findings can be generalized more broadly in the form of cognitive design patterns for games for learning. Among these findings is that game mechanics should be aligned with the learning goals of the game, that is, turn them into learning mechanics. In other words, the learning goal should be in line with the core tasks learners execute in the game. Other design patterns describe that when games use multiple representations for important information, scaffolds should be made available that support their integration, and that iconic representations of key information support learners who are younger and learners with low prior knowledge

Another design pattern from a cognitive perspective is that game elements that are not directly related to the cognitive processing of information, and that require nonessential processing and therefore hinder learning, should be reduced or eliminated. This often includes elements that foster emotional, motivational, and sociocultural aspects of learning, which are viewed as helpful only if they help optimize cognitive processing.

There are a number of ways that games can facilitate cognitive processing, of which we describe the situatedness of learning, transfer of learning, scaffolding and feedback, dynamic assessment, information design, interaction design, and gestures and movement.

Situatedness

One of the great potentials of games and playful learning is that they provide opportunities for situated learning. Through games, learning can take place in a meaningful and relevant context by providing information at the precise moment when it will be the most useful to the learner, for example, by giving information needed by learners to solve a problem at the time they are trying to solve it. A second, related benefit of games is that they can present information and problems in ways that closely mirror real life, which facilitates transfer of learning. Although the application of these benefits to games for learning seems logical intuitively, and even though they have been advanced by advocates such as Gee and Prensky, their cognitive impact in game based environments has not been sufficiently validated empirically. We later discuss their impact from a sociocultural perspective.

Transfer of Learning

One of the great challenges for education is teaching in ways that allow students to apply their knowledge outside of the school context. Transfer is generally easier when the novel context is similar to the context of learning, but several factors have been identified as affecting transfer of knowledge. Perkins and Salomon proposed two main ways by which knowledge can be transferred to novel situations: a low road, which depends on automaticity through repeated practice of a skill, and a high road, which depends on conscious abstraction and application of knowledge. Games can facilitate both roads to transfer by giving repeated opportunity to practice skills and apply knowledge (low road) and by providing different, but related, experiences that facilitate the abstractions needed for knowledge to be generalized to novel situations (high road). Considering the functions of games just outlined, both the teaching of new skills and the practice and reinforcement of existing knowledge and skills have the potential to facilitate transfer.

Scaffolding and Relevant Feedback

As games and related digital media have become more complex and more intentionally instructional, there has been an effort to capture the scaffolding that occurs naturally during play within the digital environment in order to support learning. The idea of scaffolding was first introduced by Wood, Bruner, and Ross to describe the ways in which an adult or expert tutors someone who is less competent to solve a problem or complete a task. Scaffolding takes place when an expert controls aspects of a task that are beyond the learner's capabilities, thereby allowing the learner to complete a task that he or she would not be able to do on their own. Although Wood do not make the link between scaffolding and Vygotsky's zone of proximal development directly, it is evident that for effective scaffolding to take place, the task or problem being solved must fall within the learner's zone of proximal development.

In more recent times, the term scaffolding has come to be used so broadly in education that is in danger of losing its meaning. Pea argued that there are several essential components of true scaffolding, including being dynamically adaptive, which requires an ongoing evaluation of the learner, and fading as learners acquire skills and knowledge. This means that there are two essential components to true scaffolding: an ongoing dynamic evaluation of the learner's acquisition of the skills to be learned, and a progressive fading of supports as the learner progresses. Pea pointed out that many of the "scaffolds" in educational technology are actually supports that cannot be faded or removed, resulting in distributed cognition rather than true scaffolding.

Current entertainment games are very successful in scaffolding new players as they learn how to play the game. Often games will start with a tutorial level in which players' actions—and subsequent success or failure—are closely monitored. Appropriate feedback and support is given in areas of game play where the player is having trouble, thereby providing dynamic feedback to scaffold learning of game play. As players succeed in the tutorial level, the supports are removed, thereby fading the scaffolding. Although this scaffolding process is relatively straightforward and successful for entertainment games, success of scaffolding has been much more limited in games for learning, in part because of the increased difficulty in doing the dynamic assessment required in games for learning.

