The Essence of Academic Performance

Edited by: **Dr. Ricardo Alfred**

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PREFACE

Academic performance refers to outcome, result or achievement of education as a result of learning within a period of time. The learning outcome also shows the scope of knowledge a student has acquired or that a learner has accomplished specific goals that were the focus of activities in instructional environments. There are many determinants responsible for a student's success in academic pursuit. The nature of motivation and learning strategy use is vital to improving student learning outcomes. Motivation is a fundamental recipe for academic success. It involves internal and external factors that stimulate desire and energy in people to be continually interested and committed to job, role, or subject, or to make an effort to attain a goal.

The present book comprises chapters that look into the extent to which various cognitive, non-cognitive or psychological, and contextual factors contribute to the academic achievement of learners with various sociodemographics and sociocultural backgrounds. Excellent performance at any stage in life is paramount to great achievement and good success at all levels of human endeavors including scholastic attainment. High academic performance requires thorough progressive guidance, adequate preparations through constant supervisions and mentoring from significant others which include but not limited to the

learners, the teachers, school administrators, counselling psychologists and concerned parents. However, some learners are fraught with low academic performance and therefore would perform abysmally low. The low academic performance could be due to many factors. Internal factors within learners and external factors which could be positively managed to increase or activate high academic performance in the learners.

This book presents a comprehensive view of recent developments in the field of academic performance. This book therefore seeks to establish the synergy between the internal and external factors through effective mentoring to activate high academic performance in learners.

CHAPTER 1

INTRODUCTION TO ACADEMIC ACHIEVEMENT

INTRODUCTION

Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university. School systems mostly define cognitive goals that either apply across multiple subject areas (e.g., critical thinking) or include the acquisition of knowledge and understanding in a specific intellectual domain (e.g., numeracy, literacy, science, history). Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning. Because the field of academic achievement is very wide-ranging and covers a broad variety of educational outcomes, the definition of academic achievement depends on the indicators used to measure it. Among

the many criteria that indicate academic achievement, there are very general indicators such as procedural and declarative knowledge acquired in an educational system, more curricular-based criteria such as grades or performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates. All criteria have in common that they represent intellectual endeavors and thus, more or less, mirror the intellectual capacity of a person. In developed societies, academic achievement plays an important role in every person's life. Academic achievement as measured by the GPA (grade point average) or by standardized assessments designed for selection purpose such as the SAT (Scholastic Assessment Test) determines whether a student will have the opportunity to continue his or her education (e.g., to attend a university). Therefore, academic achievement defines whether one can take part in higher education, and based on the educational degrees one attains, influences one's vocational career after education. Besides the relevance for an individual, academic achievement is of utmost importance for the wealth of a nation and its prosperity. The strong association between a society's level of academic achievement and positive socioeconomic development is one reason for conducting international studies on academic achievement, such as PISA (Programme for International Student Assessment), administered by the OECD (Organisation for Economic Co-operation and Development). The results of these studies provide information about different indicators of a nation's academic achievement; such information is used to analyze the strengths and weaknesses of a nation's educational system and to guide educational policy decisions. Given the individual and societal importance of academic achievement, it is not surprising that academic achievement is the research focus of many scientists; for example, in psychology or educational disciplines.

1.1 AN OVERVIEW OF ACADEMIC ACHIEVEMENT

Academic achievement during adolescence is predicted by interpersonal (e.g., parental engagement in adolescents' education), intrapersonal (e.g., intrinsic motivation), and institutional (e.g., school quality) factors. Academic achievement is important in its own right as a marker of positive adjustment during adolescence but also because academic achievement sets the stage for future educational and occupational opportunities. The most serious consequence of school failure, particularly dropping out of school, is the high risk of unemployment or underemployment in adulthood that follows. High achievement can set the stage for college or future vocational training and opportunities.

1.1.1 Importance of Academic Achievement

A standards-based education system promotes equity by establishing a baseline of knowledge and skills that all students, regardless of their background, should master as part of their education. Measuring academic achievement provides key information about students' mastery of standards. Identifying

schools where many students are struggling to achieve proficiency on state tests provides a reasonable starting point when searching for schools that would most benefit from support. Looking at academic achievement data in combination with other information helps to prioritize schools for support.

More broadly, academic achievement for all students is one of the key goals of the public school system, and mastery of state standards provides students with useful skills for a fulfilling and productive life. While not all aspects of achievement can be efficiently measured and compared statewide, it is important to include some measurement of academic achievement when evaluating and prioritizing support for schools.

The tests used to measure academic achievement are meant to provide system-level data about how schools, districts, and the state are functioning. An individual student's scores should not be used to determine, for example, which courses they can or cannot take during their K-12 years. Schools should look at multiple sources of student-level data when planning instruction and support for individual students.

1.1.2 Parental Engagement with School

As adolescents become more independent in managing their academic roles, they still may need parental support to be

successful in school. Parents vary in their level of involvement with their children's schools. Teachers often complain that they have difficulty getting parents to participate in their child's education and devise a variety of techniques to keep parents in touch with daily and overall progress. For example, parents may be required to sign a behavior chart each evening to be returned to school or may be given information about the school's events through websites and newsletters. There are other factors that need to be considered when looking at parental involvement. To explore these, first, ask yourself if all parents who enter the school with concerns about their child be received in the same way?

Teachers seek a particular type of involvement from particular types of parents. While teachers thought they were open and neutral in their responses to parental involvement, in reality, teachers were most receptive to support, praise, and agreement coming from parents who were most similar in race and social class with the teachers. Parents who criticized the school or its policies were less likely to be given a voice. Parents who have higher levels of income, occupational status, and other qualities favored in society have family capital**.** This is a form of power that can be used to improve a child's education. Parents who do not have these qualities may find it more difficult to be effectively involved. The authors suggest that teachers closely examine their biases against parents. Schools may also need to examine their

ability to dialogue with parents about school policies in more open ways. Any efforts to improve effective parental involvement should address these concerns.

1.1.3 Motivation to Achieve

Motivation varies and is demonstrated by the kind of goals that students set for themselves, and by how the goals support students' academic achievement. As you might suspect, some goals encourage academic achievement more than others, but even motives that do not concern academics explicitly tend to affect learning indirectly. What kinds of achievement goals do students hold? Some students' goal may be to learn the material as well as possible because they find it interesting and because they believe it will be useful later—this is a mastery goal because they want primarily to learn or master the material. Other students are concerned less about learning the content than about getting high grades in the course—this is a performance goal because the focus is primarily on looking successful by performing well in the eyes of peers and teachers. There may also be students that are primarily concerned about avoiding a poor or failing mark—this is a performance-avoidance goal because they are not really as concerned about learning or about competitive success but is simply intending to avoid failure.

As you might imagine, mastery, performance, and performance-avoidance goals often are not experienced in pure form, but in combinations. If you play the clarinet in the school band, you might want to improve your technique simply because you enjoy playing as well as possible—essentially a mastery orientation. But you might also want to look talented in the eyes of classmates—a performance orientation. Another part of what you may wish, at least privately, is to avoid looking like a complete failure at playing the clarinet. One of these motives may predominate over the others, but they all may be present.

Mastery goals tend to be associated with the enjoyment of learning the material at hand, and in this sense, represent an outcome that teachers often seek for students. By definition, therefore, they are a form of **intrinsic motivation**. As such, mastery goals have been found to be better than performance goals at sustaining students' interest in a subject. In one review of research about learning goals, for example, students with primarily mastery orientations toward a course they were taking not only tended to express greater interest in the course, but also continued to express interest well beyond the official end of the course, and to enroll in further courses in the same subject

Performance goals, on the other hand, imply **extrinsic motivation** and tend to show the mixed effects of this orientation. A positive effect is that students with a performance orientation do tend to get higher grades than those who express primarily a mastery orientation. The advantage in grades occurs both in the short term (with individual assignments) and in the long term (with overall grade point average when graduating). But there is evidence that performance-oriented students do not actually learn the material as deeply or permanently as students who are more mastery-oriented. A possible reason is that measures of performance—such as test scores—often reward relatively shallow memorization of information and therefore guide performance-oriented students away from processing the information thoughtfully or deeply. Another possible reason is that a performance orientation, by focusing on gaining recognition as the best among peers,

encourages competition among peers. Giving and receiving help from classmates is thus not in the self-interest of a performance-oriented student, and the resulting isolation limits the student's learning.

As we mentioned, failure-avoidant goals by nature undermine academic achievement. Often they are a negative byproduct of the competitiveness of performance goals (Urdan, 2004). If a teacher (and sometimes also fellow students) put too much emphasis on being the best in the class, and if interest in learning the material as such therefore suffers, then some students may decide that success is beyond their reach or may not be desirable in any case. The alternative—simply avoiding failure—may seem wiser as well as more feasible. Once a student adopts this attitude, he or she may underachieve more or less deliberately, doing only the minimum work necessary to avoid looking foolish or to avoid serious conflict with the teacher. Avoiding failure in this way is an example of **self-handicapping**—deliberate actions and choices that reduce the chances of success. Students may self-handicap in a number of ways; in addition to not working hard, they may

procrastinate about completing assignments, for example, or set goals that are unrealistically high.

1.1.4 Schools

Adolescents spend more waking time in school than in any other context. **Secondary education** is traditionally grades 7-12 and denotes the school years after elementary school (known as primary education) and before college or university (known as tertiary education). Adolescents who complete primary education (learning to read and write) and continue on through secondary and tertiary education tend to also have better health, wealth, and family life. Because the average age of puberty has declined over the years, **middle schools** were created for grades 5 or 6 through 8 as a way to distinguish between early adolescence and late adolescence, especially because these adolescents different biologically, cognitively, and emotionally and definitely have different needs.