Dynamic Assessment

Effective scaffolding requires accurate and ongoing assessment of learners' knowledge and skills. Assessment needs to be accurate in order to know which scaffolds will be the most effective, and it needs to be dynamic in order to know when to fade or change the scaffolds. Similarly, other forms of adaptivity require dynamic assessment. For example, when learning progressions in a game are adaptive to a learner's current knowledge, the dynamic assessment of the success rate of solving the current task will determine which task the learner will be presented with next, for example, by adjusting the difficulty level or deciding whether to move on to the next topic. A first step for dynamic assessment is therefore to clearly identify the specific factors to be assessed. This will depend upon specific learning goals, as well as other individual-level variables that can affect learning outcomes. Evidence-Centered Design provides a useful framework for thinking about in game assessments. Key information can be obtained from both process and product data, from both the activities of the learner and from anything created by the learner within the game.

Games for learning are often designed intentionally in ways that require players to engage in specific activities that will provide information about the learner's knowledge or skills. Plass, Homer discussed this in terms of the assessment mechanics of the game. Accurate ingame assessments not only provide the resources for effectively adapting games to support learners but also may eliminate the need for external evaluation of learning outcomes.

Information Design

Representation of Information Another strength of games is their highly visual nature: Most games represent key information in compelling visual form. The design of this visual information for purposes of learning can be based on research on multimedia learning and its principles, as well as on principles related to cognitive load theory. This results in a tension between the desire to reduce cognitive load and the desire to enhance the visual appeal of the information, which is elaborated on affective design factors. The design of these representations should reflect its function in the learning process to support the selecting, organizing, or integration of information. Visual design should also consider the importance of semiotics, that is, the impact that the choice of signs for the learning content, either via iconic or symbolic representation. Here, studies have shown that iconic representations, for example, icons such as burners to represent heat, are particularly helpful for learners with low prior knowledge and for learners at younger developmental stages.

Typical of games is that information is shown in multiple representations that learners need to integrate. Research suggests that learning can be facilitated when information is available in more than one format, though this depends on the function of the multiple representations. The integration of multiple representations is difficult for many learners, especially when they have low prior knowledge, but can be facilitated by the visual design of the learning materials in ways that guides learners visual attention to conceptual links between representations.

Interaction Design: Learning Mechanics

The design of the learning interactions within a game, which are referred to as learning mechanics, is the process of mapping learning objectives onto instructional strategies that are based on appropriate learning theories. This mapping ideally uses systematic processes such as Evidence-Based Design to ensure that the resulting core mechanics of a game are suitable for its intended learning goals. However, a recent meta-analysis suggests that few designers have based their game designs on learning theories. A similar process can be used for the design of assessment mechanics, which aim to provide conditions for learners during game play in ways that evaluate their performance to determine their mastery of the content

Research on learning mechanics has shown that the mechanics need to be aligned with the learning goals to be effective. A study with Japanese English language learners showed, for example, that players of a game in which the mechanic was mismatched with the learning goal performed much worse on immediate and delayed measures of vocabulary learning than paired observers of the game play. An indication for the cause of the lower learning outcome of players was that they reported perceiving the game. as more difficult than the observers.

Other research has compared the impact of different learning mechanics. For example, in the Noobs v. Leets geometry game, two different mechanics were used to solve for missing angles.

In one mechanic, players would specify the numeric answer to the problem, such as indicating that the missing angle was 55. An alternative mechanic asked learners to indicate which rule they would apply to solve the problem, for example, the complementary angles rule. Results showed higher learning outcomes for the rule mechanic, and a related study showed higher engagement, enjoyment, and situational interest in the game designed with the rule mechanic. Similarly, for the factoring game Factor Reactor, one mechanic allowed for individual play, one for collaborative play, and one for competitive play. Results for this skills game showed higher learning outcomes for the competitive mechanics, and other research has shown that collaborative mechanics can have positive affective outcomes, such as math attitudes.

Gestures and movement embodied cognition using digital technologies has been studied for some time and involves motoric engagement and focuses on gestural congruity, that is, the mapping of a gesture or movement to key features of the content to be learned. The impact of embodiment on learning has been considered as a perceptual effect, a cognitive effect, or a combination of the two.