Middle School

Transition to middle school is stressful, and the transition is often complex. When students transition from elementary to middle school, many students are undergoing physical, intellectual, social, emotional, and moral changes. Research suggests that early adolescence is an especially sensitive developmental period. Some students mature faster than others. Students who are developmentally behind typically experience more stress than their counterparts. Consequently, they may earn lower grades and display decreased academic motivation, which may increase the rate of dropping out of school. For many middle school students, academic achievement slows down, and behavioral problems can increase.

While young adolescents seem to desire independence, they also need protection, security, and structure. Bullying increases in middle school, particularly in the first year. Additionally, unlike elementary school, concerns arise regarding procedural changes. Just when egocentrism is at its height, students are worried about being thrown into an environment of independence and responsibility. They are expected to get to and from classes on their own, manage time wisely, organize and keep up with materials for multiple classes, be responsible for all classwork and homework from multiple teachers, and at the same time develop and maintain a social life. Students are trying to build new friendships and maintain the ones they already have. As noted throughout this section, peer acceptance is particularly important.

Another aspect to consider is technology. Typically, adolescents get their first cell phone at about age 11, and, simultaneously, they are also expected to research items on the Internet. Social media use and texting increase dramatically, and the research finds both harm and benefits to this use.

High School

As adolescents enter high school, their continued cognitive development allows them to think abstractly, analytically, hypothetically, and logically, which is all formal operational

thought. High school emphasizes formal thinking in an attempt to prepare graduates for college where analysis is required. Overall, high school graduation rates in the United States have increased steadily over the past decade, reaching 83.2% in 2016 after four years in high school. Additionally, many students in the United States do attend college. Unfortunately, though, about half of those who go to college leave without a degree. Those that do earn a degree, however, do make more money and have an easier time finding employment. The key here is understanding adolescent development and supporting teens in making decisions about college or alternatives to college after high school.

High School Dropouts

The **status dropout rate** refers to the percentage of 16 to 24 year-olds who are not enrolled in school and do not have high school credentials (either a diploma or an equivalency credential such as a General Educational Development [GED] certificate). The dropout rate is based on sample surveys of the civilian, noninstitutionalized population, which excludes persons in prisons, persons in the military, and other persons not living in households. The dropout rate among high school students has declined from a rate of 12%

in 1990 to 7% in 2013. The rate is lower for Whites than for Blacks, and the rates for both Whites and Blacks are lower than the rate for Hispanics. However, the gap between Whites, Blacks, and Hispanics have narrowed (see Figure 1).

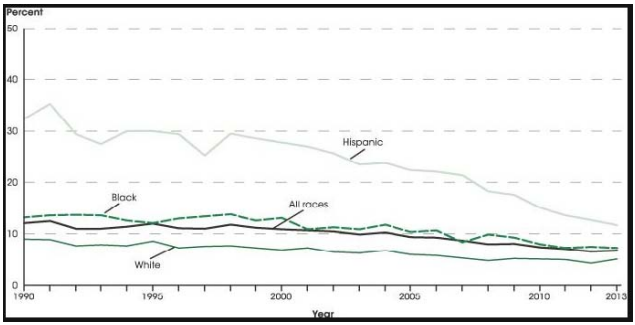


Figure 1. Status dropout rates of 16- through 24-year-olds, by race/ethnicity: 1990 through 2013.

The dropout rate for males in 1990 was 12%, where it stayed until 2000. Thereafter the rate dropped to 7% in 2013. The dropout rate for females in 1990 was 12%, where it dropped to 10% in 2000, and in 2013 was 6%. From 1997 until 2012, the rate for males was appreciably higher than for females, while in 2013, the gender difference was minimal.

Higher Education

College is an important aspect of the lives of many young adults in the United States, with 36% of 18 to 24-year-olds. The rate of college attainment has grown more slowly in the United States than in a number of other nations in recent years. This may be due to the fact that the cost of attaining a degree is higher in the U.S. than in many other nations.

As the level of State funding of higher education declines, students are finding that the cost of college is outpacing the rate of inflation, Pell grant increases, and other student scholarships. One in six students are funding their education through personal loans. With the rising costs of higher education, various news

headlines have asked if a college education is worth the cost. One way to address this question is in terms of the earning potential associated with various levels of educational achievement. In 2016, the average earnings for Americans 25 and older with only a high school education was $35,615, compared with $65,482 for those with a bachelor's degree, compared with $92,525 for those with more advanced degrees. Average earnings vary by gender, race, and geographical location in the United States.

Nonetheless, the benefits both to the individual and society outweigh the initial costs. As can be seen in Figure 2, those in America with the most advanced degrees earn the highest income and have the lowest unemployment.

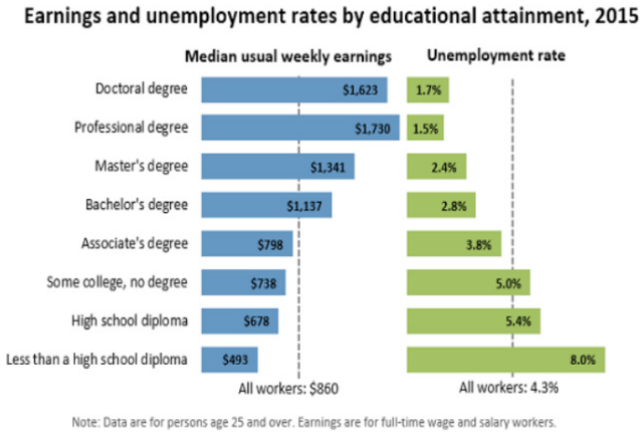


Figure 2. Earning and unemployment rate by education attainment, 2015.

Worldwide, over 80% of college-educated adults are employed, compared with just over 70% of those with a high school or equivalent diploma, and only 60% of those with no high school diploma. Those with a college degree will earn more over the course of their lifetime. Moreover, the benefits of a college education go beyond employment and finances. The OECD found that around the world, adults with higher educational attainment were more likely to volunteer, felt they had more control over their lives, and thus were more interested in the world around them. Studies of U.S. college students find that they gain a more distinct identity and become more socially competent, less dogmatic, and ethnocentric compared to those not in college.

Who is Going to College?

Each generation tends to earn (and perhaps need) increased levels of formal education. As we can see in Figure 3, approximately one-third of the American adult population has a bachelor's degree or higher, as compared with less than 5% in 1940. Educational attainment rates vary by gender and race. All races combined, women are slightly more likely to have graduated from college than men; that gap widens with graduate and professional degrees. However, wide racial disparities still exist. For example, 23% of African-Americans have a college degree, and only 16.4% of Hispanic Americans have a college degree, compared to 37% of non-Hispanic white Americans. The college graduation rates of African-Americans and Hispanic Americans have been growing in recent years. However, the rate has doubled since 1991 for African-Americans, and it has increased by 60% in the last two decades for Hispanic-Americans.

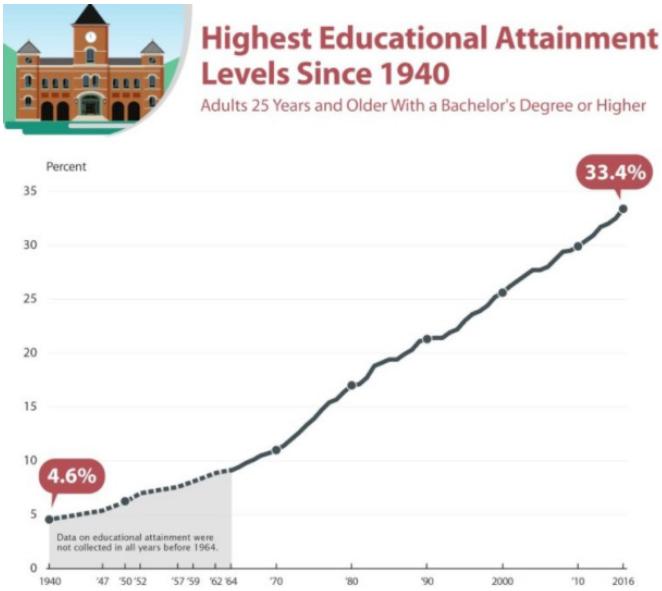


Figure 3. Higher education attainment for adults over age 25.

What about those young or emerging adults graduating high school today—is the majority of that group going to college? According to the U.S. Bureau of Labor Statistics (2017), 66.7% of youth ages 16-24 who graduated high school between January and October 2017 were enrolled in colleges or universities in October 2017. There were gender differences (71.7% of females vs. 61.1% of males) and racial differences (83% of Asians, 67.1% of non-Hispanic whites, 61% Hispanics, and 59.4% Blacks). Not all of these students will persist and earn college degrees, however (U.S. Census Bureau, 2017).

Higher Education and Career Preparation

Of concern in recent years is the relationship between higher education and the workplace. In 2005, American educator and then Harvard University President, Derek Bok, called for a closer alignment between the goals of educators and the demands of the economy. Companies outsource much of their work, not only to save costs but to find workers with the skills they need.

What is required to do well in today's economy? Colleges and universities, he argued, need to promote global awareness, critical thinking skills, the ability to communicate, moral reasoning, and responsibility in their students. Regional accrediting agencies and state organizations provide similar guidelines for educators. Workers need skills in listening, reading, writing, speaking, global awareness, critical thinking, civility, and computer literacy—all skills that enhance success in the workplace.