Games and other virtual environments are especially suited to foster this kind of learning because most gaming platforms now allow for gesture input and haptic responses. For example, in a Kinect-based literacy game for beginning readers, in-game activities using gestures and movements enhanced several key literacy outcomes compared to a group without these activities. In addition to their cognitive impact, research has also been investigating the emotional impact of gestures and movement.

7.8 MOTIVATIONAL FOUNDATION OF GAME-BASED LEARNING

When game-based learning is viewed from a motivational perspective we emphasize the ability of games to engage and motivate players by providing experiences that they enjoy and want to continue. It is assumed that when playing an educational game, players' interactions with the game will motivate them and will foster cognitive processing of the game content, thereby improving learning, although some researchers have suggested that the high level of engagement found with entertainment games is unlikely to transfer to educational contexts. Nonetheless, there have been several efforts to identify the specific elements that contribute to engagement and motivation in games, such as incentive systems, visual aesthetics, game mechanics, narrative/ fantasy, and musical score, and to consider their use within educational games. However, in spite of the great interest in this area there have been few efforts to systematically apply motivational theories to understanding learning in games, even though the theoretical and empirical foundation of motivation in education is extensive.

A motivational approach to game-based learning emphasizes that games are able to engage and motivate players by providing experiences that they enjoy and want to continue. A focus on motivation takes into account learners' reasons for wanting to play a game (e.g., their drives, interests, goals, etc.), and investigates the ways in which games can be designed to enhance learners' motivation. Several key concepts from motivational theories are relevant to the design of educational games, including intrinsic versus extrinsic motivation, situational versus individual interest, and mastery versus performance goal orientations. Although theories of motivation can help inform the design of game features that enhance learners' motivation, the establishment of design patterns for motivation that relate to all games for all learners may not yet be possible. Even though we know motivational factors that influence learning, the learning objectives of a game, the target population of players (i.e., their age, gender, educational level, etc.), and even the game's genre can interact to such an extent that much of the research must be considered to apply to a specific population of learners with a specific game. The extent to which design principles can generalize across games may be limited to games with similar learning goals, game mechanics, and learners.

Intrinsic Motivation

Most theories make a distinction between intrinsic motivation, in which students are motivated to do an activity for its own sake, and extrinsic motivation, in which students are motivated to do an activity for instrumental or other reasons, such as receiving a reward. Contemporary theories of motivation, such as self-determination theory, argue that motivation cannot be viewed as a dichotomy of intrinsic and extrinsic factors but that it operates in a continuum to satisfy innate psychological needs for competence, autonomy, and relatedness. From the perspective of the design of games for learning, there is an added layer of complexity in that if the learning and game mechanics are not tightly linked, students may be intrinsically motivated to play the game but not necessarily to learn, which can lead to "gaming the system" in which students find ways to complete the game without necessarily learning the educational content. Motivation elements, therefore, can be considered to be intrinsic or extrinsic to the game as well as to the learning content, depending on how they are designed and how they are perceived.

Core elements of game design, including challenge, curiosity, and fantasy, are thought to be intrinsically motivating for players. Challenge, for example, can be very motivating, and games will often level up, increasing in difficulty if the player is succeeding too easily, thereby providing an optimal challenge to players, which is intrinsically motivating. In a study on a game teaching middle school youth how to program, it was found that making the learning task within the game challenging yet personally meaningful and attainable to the learner elicited feelings of self-efficacy and control of one's own success.

An optimal level of challenge is also key in inducing a state of flow, which prompts some advocates to argue that well-designed educational games result in effortless learning. A more precise way to state this claim may be that players may perceive of their effort as low when in fact learners playing a game posing an optimal level of challenge will engage in cognitive processing, which implies the investment of mental effort.

Values and Interests

Several motivational theories focus on the values and interests of learners. For example, expectancy-value theories identify different motivational components that can provide value to a learning task and focus on the specific outcomes that learners expect and what value they place on those outcomes. Similarly, researchers studying interest argue that students are more likely to engage in activities that they find personally interesting and relevant. A distinction is often made between situational and individual interest. Situational interest is an immediate affective response to an activity, resulting in learners' directing of their attention to the task. Over time, learners' situational interest can lead to the development of individual interest, that is, increase their intrinsic desire and tendency to engage in a particular subject matter or activity. With well-designed games for learning, there is often the expectation that the situational interest they generate in learners will eventually develop into individual interest in the educational content.