More than a decade later, the question remains: does formal education prepare young adults for the workplace? It depends on whom you ask. In an article referring to information from the National Association of Colleges and Employers' 2018 Job Outlook Survey, Bauer-Wolf (2018) explains that employers perceive gaps in students' competencies, but many graduating college seniors are overly confident. The biggest difference was in perceived professionalism and work ethic (only 43% of employers thought that students are competent in this area compared to 90% of the students). Similar differences were also found in terms of oral communication, written communication, and critical thinking skills. Only in terms of digital technology skills were more employers confident about students' competencies than were the students (66% compared to 60%).

It appears that students need to learn what some call "soft skills," as well as the particular knowledge and skills within their college

major. As education researcher Loni Bordoloi Pazich (2018) noted, most American college students today are enrolling in business or other pre-professional programs and to be effective and successful workers and leaders, they would benefit from the communication, teamwork, and critical thinking skills, as well as the content knowledge, gained from liberal arts education. In fact, two-thirds of children starting primary school now will be employed in jobs in the future that currently do not exist. Therefore, students cannot learn every single skill or fact that they may need to know, but they can learn how to learn, think, research, and communicate well so that they are prepared to continually learn new things and adapt effectively in their careers and lives since the economy, technology, and global markets will continue to evolve.

1.2 ROLE AND IMPORTANCE OF FAMILY IN ACADEMIC ACHIEVEMENT

It is generally accepted that the quality of family interactions has important associations with children's and adolescents' academic motivation and achievement, and with young adults' eventual educational and occupational attainments. Thomas Kellaghan and his colleagues (1993) claim, for example, that the family environment is the most powerful influence in determining students' school achievement, academic motivation, and the number of years of schooling they will receive. Similarly, James S. Coleman (1991) states that parents' involvement in learning activities has substantial emotional and intellectual benefits for children. He observes, however, that because supportive and strong families are significant for school success, teachers confront increasing challenges as many children experience severe family disruption and upheaval. Although it is acknowledged that families are perhaps the most substantial influence on children's school success, it is not always clear which family influences are the most important. In addition, research findings are inconclusive about the extent to which relationships between family interactions and academic performance are independent of a child's family background and family structure.

1.2.1 Family Influences

The family influences can be separated into components such as economic, human, and social capital. *Economic capital* refers to the financial resources and assets available to families, whereas *human capital* provides parents with the knowledge resources necessary to create supportive learning environments for their children. In contrast, *family social capital* is defined by the relationships that develop between family members. It is through these relationships that children gain access to the economic, human, and cultural resources of their families. Similarly, that children in families from various social status and ethnic/racial groups have differing degrees of access to those forms of cultural capital that support academic success. Bourdieu claims that within social groups, parents provide experiences that result in children developing similar tastes, preferences, academic motivation, and preferences. Eventually, these attributes are related to social status and ethnic/racial group differences in academic and occupational outcomes. A number of theories have been developed to examine those parent-child interactions that provide children with differential access to family resources.

Steinberg's family model

In a set of investigations, Laurence Steinberg (1996) proposes that to understand family influences, it is important to disentangle three different aspects of parenting. These include: (1) parenting style, which provides the emotional context in which parent-child interactions occur; (2) the goals that parents establish for their children; and (3) the practices adopted by parents to help children attain those goals. It has been shown, for example, that a parenting style defined as authoritative is related to positive academic motivation and successful academic achievement (Darling and Steinberg 1993). Such a style creates a context in which parents encourage their children's independence and individuality, provide opportunities for children to be involved in family decision making, expect high standards for their children, and have warm relationships with their children.

Family achievement syndrome

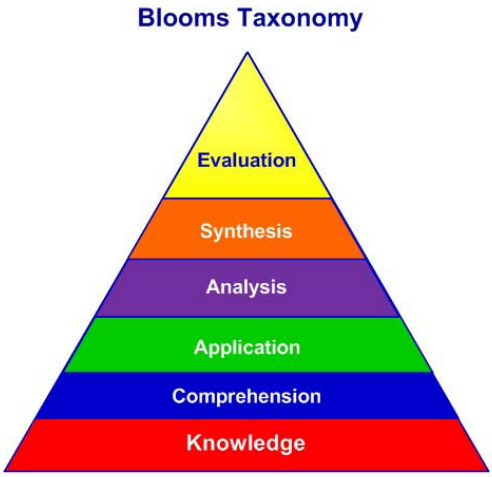
In one of the most significant attempts to construct a framework for the study of family influences, Bernard C. Rosen (1959, 1973) developed the concept of the family achievement syndrome. He

proposes that achievement-oriented families can be characterized by variations in the interrelated components of: achievement training, independence training, achievement-value orientations, and educational occupational aspirations. Whereas achievement training aims at getting children to do things well, independence training attempts to teach children to do things on their own. Rosen indicates that achievement and independence training act together to generate achievement motivation, which provides children with the impetus to excel in situations involving standards of excellence. In the achievement syndrome, it is proposed that achievement values help to shape children's behavior so that achievement motivation can be translated into successful academic achievement. Rosen states, however, that unless parents express high aspirations for their children, other family influences may not necessarily be associated with academic success. In analyses of social mobility, it has been shown that families from various social status and ethnic/racial groups place different emphases on the dimensions of the family achievement syndrome, and that variations in mobility are related to these group differences in family-achievement orientations.

Bloom's subenvironment model

It was not until Benjamin S. Bloom (1964) and a number of his students examined the family correlates of children's affective and academic outcomes, that a school of research emerged to investigate the relationships between family influences and academic outcomes. Bloom defines family environments as the conditions, forces, and external stimuli that impinge on children. He proposes that these forces, which may be physical or social as well as intellectual, provide a network that surrounds, engulfs, and plays on the child. The Bloom model suggests that the total family context surrounding a child may be considered as being composed of a number of subenvironments. If the development of particular characteristics, such as academic motivation and

academic achievement, are to be understood, then it is necessary to identify those subenvironments that are potentially related to the characteristics. The analyses guided by the subenvironment model indicate that it is possible to measure family influences that, when combined, have medium associations with children's academic motivation and large associations with their academic achievement.



Alterable family influences

In an extension of his family model, Bloom (1980) proposes that the objective of family research should be to search for those variables that can be altered, and therefore make a difference in children's learning. The findings from family learning environment research suggest that children's academic success is influenced by the interrelationships among high parental educational and occupational aspirations; a language environment that is characterized by strong reading habits and rich parent-child verbal interactions; academic involvement and support, where parents become actively involved in their children's schooling; an intellectually stimulating home setting, in which parents provide opportunities for children to explore ideas and encourage

their children to become involved in imagination provoking activities; and parent-child interactions that support the pursuit of excellence in academic and cultural experiences, and that allow independent-oriented behavior. It is important, therefore, that when attempts are made to help families develop more enriched learning environments, the strategies adopted acknowledge the significance of the interrelationships among such influences.

1.2.2 Family Background and Family Structure

Investigations that have adopted refined measures of family influences have tended to show that they are related more strongly to academic outcomes than are more global measures of family background. Kellaghan and this colleagues (1993) conclude, for example, that family social status or cultural background need not determine a child's achievement at school. They propose that for academic success, it is what parents do in the home, and not children's family background, that is significant. Similarly, Sam Redding (1999) indicates that in relation to academic outcomes, the potential limitations associated with poor economic circumstances can be overcome by parents who provide stimulating, supportive, and language-rich experiences for their children.

It is important, however, to recognize the nature of the interrelationships between family background characteristics and more refined family influences. In the development of a model of human development, for example, Stephen J. Ceci and his colleagues (1997) propose that the efficacy of a family influence for academic success is determined to a large degree by a child's family background. They observe that parent-child interactions are the forces that lead to academic performance. In addition, they claim that academic success is achieved only if family background resources can be accessed to maximize the association between family influences and outcomes: relationships between family influences and academic achievement need to take into account the potentially constraining or expanding opportunities provided by children's family backgrounds. Analyses of the relations between families and academic achievement also need to consider children's family structures, such as the influence of single-parent families and the effect of sibling structures.

Single-parent families

Research that has examined relationships between changing family structures and students' school-related outcomes, has tended to show that in relation to two-parent families, children in single-parent families have lower academic performance, are more susceptible to peer pressure to engage in deviant behavior, have higher dropout rates from high school, and have greater social and psychological problems. Although the differences are generally small, a number of theories have been proposed to explain the variations. The *no-impact* perspective claims, for example, that the association between changing family structures and children›s academic outcomes can be attributed to a combination of family background factors such as parents› education and incomes and the ethnicity/race of the family. Further, some researchers propose that much family structure research is inconclusive because it has failed to differentiate among various types of single-parent families such as whether they result from marital disruption (divorce or separation), parental death, or a never-married parent.

In addition, it is suggested that many studies fail to take into account the timing in a child›s life of a family disruption, the duration of the effects of that disruption, and whether the lone parent is the father, mother, or a guardian. An *economic deprivation theory* suggests that economic hardship in single-parent families is likely to require adolescents to work long hours and to take greater responsibility for younger brothers and/or sisters. As a result, these time-consuming activities are likely to be related to lower school achievement. In a *family socialization perspective,* it is proposed that the absence of a parent is probably associated with a decrease in total parental involvement, which in turn is related to poorer school outcomes. It is often claimed that the absence of fathers has particularly negative socialization influences, which may be especially detrimental for boys.

In general, research suggests that differences in the academic achievement of children from single- and two-parent families can be related to changes in the economic circumstances of families and to variations in the quality of parent-child interactions in the different family structures.

Sibling structure

There has been a long-standing fascination with exploring associations between sibling variables, such as the number of children in a family and a child's birth-order position in the family, and children's academic achievement. Typically, these sibling variables have small but significant inverse associations with academic outcomes, especially verbal measures of achievement. A number of theoretical perspectives have been proposed to explain these relationships, including the resource dilution hypothesis and the confluence model.

The *resource dilution hypothesis* proposes that sibling variables are related to the quality and quantity of parent-child interaction in families, and that such variations in parent resources are associated with sibling differences in academic achievement.

That is, the greater the number of children in a family or the later the birth-order position, the more those children have to share family resources. As a result, children have lower scores on those academic outcomes affected by the diluted family influences. An alternate perspective is the *confluence model* which proposes that children›s academic development is affected by the number of children in families, the age-spacing among children, and whether children are only, first, or last born in families. The model claims, for example, that with short birth intervals between children, increasing birth order is related to lower academic performance. In contrast, with sufficiently large intervals, the birth-order pattern may be mitigated or even reversed.

Generally, sibling research suggests that relationships between sibling structure variables and children's academic performance can be attributed to differences in family background, variations in family economic resources, and variations in the quality of parent-child interactions.

1.2.3 International Research

International research is increasingly examining relationships among family background, family influences, and children's academic outcomes. Kevin Marjoribanks (1996), for example, adopted the Steinberg family model and indicated that measures of family human capital, independent-oriented parenting styles, and parental involvement in children's learning accounted for ethnic group differences in Australian adolescents' academic achievement. In an investigation of U.S. students, Vincent J. Roscigno and James W. Ainsworth-Darnell (1999) show that in relation to academic performance, low social status and African-American students receive less return for family investment in cultural trips and educational resources than do their higher social status and white counterparts. In the Netherlands, Nan Dirk De Graaf and his colleagues (2000) examined associations between parental cultural capital and academic performance.

They demonstrate that parents' reading behavior is particularly important in low social status families if their children are to be academically successful. In an analysis in the former Czechoslovakia, Raymond S-K. Wong (1998) concludes that parents use a combination of family resources to affect their children's academic outcomes. As a result, he suggests that it is necessary to include both family background and refined family influence measures when attempting to explain differences in children's achievement outcomes. Kevin Marjoribanks and Mzobanzi Mboya (2000) used such a combination of family measures to examine differences in the academic goal orientations of African students in South Africa. The findings indicate that while measures of refined family influences are related to goal orientations, there continue to be unmediated differences for students from various social status backgrounds and from urban-rural locations. In an examination of differences in the academic performance of U.S. children from immigrant families, Lingxin Hao and Melissa Bonstead-Bruns (1998) investigated within- and between-family influences. They demonstrate that parents in immigrant groups provide differing within-family opportunities and support for their children. In addition, families in some groups are able to use the economic and educational resources of their communities. These between-family factors can have a large impact on children's achievement, even when parents within families are unable to provide appropriate support. These studies reflect the diversity of family research in various international settings, and emphasize the complex nature of the relations between families and academic outcomes.

Future Family Research

The complexity of relationships between family background, family structure, parent-child interactions, and academic achievement indicates the difficult task confronting parents and teachers when attempting to design and implement programs to enhance children's academic outcomes. Parents and teachers may, for example, construct what they consider to be supportive and harmonious learning environments. Children's perceptions

of those environments, however, may be affected adversely by experiences related to their family backgrounds and family structures. What is needed are investigations that examine how refined measures of within- and between-family cultural and social capital are related to the academic motivation and achievement of children with different family structures and from various social status and ethnic/racial group backgrounds. Only after such inclusive studies are completed—including a number of international contexts—will there be an advance in understanding of the relationships between families and academic achievement.

1.3 FACTORS INFLUENCING ACADEMIC ACHIEVEMENT

First, a definition for academics in the classroom. An academic classroom is one where the primary goal is to promote proficiency of academic standards. Everything else, while appreciated and winked at, comes after. The class, curriculum, and instruction, by design, are built to move students in their academic achievement.

If that's your goal, what might your focuses be? What's important? What matters? Let's take a look at six important factors at work here.

Factors of academic achievement to guide your teaching are:

1.3.1 Instructional Design Quality

While there are countless factors in the academic achievement of a student, few are more powerful than instructional design.

Consider that the 'understanding' is in large part a product of design and that starts with the most macro elements of all: what is being studied (curriculum), how it is sequenced (curriculum maps, for example), and how each is designed to maximize learning opportunities.

Consider using: Understanding by Design's framework

1.3.2 Accuracy & Alignment

Accurately unpacking the standard–-not oversimplifying it, nor making it more complex than it has to be. Making sense of what the standard says, and understanding exactly what the student needs to know and be able to do to get there.

Accurately acknowledging the rigor of the standard–accurately, which means *what it says*, not what you think it should be. The standards describe a minimal level of proficiency–feel free to push students above and beyond, but not until they've mastered the language described in the standard.

Consider Using: Your PLN. Collaboration with other teachers is critical, and not necessarily through a formal 9-step PLC process, but conversationally, over time trying to make better sense of what the standards both say and imply.

Alignment between student practice with the standard. The work students do throughout the year shouldn't merely 'engage' students or 'push them to think, make, or create.'

Those things are great, but if there isn't alignment between the practice and the standard, the mastery isn't going to show because what the students aren't mastering the standard, but rather thinking, making, and creating. Understanding by Design's Backwards Planning makes a lot of sense here. As in, do it.

Alignment between student readiness and the academic standard. Think about the Zone of Proximal Development: It does no good to create 'rigorous' work for the student who lacks the background knowledge, content knowledge, or literacy to perform the work while you browbeat them to 'meet your expectation.'

Meet the student where they are implies exactly that. Meet them, then move them. Consider Using: Understand by Design, especially Backward Planning thinking.

1.3.3 Data Forms & Quality

A climate of assessment and ways to measure understanding provide usable data that teachers can grab-and-use to revise planned instruction. Fresh, trustworthy, and relevant data teachers can use and students can understand to let them know what should come next. If it doesn't answer that question–what now?–it's an assessment of narrow value.

Data as in, units, lessons, and activities are designed to flexibly respond to that data in authentic ways without leaving it all on the teacher's shoulders to do so on the fly–or, worse, at the local "data team" meeting.

Consider Using: Exit-Slip Teaching (we're working on a model that might help here), technology that can help aggregate and report usable data consistently.

1.3.4 Whole Literacy

Literacy in terms of being able to read a variety of texts both critically and holistically. To be able to decode grade-level texts of appropriate complexity, and to then be able to take that text apart in terms of ideas, evidence, theme, and craft.

And further, 'whole' literacy, as in being able to write clearly and eloquently about what is read, learned, and thought across physical and digital forms, for a variety of audiences and purposes. In short, to be able to seamlessly use the writing process to create and refine arguments and narrate experiences for both academic and authentic purposes.

Consider using: RAFT assignments

1.3.5 Student Motivation & Engagement

Student motivation as in, helping students developing **intrinsic motivation.**

Student motivation as in, supporting students emotionally, metacognitively, and intellectually to give themselves to the process of mastering academic content.

A student's 'motivation' is everything. Teaching without engagement is like tweeting constantly with zero followers. Singing to an empty stadium. We often use words and phrases like **student engagement**, student-centeredness, curiosity, and so on–and all of these are great. But a motivated student with zero technology and limited resources and support will perform light years better than an apathetic student in a '21st-century classroom.'

Consider Using: Consistent learning feedback that makes sense to students; positive reinforcement; clear indicators of progress for students (think about video games, which constantly clarify yes/no, good/bad, warmer/colder to students); also, think gamification–points, levels, badges, unlocks, etc; lots of 'voice' and choice; also, work within their ZPD that feels designed for them specifically will carry more weight than one-size-fits-all-do-it-because-I-said so; "Teaching What Matters Most" by Silver, Strong, and Perini is a great resource as well.

1.3.6 Transfer

One indicator that the above is working? Self-Initiated Transfer.

Self-initiated **transfer is a key indicator of understanding**. It can be defined here as the ability to transfer knowledge or skill to a new and unfamiliar context, preferably unprompted. Put another way, students who know what to use what knowledge, when without being told to do so.

1.4 STUDENT ACHIEVEMENT

Student achievement is the measurement of the amount of academic content a student learns in a given time frame. Each instruction level has specific standards or goals that educators must teach to their students. Achievement is usually assessed through frequent progress and comprehension checks and examinations, however, there is no consensus on how it is best evaluated or which elements of it are most important.

Student achievement has become a hot topic in education today, especially with increased accountability for classroom teachers. The ultimate goal for any teacher is to improve the ability level and prepare students for adulthood. Defining student achievement and factors that impact progress is critical to becoming a successful teacher.

Student achievement measures the amount of academic content a student learns in a determined amount of time. Each grade level has learning goals or instructional standards that educators are required to teach. Standards are similar to a ‹to-do› list that a teacher can use to guide instruction. Student achievement will increase when quality instruction is used to teach instructional standards.

For instance, you have a to-do list that involves three tasks: dropping off the cleaning, filling your gas tank, and studying for a final. Questions you may ask yourself are: In what order do I accomplish my tasks? How am I going to get each task finished? Should I study at the library where it is quieter or at home where I may be distracted? Is it worth it to purchase gas a few blocks from home at a higher price or drive a short distance to save money? Your goal is to get your to-do list finished in the most efficient and timely way possible.

When teaching, you must use the same process when addressing instructional standards. Questions you should ask to successfully complete your ‘to-do list’ or learning standards in a timely and efficient manner include: What type of students do I have? How

am I going to teach the standard? Will they understand the vocabulary? How long do I think it will take for students to fully learn the material?

Successful instruction of standards results in student achievement. However, knowing the 'what' and the 'how' is just the first step to successful student achievement. Understanding the factors that can impact a student's ability to learn is equally important.