A number of game design elements, such as game mechanics, mode of play, and the use of badges, can affect the situational interest experienced by the learner. For example, a study compared two versions of a middle school geometry puzzle game, Noobs v. Leets, to examine the effects of game mechanic on learners' motivation. Researchers manipulated the game mechanic so that in one version players solved geometry problems by computing a missing angle and in the other version players solved the problem by selecting the appropriate solution rule. Students in the numeric condition reported greater situational interest compared to students in the rule condition, suggesting that the selection of the game mechanic has an impact on learners' motivation. Finally, Miller presented secondary school students with an online forensic science game. The authors found that after playing through one of three possible cases, students not only showed significant gains in science knowledge but also reported greater individual interest, with a significant increase in the students' interest in pursuing a career in science.

Achievement-Related Goals

Researchers who study achievement goals consider students' goals when engaging in learning activities. In general, two broad goal orientations have been identified: mastery goal orientation, in which students focus on learning new skills, mastering material, and learning new things, and performance orientation, in which students focus on maximizing favorable evaluations of their competence. In general, students with mastery goal orientations tend to have more adaptive patterns of motivation and learning.

Despite the large body of literature on goal orientation, only a few empirical studies have looked at the role of achievement goals in educational games. For example, Plass examined different versions of a math game on factoring that either involved individual play, competitive play between two players, or collaborative play of two players. Results indicated that in comparison to individual play, competitive and collaborative play resulted in the strongest mastery goal orientation of the students.

Another study compared three version the game Noobs vs. Leets in which students were assigned to play a version with performance badges, mastery badges, or no badges. In the two badges conditions, in-game badges were presented to students after completing a level. Whereas the mastery badges were designed to encourage learners based on their own ability (e.g., "You have mastered the triangle rule!"), performance badges were designed to encourage learners by making comparison to their peers (e.g., "You figured out the straight angle rule faster than most other players!"). Although students in the performance badges condition had significantly better learning outcomes that students in the mastery badges condition, this effect was mitigated by a significant interaction between badges and situational interest:

Learners with higher situational interest performed better with mastery badges; learners with low situation interest did worse with mastery badges. Overall, these results indicate a need for considering students' achievement orientation and interest when designing educational games, but more research is needed in this area.

7.9 AFFECTIVE FOUNDATION OF GAME-BASED LEARNING

An affective perspective of game-based learning focuses players' experienced emotions, attitudes, and beliefs and considers how the design of the game environment impacts learners' affective state via affective engagement. It also considers how affect is related to, and impacts, cognitive, motivational, social, and cultural aspects of learning. This consideration of affective aspects of the learning process is one of the ways in which game designers carefully design the learning experience and is often not part of the consideration of the design of other learning environments.

Models and theories such as the differential emotions theory, the control value theory of achievement emotions, and the integrated cognitive affective model of learning with multimedia, highlight the inseparable relation and mutual influence of cognition and emotion during learning. Theories of affect describe how learners interacting with an environment experience core affect that they may or may not attribute to a source. Learners continued experience of affect, either as attributed affect or unattributed, as mood, influences their cognitive processing and is in turn influenced by it. The result of this processing is an emotion schema, "the dynamic interaction of emotion and cognition", representing "processes involved in the dynamic interplay of emotion, appraisals, and higher order cognition".

One way to incorporate affect in games is by taking advantage of the ability of specific game elements, such as the aesthetic design, game mechanics, narrative, or musical score, to induce emotions in players. Here, the game is designed with the goal of impacting learners' experience of emotions such as fear, anxiety, or happiness. Another, less frequently used approach is when games try to assess learners' emotions and respond to them. This is typically used to address boredom and frustration.