1.4.1 Meaning

Student achievement refers to the extent to which a learner has attained their short or long-term educational goals. Individual differences in academic performance are strongly correlated with differences in personality and intelligence. As well, students' levels of self-efficacy, self-control and motivation also impact levels of achievement.

1.4.2 Powerful Agents for Student Learning

Figure 4: The four fundamentals of student achievement.

A central focus on students, both as learners and people

a) *The individual learner* - In terms of learning, each student's progress is assessed formatively, and summatively, and teachers are aware of where each student *has been* in terms of their learning, *where they are* at present in terms of what they can and can't do in respect of the standards and expectations held for them, and *what is needed* to move their learning forward. Constructive feedback and appropriate teaching strategies are part of the ongoing assessment of each student. Hattie (2012) has calculated an effect size of 0.54 for student-centred teaching and 0.75 for teacher to student feedback, underlining the importance of knowing students as learners and acting on this knowledge.

b) *The individual person* - The second aspect of this central focus is that every student is also known as a person. Hattie has calculated an effect size of 0.72 for teacher-student relationships. It is important that every student feels that there is someone who knows and cares about them. Some students can go weeks or longer without such personal contact or interest, particularly those students who don't stand out or draw attention to themselves because of their learning, conduct or other factors. Effective teachers find ways to communicate and connect with all their students. They know and use students' names and offer commendation or correction when appropriate. They keep records. They notice changes in a student's engagement, enthusiasm, work or even health, and intervene before small problems become bigger.

However, sometimes there is a lack of relative balance between knowing students as learners and as people. In some schools the emphasis is more on the learning side. The school prides itself on the academic success of its students and those who don't measure

up are ignored, put in a bottom class, or can go elsewhere. School newsletters, websites and notice boards outside the school advertise academic success as defined by Australian Tertiary Admission Ranks (ATARs) and how many students enter university.

On the other hand, other schools, usually of lower SES, have lesser expectations for their students. The language used here can be instructive. You have heard variations on all of these and more: 'Don't expect too much and you won't be disappointed'; 'This is a poor area and the best we can do is give our students the basics'; 'The local community doesn't value education'; 'The most important thing we can do is to boost students' self-esteem and make them feel better about themselves', and finally 'We are a welfare school'.

It is clear that those schools that are most successful in terms of overall student achievement maintain that essential balance between 'academic' (learning) and 'welfare/well-being' (personal) aspects of schooling.

Professional learning

A second broad factor responsible for successful teaching, learning, schools and systems is professional learning. It is no coincidence that the most effective teachers, subject faculties and schools are never satisfied with what they know. They never reach the point where they feel they can put their feet up and say they have it all worked out. There are always new challenges and every year, new students. These educators continually question what they do and how and why they do it, use evidence to inform this knowledge, and are always on the lookout for new strategies, resources and approaches to improve teaching and learning. Hattie found professional development to have an effect size of 0.51 in respect of student achievement. Teachers utilising micro-teaching to improve their practice has an effect size of 0.88. Providing teachers with formative evaluation and feedback on their performance has an even larger effect size of 0.90. Robinson, Hohepa and Lloyd found from their meta-analyses that leaders 'promoting and

participating in teacher learning and development' had a very large effect size of 0.84.

Professional learning – one of the 'big levers' at our disposal - is essential to teacher development and school improvement. It can't see how we can change what teachers know and can do without it. Any change we introduce into a school or system must be accompanied and supported by relevant and effective professional learning, if it is to have any chance of success.

Leadership

Leadership is another 'big lever' in improving teaching and learning. Our earlier views of leadership have changed and we now recognise that leadership resides in all teachers and not just in those occupying formal leadership positions. Every time a teacher takes a class, an extra-curricular activity, works with a less experienced teacher or sits on a school committee or working party, to give but a few examples, he or she is exercising leadership.

Leadership, as with professional learning, is a powerful enabler in schools. It is possible to have good teachers and teaching without having a successful school but it is impossible to have a successful school without good leadership. Hattie has identified an effect size of 0.39 for principals/school leaders but as, the effects of leaders and leadership are often widely variable, indirect, and therefore more difficult to measure than those for teaching. Additionally, some forms of leadership, such as instructional leadership, have been found to have more effect on student learning than others, such as transformational leadership. Leadership is a group function which over time can lift a school's performance, but poor leadership can quickly undo this good work.

Quality teaching

Not surprisingly, quality teaching has been found to be essential in facilitating successful student learning. There are two sides to the quality teaching coin: the qualities of the teacher and the

quality or effectiveness of his or her teaching. There has been great interest in the quality of those entering teaching in recent times (and with the quality of initial teacher education programs), as there has been for teaching performance or effectiveness. Hattie found an overall effect size of 0.48 for the quality of teaching, but research has also revealed the wide variation in teacher quality that can occur in any school. Whilst the teacher is the biggest *in-school* influence on student achievement, the big challenge is to get a quality teacher in every classroom, something we have described as being the biggest equity issue in education.

1.4.3 The Three Dimensions of Student Achievement

When a student is done with school and enters adult life, she will be judged for the rest of her life not by her performance on tests of basic skills, but by the quality of her work and the quality of her character.

Mastery of Knowledge and Skills

Students:

- Demonstrate proficiency and deeper understanding: show mastery in a body of knowledge and skills within each discipline
- Apply their learning: transfer knowledge and skills to novel, meaningful tasks
- Think critically: analyze, evaluate, and synthesize complex ideas and consider multiple perspectives
- Communicate clearly: write, speak, and present ideas effectively in a variety of media within and across disciplines

Teachers and Leaders:

- Ensure that curriculum, instruction, and assessments are rigorous, meaningful, and aligned with standards
- Use assessment practices that position students as leaders of their own learning

- Use meaningful data for both teachers and students to track progress toward learning goals
- Engage all students in daily lessons that require critical thinking about complex, worthy ideas, texts, and problems

Character

Students:

- Work to become effective learners: develop the mindsets and skills for success in college, career, and life (e.g., initiative, responsibility, perseverance, collaboration)
- Work to become ethical people: treat others well and stand up for what is right (e.g., empathy, integrity, respect, compassion)
- Contribute to a better world: put their learning to use to improve communities (e.g., citizenship, service)

Teachers and Leaders:

- Elevate student voice and leadership in classrooms and across the school
- Make habits of scholarship visible across the school and in daily instruction
- Model a school-wide culture of respect and compassion
- Prioritize social and emotional learning, along with academic learning, across the school

High-Quality Work

Students:

- Create complex work: demonstrate higher-order thinking, multiple perspectives and transfer of understanding
- Demonstrate craftsmanship: create work that is accurate and beautiful in conception and execution

- Create authentic work: demonstrate original thinking and voice, connect to real-world issues and formats, and when possible, create work that is meaningful to the community beyond the school

Teachers and Leaders:

- Design tasks that ask students to apply, analyze, evaluate and create as part of their work
- Use models of excellence, critique, and multiple drafts to support all students to produce work of exceptional quality
- Connect students to the world beyond school through meaningful fieldwork, expert collaborators, research, and service learning

1.4.4 Tips To Improve Student Performance and Increase Student Achievement

Five tips to increase student achievement are:

- **Align instructions to learning standards.** Instructions for an assignment should always be clearly aligned to the learning target and task for mastering a learning standard. We can best know that our students have met the learning standard if we use a measurable learning target. Likewise, we should align our feedback strategies to the learning task to help our students master a learning target.

- **Include formative assessment.** Royce Sadler, Professor Emeritus at Griffith University, suggests that students must be able to understand quality work and be able to asses the quality of their own work. Give your students examples of quality work so they have something they can compare their work to and can identify their learning gaps themselves. This helps to show where students need improvement. Students become more motivated about learning and confident in their abilities.
- **Provide consistent feedback.** Education experts, Paul Black and Dylan Wiliam, found that students whose teachers have used formative assessment with them significantly improved their performance on standardized tests. As a result, the highest gains occurred from lower performing students
- **Use the feedback loop concept.** This involves teachers and students simultaneously collecting and analyzing student learning information to determine where students are and where they need improvement. Students' movement from one learning target to another works best when students receive feedback to help them improve. Students rely on feedback and, without it, their chance for remaining engaged learners spirals downward.
- **Self-assess regularly.** Teachers should self-assess how well they perform these three actions:
  - My students clearly see how one day of learning builds on the next day of learning.
  - I create opportunities where my students receive continuous and specific feedback that helps them improve.
  - I consistently recognize my students' strengths.

These are five basic tips that teachers can use to help them better themselves so they can better help their students.