When taking an affective perspective on game-based learning, emotional aspects of play and their impact on learner engagement are considered, whether they are facilitating or hindering learning. This means that the goal of the design of a playful learning environment is to optimize engagement and stickiness of the game, often at the expense of the cognitive load that the game induces. In fact, an argument advanced from this perspective is that playful learning may reengage some learners who have disengaged from academic learning altogether and who cannot be engaged with other methods. In contrast, however, some researchers have cautioned that the emotion regulation demands of some games may overwhelm learners, for example, by requiring a high level of empathy, which may hinder learning. However, there is evidence that emotion can positively impact learning, which has emerged from research on emotional design.

Emotional Design

Emotional design refers to the use of design features to induce emotions that are conducive to learning. Virtually all elements of game design can be used to induce emotions, and empirical evidence suggests that positive emotions can broaden the scope of cognitive resources and enhance learning outcomes. There is also empirical evidence showing that confusion can lead to enhanced learning and that empathetic agents responding to the player's emotional state impact learning.

Research on emotional design has focused so far on two methods of inducing emotion, through the representation of information and through game mechanics. Representation of information, such as the visual design of learning materials, impacts learners' emotional state and, in turn, can enhance learning outcomes.

Initial research in this area investigated how shapes and colors can be used to induce positive emotions in learners. Results showed that round shapes and warm colors induced positive emotions and that these positive emotions facilitate learning and enhance comprehension and transfer test outcomes. When decomposing this effect, it was found that both warm colors and round shapes were individually able to improve comprehension. Round shapes were also independently able to improve transfer, but color alone did not. Follow-up research has been investigating how the use of different shapes and colors for game characters can impact emotions in games for learning.

Research on game mechanics, another method to impact learners' affect, has shown that different implementations of these mechanics can result in experience of boredom, frustration, or joy in players, though these findings have not yet been related to learning outcomes. Other research has shown that certain mechanics can generate high situational interest, and related positive emotions, that can lead to improved learning outcomes. Game mechanics can also impact emotions through the inclusion of affective tutors that diagnose players' emotions and respond to them, which has been shown to positively impact learning. Although these studies investigated the relative impact of different mechanics on affect, they do not allow for the generalization of findings to other mechanics.

A number of other design elements have been linked to players' affect. For example, research on the effects of the musical score in games on players' emotions showed that music impacts affect in a highly complex and varied way. Body movements and gestures in video games have been found to impact players' affect, but also in complex patterns that require further research. The inclusion of a narrative in a video game lead to increased positive arousal compared to a game without narrative. Game characters with which players identify lead to positive emotions during play. Some studies showed that individual game events impact players' emotions. For example, events that were positive and rewarding (e.g., finding an item of value) elicited positive affect, as did some negative game events. However, none of these studies were conducted with games that had educational outcomes. Consequently, no performance or outcome measures were included.

7.10 SOCIOCULTURAL FOUNDATION OF GAME-BASED LEARNING

When game-based learning is described from a sociocultural perspective, we acknowledge that learning is considered to be socially constructed and motivated. Games can include opportunities for social engagement and provide contexts where peers and social interactions occur to enhance learning. The goal of learning designs that focus on social and cultural aspects of learning relate to how learners can participate in groups, use collective knowledge to meet goals, relate learning to aspects of cultural norms and identities, and use social and cultural influences as motivators for learning through features that are contained within immediate and more distributed game play.

Social and cultural aspects of learning are difficult to separate from the other foundational pillars just discussed, as cognitive and affective aspects of learning interact with and often function within social and cultural contexts. In fact, even designers who do not intentionally consider social or cultural issues in their design are still influenced by these factors, and their own experience and values impact their design choices even when they are not aware of it.

For example, Western RPGs as a group differ from Japanese RPGs in consistent ways not only because of conscious design decisions but because their designers are influenced by the Western or Japanese sociocultural factors that form their backgrounds. Western RPGs are often open worlds where players create their own characters, whereas Japanese RPGs rely more heavily on narration and player selection of characters. Similarly, Holbert noted that Western RPGs often have relatively undefined enemies, whereas Japanese

RPGs have well-defined enemies, with characters and enemies that are often based on folklore and historical tales. Such elements and differences do not necessarily appear in games by conscious design but rather reflect designers' embodied backgrounds, histories, and implicit social and cultural norms. Other examples include unconscious use (or non-use) of certain colors or numbers within games, when those colors or numbers have been socially constructed within a cultural group as being lucky or unlucky. Game designers stay away from (or use) those colors or numbers not necessarily by conscious design but because this cultural knowledge is ingrained and thus becomes an automatic and unconscious part of a game's design as a consequence.

However, even though it is difficult to separate social and cultural from the other design factors discussed earlier, claims that games are dependent upon and maximize social and cultural aspects of play are salient enough that these aspects must be considered separately. While doing so, we believe that cognitive, affective, and sociocultural features of game play interact, though any one may be either privileged or deemphasized in any particular game. A large part of the motivational value of games, and the desire to return to play (stickiness), lies in anticipated social interaction. This is especially true for players of MMOs, who may look forward to game play because they can interact with others and participate in group-related activities and quests. Social interaction within games also influences self-perception, where feedback during group play can result in feelings of worth or negativity as a learner. Thus, identity formation is related to how one is perceived by others and how one perceives oneself. This is influenced by social interactions, which influence notions of self-efficacy and learning performance.

From a social and cultural perspective, game-based learning designs would emphasize motivation and engagement in much the same way as discussed focusing on affect. A goal of social and cultural factors related to design of game-based learning thus strives to build opportunities for social and cultural factors to positively influence learning by creating meaningful, socially supported learning contexts. Although sociocultural factors can facilitate or detract from learning, they do not on their own result in learning. Design principles, therefore, deal more with providing motivational opportunities rather than specific content or strategies for instruction. Much as in real-world learning, social actions and interactions influence learning, and these can be embedded in game play. We next discuss some of the theories and approaches related to sociocultural aspects of game-based learning, following a brief overview of the various methods used to address the challenges in studying social interactions in games.

Activity Theory

Numerous studies have relied on activity theory to describe the social interactions between players and players with artifacts. Activity theory has been attractive because games are dynamic and situations, artifacts, and player expertise all change throughout the course of play. The theory acknowledges that the players and artifacts in games change as conditions change, in both positive and negative directions, and that change is a result of both social factors and the mediation of artifacts related to play. Because social and cultural interactions are based around interactions with objects, designers must consider how objects within the game can facilitate interactions. An object that requires more than one person to use it, for example, would facilitate social interaction and learning more than an object that does not.

More recently, and related to the notion that artifacts and their affordances are important to social play and players' learning, attempts to address research into social and cultural interaction have used actor network theory and rhizomatic analyses to document and explore how artifacts interact with social and cultural foci and learning. Such analyses are related to Vygotskian notions of identities, and Moll's Funds of Identities, which argue that it is the interaction of artifacts with individuals and groups that determine individuals' perceptions of self and others. Such perceptions include perceptions of oneself as a learner and beliefs about one's ability.

In research related to social interactions, investigating why and how those interactions occur, and how they link to learning, qualitative measures have generally been used. As social and cultural interactions that influence learning are fluid and flexible, traditional experimental methods have not, historically, been the norm. More recently, however, biometric and eye-tracking data, as well as log-file data collected during game play, are allowing insights into movement within and across social groups, and how such movement and interaction affects learning.

Designs for game-based learning must acknowledge that games appear to be social experiences for teen players, who discuss their play with others and who often play to foster a sense of community. The Pew Internet and American Life Project found that games are often social activities, reporting that 75% of teens play games with others at least some of the time, which 65% of those teens play with people who are in the same room with them, and that 27% play games with people they connect with through the Internet. Similarly, we showed how teens are greatly influenced by social interactions as motivators in participatory communities. They noted the importance of interest-driven and friendship-driven participation in media-related activities, showed how interest-driven and friendship-driven participation relates to engagement, and noted the various modes of media engagement in which "kids are tinkering, learning, and getting serious about particular modes and practices, which are often supported by social networks".

This interaction and fluidity between interest-driven and friendship-driven social participatory structures imply that designs should take into account activities specifically designed to promote social interaction and friendship, social networking around a specific activity, and social support structures that result in learning around the interaction related to a specific activity. For example, designs that provide profile information when allowing players to select individuals to form a team would maximize the possibility for both interest-driven and friendship-driven social structures.