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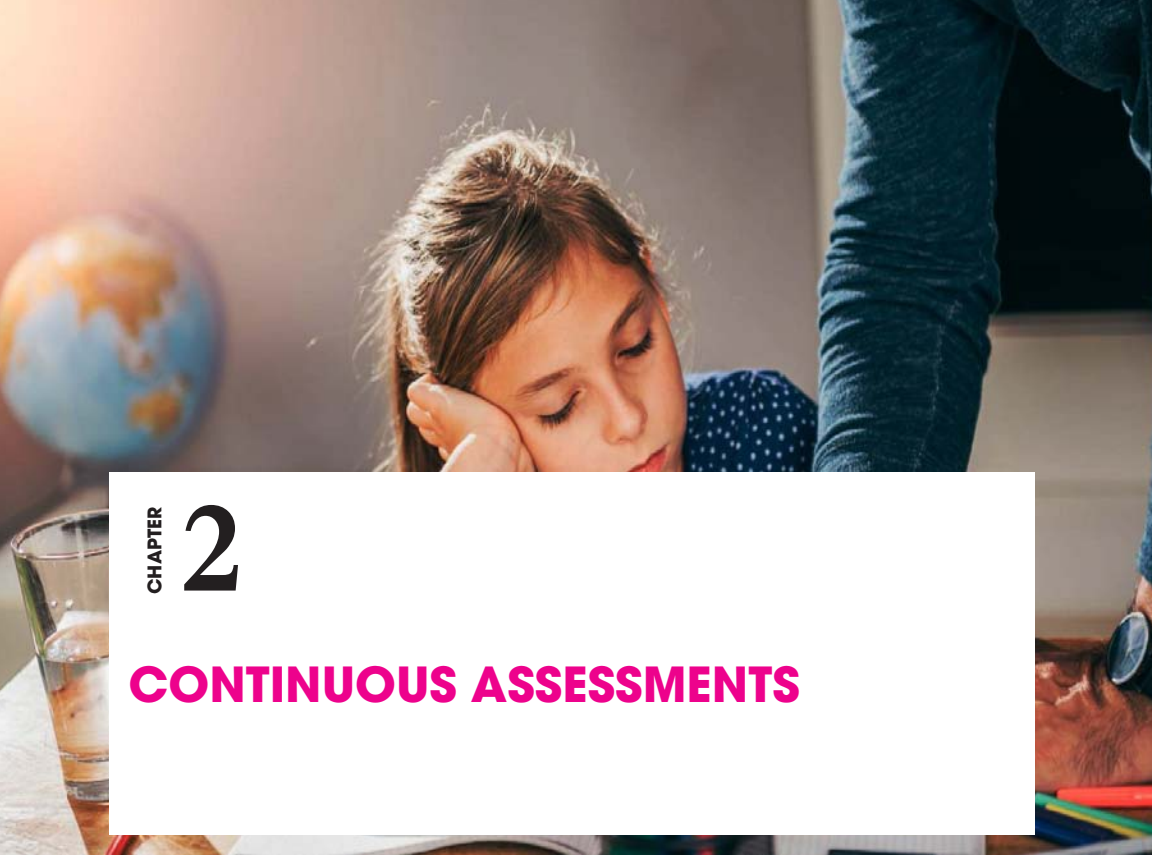


CHAPTER 2

CONTINUOUS ASSESSMENTS

INTRODUCTION

The term ‘continuous assessment’ is used to describe assessments that are completed during the course module. The method is also referred to as curriculum integrated assessment or embedded assessment. Continuous assessment can replace the final assessment or can be combined with the final assessment to calculate a final grade.

Continuous assessment is a form of educational examination that evaluates a student›s progress throughout a prescribed course. It is often used as an alternative to the final examination system. Proponents of continuous assessment argue that the approach allows tracking of progress and has a chance of offering students more support, guidance, and opportunities to improve during the course or programme.

2.1 CONTINUOUS ASSESSMENT – FEATURES AND PURPOSE

Continuous assessment is as the name suggest, continuous and frequent analysis of the learning performance. Moreover, this method is more of a tool, considering the increase in the need for constantly assessing students. Further, it also proves to be a technique of performance assessment that many educational institutes adopt.

Continuous assessment means assessing aspects of learners' language throughout their course and then producing a final evaluation result from these assessments. It can be compared with a final or summative assessment, which only assesses the learner at the end of the course. Continuous assessment often provides a more accurate and complete picture of the learner's level and has a positive impact on learning.

Continuous assessment is an ongoing assessment and helps teachers to evaluate the learner's performance. It is based on observations of what students are doing.

While examinations are one way of assessing learners, continuous assessment refers to what is taking place in the classroom on an ongoing basis. I use continuous assessment in the classroom to ensure that all my students are succeeding and in this way I can adopt my instructions to the needs of all my students. Thus, there are many reasons why I use continuous assessment in the classroom with my students. These reasons are as follows: to find out what students know and can do, to ensure ourselves in what we say our students know and can do, to provide all students with opportunities to show what they know, to promote learning for understanding, to improve teaching, to help determine what kind of remediation and enrichment activities to provide, and to identify which students need assistance, to let the students know how well they are progressing in their own learning, and to lead to overall evaluation.

Features of Continuous Assessment

There are certain characteristic features of continuous assessment that makes it different from the mainstream tests. They are as follows.

- They are regular and frequent in nature.
- Also, continuous assessment can either be an intensive tool or a relaxed yet efficient technique.
- They focus primarily on the course module and ensure that they are treated as regular feedback.
- Moreover, the form of the continuous assessment can be different than usual, considering the final objectives.
- The continuous assessment technique is an effective instrument to determine and develop competencies.
- This method is comprehensive, cumulative, diagnostic, formative, guidance-oriented and systematic in nature.

Purpose of Continuous Assessment

There are 3 main and primary purpose for continuous assessment:

1. *Enhancing the student's learning*. Continuous and comprehensive assessment of the knowledge that the student acquires during the course of the module is very important. Moreover, this ensures that the student invests considerable time in studying, preparing and building on academic skills. This also ensures that the students is in constant touch with the curriculum and all that it has to offer. A constant, continuous and regular assessment of student performance and learning is the key to building a competent and skilled prospective workforce.
2. *Improving the faculty's teaching skills*. The pressure of continuous assessment can ensure optimum performance of the teachers as well. Let's say that a particular curriculum only has 1 final examination for 100 marks at the end of its course. The students, as well as the

teachers, will find the necessity to consistently perform throughout the term and not only towards the end of the course, making it a great performance improviser.

3. *Improving the education and institutional assessment system.* An education system that understands the importance of comprehensive assessment is great. Not only does this kind of system portray development but also shows how serious they are when it comes to providing opportunities and student performance.

The Purpose and Use of Your Assessment

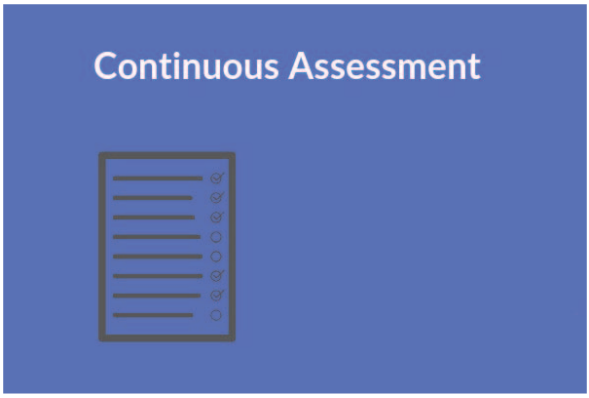
The use of the information you gather about student learning is what is important here. Are you gathering information in order to provide documentation of individual students' progress over time? Is it a way to convey your expectations to students? Will the information be used to guide or change your instruction? If it is any one or all of these, then the focus of your assessment is formative and is on individual students.

If, instead, the data are collected for the purpose of monitoring the outcomes of a body of students and are to be used to provide a basis for planning and implementing improvements to a program, or to provide guidance for the allocation of resources to the program, materials, or the school building, then the assessment is most likely to be summative and to focus on the program.

2.1.1 Continuous Assessment or Comprehensive Analysis

Testing students on the basis of knowledge that they acquire from classes, books, and videos are not sufficient. Many times, students are excellent when it comes to studying the course out of a well-written book.

However, the challenge lies in testing the student on something more. This is often in relation to the curriculum and the course.



If a student is able to score excellent grades in a written test or a viva, this is great. However, it does not show how the student is able to differentiate themselves with others. In order to be able to test the student on various skills, continuous assessment is crucial. Also, over the past few years, students have proven that they can burn the midnight oil and get their grades. But this does not showcase the knowledge that they have acquired over a period of time from the course. Therefore, continuously and regularly assessing and testing their performance on the various parameter is critical.

Definition of Continuous

Assessment Continuous assessment according to the Federal Ministry of Education, Science and Technology (1985) can be defined as:

- A mechanism whereby the final grading of a student in the cognitive, affective and psychomotor domains of behavior takes account of all his performances during a given period of schooling. Such an assessment involves the use of a great variety of modes of evaluation for the purpose of guiding and improving the learning and performance of the student.

Some Certificate of Secondary Education (CSE) examination boards in Britain, defined continuous assessment as "a process

which deliberately allows for periodic assessment throughout the course and takes into account progress towards the goal as well as success in reaching it".

Continuous Assessments are assessments evaluations that take place over a period of time. In other words, the student is assessed right through the learning process and not only after the learning process. Continuous Assessment of learner's progress could be defined as a mechanism whereby the final grading of learners in the cognitive, affective and psychomotor domains of learning systematically takes account of all their performances during a given period of schooling. Assessment in the cognitive domain is associated with the process of knowledge and understanding.

The affective domain applies to characteristics such as attitudes, motives, interest, and other personality traits. Assessment in the psychomotor domain involves assessing the learners ability to use his or her hands (e.g. in handwriting, construction and projects).

Continuous Assessment as any assessment approach which should depict the full range of sources and methods teachers use to gather, interpret and synthesize information about learners; information that is used to help teachers understand their learners, plan and monitor instruction and establish a viable classroom culture. The opined that continuous assessment should involve a formal assessment of learners' affective characteristics and motivation in which they will need to demonstrate their commitment to tasks over time, their workforce readiness and their competence in team or group performance contexts.

From these definitions, one could infer that continuous assessment is a mode of evaluation and certification of learning outcome that takes into account the learners performances in the area of cognitive, affective and psychomotor domain of educational objectives. It considers everything the child does in school assessed through test, assignment, interviews, observation, examinations etc. beginning from the first day he enters a given course of study. It accumulates information obtained in respect of a child with a view of using them guide and shape his learning from time to time.In another

development, continuous assessment is an assessment approach which involves the use of a variety of assessment instruments, assessing various components of learning, not only the thinking processes but including behaviors, personality traits and dexterity. Continuous assessment also takes place over a period of time. Such an approach would be more holistic, representing the learner in his/her entirety. It begins the decisions that the teachers and administrators make on the learners regarding end-of-year grading and promotion.