Social Context of Learning

Social contexts facilitate learning, often by allowing players to participate in communities of practice that involve the beneficial effects of collaboration. Games are social spaces when their designs and expectations allow players to feel that they are a part of a community and can participate in actions and decisions.

Although it seems obvious that multiplayer games require social interaction and decision making, even single player games take advantage of social pressure, through competitive and supportive structures—both of which are factors in social interaction. For example, leaderboards in single player games are a window into how others are doing, and the competitive nature of the social group revealed by the leaderboard can influence how often one plays and how much attention and effort one puts into the game. Thus, although leaderboards provide feedback and generally fall under feedback and assessment design categories, they also indicate social presence as related to a larger group of players. Similarly, badges, cards, and other visible reinforcement and feedback items often form a part of gamification designs. Although potentially motivating, these can be counterproductive unless they are designed to match closely to intrinsic learning goals rather than positioned as extrinsic rewards for their own sake.

Participatory Learning Culture

Social aspects of playful learning include user-generated content as well as the blogs, listervs, cheat sites, and forums that form part of a game's community, though they reside outside of the actual game itself. Some such venues are created and supported by game publishers, whereas others spring up from the players themselves (e.g., Simtropolis). Such communities help players learn by providing resources and hints to solve puzzles and quests but are supportive social sites in many ways—not only in game play but also in life outside the game. For example, a community within World of Warcraft provided in-game events and raised funds for a member on learning of his cancer diagnosis.

Social Aspects of Agency

The aforementioned example reminds us that learning is related to goal-directed behavior and that agency is important in motivation and goal orientation. Bandura noted that three areas related to agency can result in meeting one's goals: personal agency (exercised individually), proxy agency (where individuals influence others), and collective agency (where individuals form groups and act together). All three types of agency can appear in well-designed games that maximize social aspects of play, but proxy and collective agency appear to be most relevant to MMOs. Becoming a guildmaster and leading groups in MMO games, becoming a part of a tribe, forming alliances, or participating in group-based quests are examples where proxy and collective agency are aspects of social agency. These aspects move beyond learning of specific skills to learning of more abstract areas within what are termed the 21st-century skills. Through proxy and collective social agency as designed in playful learning games, knowledge of how to work in teams, how to set joint goals, how to reach both personal and community outcomes, and how to collaborate in learning is also being developed through social aspects of game play. Collective agency is also related to distributed cognition where expertise is provided within socially normed contexts to solve problems.

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An Introduction to Active Learning Strategies

Active learning involves students in the process of learning through activities such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of class content. Extensive research has shown that active learning strategies are generally more effective than traditional lecture in promoting a variety of desirable educational outcomes, such as increased student learning and retention in STEM programs. However, implementation of evidence-based instructional strategies into actual classroom practice has been slow. Previous surveys of STEM instructors have revealed a number of specific barriers to their use of active learning strategies. Concerns about (a) the effectiveness of these new methods, (b) preparation time, (c) the class time required to implement active learning and instructors' ability to cover the syllabus as a result, and (d) student resistance, which includes any number of possible negative responses to the new teaching methods, are among these barriers. Active learning is an essential part of education. Students are better able to apply what they learn when they are actively involved in the learning process.

This book describes the evidence that supports the use of active-learning strategies in education, as well as strategies for incorporating active learning into curricula in the classroom and during practice experiences. Active learning is used to stimulate higher-order thinking and increase student motivation to learn. Active learning should be integrated into classroom-based courses and practice experiences throughout all professional pharmacy program curricula, including adjunct faculty preceptors.

Learning without meaning is frequently forgotten because it is difficult to apply information to future reasoning without understanding. Simply put, learning is the result of teaching, but it does not always occur simply because an instructor teaches. Teachers' understanding of learning will influence how they teach and how their students learn. It is critical for teachers to shift their understanding of learning from simple knowledge acquisition, with learners memorizing by rote, to more consequential knowledge construction with skill application. The book presents a wide range of teaching strategies that engage students as active participants in their learning with their instructor during class time. These strategies typically involve some students working together during class, but they may also involve individual work and/or reflection. These teaching methods range from short, simple activities such as journal writing, problem solving, and paired discussions to longer, more involved activities or pedagogical frameworks such as case studies, role plays, and structured team-based learning.

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