2.1.2 Characteristics of Continuous Assessment

Continuous Assessment has four major characteristics which are that it is comprehensive, cumulative, and systematic and guidance oriented.

Continuous assessment is regular assessment of the learning performance related to a course module and that is separate from examinations, and accompanied by regular feedback.

- Continuous assessment can take various forms, depending on the final objectives and competencies. A few examples:
  - Regular observation of practical skills or attitudes, e.g. nursing skills, your team's collaboration skills, collaboration during tutorials, etc.
  - Regular feedback on your portfolio, paper, etc.
  - Regular assessment of your verbal language skills.
  - Regular testing of your insight into theoretical concepts.
- Continuous assessment can take place within various types of contact moments, e.g. practical's, workshops, lectures, placements, projects, cases, etc.
- Continuous assessment is the result of the continuous assessment of the learning performance on a course module. The assessment task can verify which developmental process you are going through. The

continuous assessment (partially) counts towards the final mark for the course module.

- Continuous assessment often goes hand in hand with information about: the assessment criteria, how you performed, what went smoothly, what went less smoothly, and the things you still have to work on.
- Comprehensive
- Cumulative
- Diagnostic
- Formative
- Guidance-oriented
- Systematic in nature

Assessment literacy involves understanding how assessments are made, what type of assessments answer what questions, and how the data from assessments can be used to help teachers, students, parents, and other stakeholders make decisions about teaching and learning. Assessment designers strive to create assessments that show a high degree of fidelity to the following five traits:

1. Content validity
2. Reliability
3. Fairness
4. Student engagement and motivation
5. Consequential relevance

Continuous Assessment is Comprehensive

It is comprehensive in the sense that it assesses every aspect of the learners' activities. For instance, it assesses cognitive, affective and psychomotor activities in the learner. Also, in making assessment, it uses a variety of assessment instrument like test, assignment, examination, socio-gram, checklist, rating scale, observation and even the notes the student copies. This is a major deviation from the former practice which assesses achievements in the cognitive domain only.

Continuous Assessment is Cumulative

Continuous Assessment is cumulative in the sense that there is continuity in the collection and assessment of data. Each score adds to the previous ones. That is to say, assessment mode of a students' performance at the end of the term or year is based on cumulative scores from series of assessment instruments. This characteristic of continuous assessment requires that there should be proper keeping of records.

Continuous Assessment is Systematic

It is systematic in the sense that the teacher should specify well in advance what should be assessed, the time of assessment, varieties, and types of assessment (class, tests, essays, quizzes, projects, assignments). The teacher should also specify the criteria for assessment. The implication of all these is that there should be a plan to produce a programme of assessment. This characteristic according to Ipaye (1982) takes the sting (fear, anxiety, trepidation, intimidation etc.) out of continuous assessment. It also makes continuous assessment less random and sporadic.

Continuous Assessment is Guidance Oriented Continuous

Assessment is guidance oriented in the sense that it provides information which can be used to guide the learners to grow and develop in the right direction. Diagnostic and formative tests are carried out from time to time within a course of study or a programme. Such tests provide the information needed to guide the learner. It may be too late to wait till the end of a programme to collect such information. By that time, some irreparable damages may have been done on the learners. Continuous assessment provides the opportunity to diagnose weaknesses on the part of the learner in time among others.

Instruments Used in Continuous Assessment

Instruments used in Continuous Assessment include:

Tests

Test is very suitable for assessing learning outcome in the cognitive domain. Test could be standardized or teacher made.

Projects

These are tests given to students or group of students to be completed on their own within a given period. This can also be used to assess cognitive, affective and psychomotor domains.

Assignment

These are specific tasks given to students in the course of teaching to find out how much they have followed.

2.1.3 Advantages and Disadvantages

Continuous assessment can help students learn in the following ways:

1. Continuous assessment can provide early indications of the performance of students.
2. *An increased sense of inclusiveness*: Continuous assessment provides students with a constant stream of opportunities to prove their mastery of material and sends the message that everyone can succeed if given enough time and practice. This reduces the anxiety around testing and heightens the emphasis on the learning itself.
3. *Higher learning standards for all*: In a system of continuous assessment, advanced students can progress through material at their own pace and remain engaged by pursuing more challenging work as they master the basics.

- One very important advantage of Continuous Assessment is that it is guidance -oriented. Since it involves data gathering over a long period of time, it yields more accurate data reaching the teachers early enough to modify instruction. This plays vital roles in diagnosing and remedy areas of learners' weaknesses if properly anchored in what occurs in classrooms.
- Teachers should be involved in all final assessment of the pupils under their care. Continuous assessment gives the teacher greater involvement in the overall assessment of his or her students. That is to say, it encourages more teacher participation in the overall assessment or grading of his or her learners. It places teachers at the center of all performance-assessment activities. As suggested by Paris and Lawton (1991) teachers must be given opportunities to select and review assessment so that they become involved and knowledgeable in the process. Through this approach, teachers would be able to integrate assessment and assessment results into instructional practice. Teachers will be expected to incorporate assessment into larger learning frame work and possibly to provide evidence regarding how assessment information is used to inform and guide instruction for individual learners. With continuous assessment teachers must embed the assessment in their instructions, score the assessments and discuss standards for good learners work with colleagues, parents and learners.
- Continuous Assessments provides more valid assessment of the overall ability and performance. This is because it takes into account all the information and data about the students' performance before decision is taken about the Students ability and performances.
- Continuous Assessment enables teachers to be more flexible and innovative in their instruction .It enables teachers to improve his or her instructional methods. This is because it provides information and data

needed by the teacher on a formative basis, to assess the effectiveness of his or her instructional methods.

- Continuous assessment reduces examination malpractices. It makes students to develop good study habits by studying on a continuous basis rather than accumulating their works. By so doing, they are always alert and examination or test ready.
- Continuous assessment assists the student to identify right early their strengths and weaknesses. They can seek assistance to remedy their weaknesses.

Disadvantages

1. *Greater study pressure*: Unlike the final exam system, students and teachers need to focus throughout a course or programme, as all work counts towards the final grade. This may cause learners to feel more stressed. Under the final exam system, students may "cram", or study for long hours, before the test in order to get a good grade. Thus, they only have to work hard for a shorter period.
2. *Risk of plagiarism*: As homework and assignments become more important, students may not feel secure just showing their own knowledge. Instead, they may plagiarize other›s work in order to secure a better score

Formative Assessment

Continuous assessment will often include some form of formative assessment. The formative assessment covers the range of informal diagnostic tests a teacher can use to assist the process of learning by their students. This may include activities such as weekly pop quizzes or preparatory assignments. Prescriptive but ungraded feedback ructional Research and Curriculum Evaluation, likens formative assessment to a cook tasting a soup before serving it to a guest. Despite its advantages, formative assessment can be time-consuming, and incentives in education systems tend to favor more objective assessments.

An advantage of formative assessment for learning is that it is ongoing. This allows for incremental feedback to identify problems at their earliest stages. For example, a student can correct conceptual errors before undertaking work on a term paper. As a student works on a topic, input from the teacher can inform, guide, and validate each step of the process. Cheating and plagiarism remain significant problems in academic settings. Compared to graded summative assessments like final exams, ungraded formative assessments reduce the temptation to cheat. This allows students to focus on learning instead of grades.

2.1.4 Problems of Continuous Assessment

The problems associated with continuous assessment are numerous. One very important one is the comparability of standard. The availability of valid and reliable test which could be used in all schools is one of the problems of continuous assessment.

This problem can be attributed to:

- Variation in the quality of tests and other assessment instruments in use in various schools.
- Variation in the procedures for scoring and grading of different assessment instruments in different schools.
- The standards used by different teachers during assessment of students work may not be the same.

For example if a teacher in one school awards a score of 60 % to a student in a subject is there any guaranty that another score of 60 % awarded by another teacher to another student in another school in the subject is the same? This puts to question the concept of comparability of standards. Teachers are not properly trained to carryout continuous assessment. Many of them do not have the skills required to carry it out effectively. Workshops and seminars to improve the teachers' skills are very scarcely organized by the school administrators and government. These workshops would help to solve the problem of identifying the appropriate instrument for continuous assessment and how to use them.

There is still heavy reliance on tests on the cognitive domain of educational objective to the detriment of the affective and psychomotor domains. Apart from the skills of test construction on measuring cognitive aspect of learning, teachers should also be able to measure the learners affective attributes such as attitudes, motives, interests, values and other personality characteristics otherwise, the characteristics of comprehensiveness is far from being attained. Affective characteristics could be as important as others associated with intelligence. They would assist the teachers and administrators to understand the learners better both in the process of education and in the practical affairs of everyday life. They would help to answer questions such as why learners perceived to have high academic abilities do not do well at school. They also provide clues about the interest patterns of learners which could be used in their placement in schools of higher learning and for employment purposes. It is believed that anti-social behaviors such as truancy, lying, cheating and poor attitude to work could be corrected by providing affective education in schools.

For successful implementation of the continuous assessment approach, teachers need to give tests, which means more marking. Continuous assessment makes heavy demands on the teacher's time, initiative, patience, objectivity, diligence, resourcefulness, carefulness etc. The teacher has to be initiative in clarifying his objectives in assessing the students, diligent and careful in record keeping and continuity of records, patient and resourceful in grading and transforming raw scores to facilitate decision making etc. All these could mean more work to the teacher, more demand on his or her time and more responsibility.

Another problem with continuous assessment is the issue of record keeping. It is known that record keeping in most school is not properly carried out. Learners' records have to be adequately and meticulously kept over a long period of time. It is observed that there is paucity of storage facilities and space. Records should be properly stored and easily retrievable. Security of the offices and whatever is stored in them is not guaranteed. It is therefore

necessary for schools to carefully keep cumulative records of each student's performance.

Continuous assessment is time consuming. At this time of economic crisis that is often characterized by galloping inflation, most teachers engage in other thing which they feel is more beneficial to them. Some of them have large stores in the markets where they buy and sell. Those teachers do so in other to survive. Very little or no time is made available for continuous assessment by the teachers.

Most government schools are over populated. Population explosion in schools makes serious demands on the facilities, equipment and materials in the school system. This has also increased teachers work load. So there is little or no time for continuous assessment. Continuous assessment is very demanding in terms of financial resources and there is little or no provision of fund in the school budget to take care of continuous assessment.

2.1.5 Techniques and Tools for Continuous Assessment

The techniques of continuous assessment listed below will not necessarily be new to you. In fact, you will recognize these techniques not only as good assessment strategies, but as excellent teaching strategies as well. These, when combined with some familiar tools, help you to gain and document information about students' understanding of science concepts, the practice of scientific dispositions, and the development of the processes of science.

Techniques for Continuous Assessment

- Sitting and Listening Closely. Teachers watch the behavior of the students at work and listen closely to their conversations. At times, they may ask questions during conversations to clarify details about what students are doing and what they are finding out, but otherwise do not interfere.

- Purposeful Questioning. Teachers ask open-ended questions that enable students to reflect on, clarify, and explain their thinking and actions and give their point of view during investigations.
- Sharing New Material/Information. Teachers give students new materials or information to help them move deeper in their inquiry.
- Sparking Science Conversations. Teachers structure opportunities for whole-class, group, and individual conversations to explore the learning occurring through the inquiry.
- Student Self-Assessment. Students conduct routine reflection.

Tools for Continuous Assessment

- Teacher's observation notes
- Videotape
- Audiotape
- Photographs
- Student science writing
- Artifacts and products of student science

You will see a more thorough description of the benefits of each technique and tool.

2.1.6 Why use continuous assessment?

Black and Wiliam (1998) use the metaphor of the classroom as a "black box" to describe what the public, school administrators, and the media often focus on regarding assessment. In this model, inputs (e.g., curriculum requirements) go into the black box and outputs (e.g., test results) come out. There is often little attention paid to whether the students actually understand the concepts, but rather whether they can pass the tests. In contrast, continuous assessment uses the black box of the classroom as the site for an

ongoing inquiry into what and how the students are learning. This collection of data, in conjunction with performance tasks and standardized tests, provides a more complete picture of what students have learned. There are a number of benefits for you and your students when you start using continuous assessment in your classroom.

Serves Instruction While Monitoring Growth

By using continuous assessment strategies and tools, you are able to capture what your students are doing with and without your intervention. Whether you are a removed observer or sitting and listening closely as you watch your students and document what you see, the information you glean helps you to determine next steps to support their growth. At times this support is immediate and happens in the moment you suggest a new material for a group of students to use in their investigation, or help a student further understand a concept by offering an explanation.

Other times the information helps you decide what to do the next day. For instance, hearing a misconception like "all fruits float" helps you to think what you might do the next day. You may decide to bring in some different fruits to initiate an investigation to help the students see that while many fruits float, some sink, and to consider the factors of floating and sinking. This discussion may lead to other questions such as, "Do fruits that float, still float without their skins?" "What about vegetables? Do they sink or float?"

Consideration of how you might support your students' development over the long term is another benefit/use of the data you collect. You may also find yourself thinking about what you will do in next week's class or during next month's unit.

Enhances Student Learning

You will find you are able to catalyze "deeper" thinking and understanding as students reflect on their own investigative

processes and experiences. Reviewing a portion of a videotape of class discussion is one example. After watching a video clip of an initial scientist meeting at the beginning of a unit on motion, one student was able to describe a change in his conceptual understanding. He described what he originally thought would happen when his group rolled balls of various sizes and weights on linoleum and carpeted floors. Because the more massive balls rolled farther on the linoleum floor, he thought that the more massive balls would also roll farther on the rug. What he actually found out is that in some cases the less massive balls rolled farther than the more massive balls. After talking with the students in his group, other students, and the teacher, and continuing to experiment further, he determined that the rug provided a certain amount of interference for objects of different masses. He compared what he thought at the beginning of the unit to what he now understood about mass and friction, and the data he collected showing how the resistance of the rug affected the results of the trials on both surfaces. During the process, he was beginning to think that the angle of the "ramp" might also have something to do with his results.

Using continuous assessment data to provide timely feedback throughout an investigation encourages students to expand their thinking, modify their investigation, and revise their ideas while the investigation is still going on. Continuous assessment also enhances student learning in an inquiry based classroom when the students and teacher work together to articulate a vision of "good science." Just as the national committees did when developing the National Science Education Standards, when you work with your students in their science investigations, you can help them see that what they are doing is considered "good science." They begin to realize that when they make a careful observation, when they make a table to organize their data, when they communicate their findings to the group, they are doing the same things that scientists do. Pointing these things out helps students recognize what is valued so they can work toward concrete learning goals and identify their own growth. If you keep a list of these indicators posted, you'll find that in addition to it being a guide for you,

the students can use the list to self-assess how they are doing in science.

Enables Teachers' Professional Growth

By striving to better understand and guide students' thinking and learning, you can become more reflective about your own practices and refine your teaching strategies. As a result of looking closely and sharing experiences with colleagues, you can develop new perspectives about how teaching, assessment, and learning interact and consider adjustments you might make in your teaching.

As soon as this teacher became more of a researcher into what her students were thinking and doing and less of a collector of information for end evaluations such as report cards, she was able to reflect on her practice. She decided to focus on becoming a better listener.

2.2 ESSENTIAL OF EDUCATIONAL ASSESSMENT

An educational assessment is the documentation of a wide array of academic factors, such as achievement, styles of learning, and attitudes and beliefs in relation to learning. Most assessments are based on measurable information. An assessment can focus on one student, a group of students, or even extend to an entire learning institution or educational system. A common way of performing an educational assessment is to collect data directly from students. This usually involves the distribution of surveys, which are then compiled and examined for patterns and emerging trends. These results can be used to gauge the success of an educational program and serve as a guide for making future improvements.

An educational assessment may also include the study of individual and group student achievement. Grades, test scores, and other academic benchmarks can be used to gauge student success. These results often help teachers and administrators to

make immediate adjustments and long-term plans in order to encourage student success.

Effective educational assessments can also be used to help students thrive in existing academic structures. Data may be used to help teachers and administrators decide which particular programs will work best for individual students or classrooms. Sometimes students are moved to more beneficial programs mid-year as a result of assessment findings, though this is rare. Most assessments are conducted at the end of the academic year in order to provide a template for the year to come.

A successful educational assessment will consist of a thorough examination of the source of information. In order to collect accurate data, all individuals involved in conducting an assessment will typically follow a specific, strict set of procedures for research. It is important to establish from the beginning what information must be collected, as the results will often not be effective if valuable elements are missed. There should also be a consensus as to how the information should be compiled and reported so that it is consistent, accurate, and understandable to outside parties.

In the context of education, alignment can be broadly defined as the degree to which the components of an education system such as standards, curricula, assessments, and instruction work together to achieve desired goals. Most recently, alignment studies examine the degree to which standards and assessment address the same content. Porter's work on the enacted curriculum extends this to standards, assessments, and curriculum. Criterion-referenced tests focus on instructional objectives small, discrete improvements of learning not standards. With the passage of the no child left behind and the resulting era of accountability in education, the attention of education policymakers and researchers has recently turned to alignment. Conceptions of alignment have become increasingly sophisticated to meet goals for strengthening education systems and to satisfy rigorous requirements for accountability assessments. To provide an overview of this wide-ranging topic, this report discusses the background of alignment in educational assessment, traditional alignment methodology,

the three most frequently used alignment models, and broader issues of alignment in education.

Educational assessment is the process of documenting, usually in measurable terms, knowledge, skill, attitudes, and beliefs. It is a tool or method of obtaining information from tests or other sources about the achievement or abilities of individuals. Often used interchangeably with test. Assessment can focus on the individual learner, the learning community (class, workshop, or other organized group of learners), the institution, or the educational system as a whole.

An assessment can be as simple as a single test or survey or it can extend over a longer period of time and cover a greater field of information. It can be performed in-house or via an external contractor. Assessments can cover a general student population or specific categories or programs, such as special education.

2.2.1 Scope of Assessment

These assessment act as a framework for conceptualizing the various roles assessment plays in education, as well as an overview of educational assessment in the developing world. It undertakes an analysis of some assessment related issues that arise when

planning to expand dramatically educational access and quality. In particular, it suggests how assessment practices and systems can generate relevant and timely information for the improvement of education systems, presents case studies of a number of nations, describes some international efforts, and proposes next steps.

The education landscape in many, if not most, developing countries is characterized by a number of patterns:

- There exist substantial disparities in the distribution of opportunity to learn and in achievement. These disparities are associated with factors such as geographic location, race/ethnicity, language, social class, and gender, among others.
- In a particular region, disparities within a country are usually much greater than average differences among countries.
- In general, achievement levels are low, both with respect to a country's own standards and in comparison to the norms established by developed nations.
- There are many impediments to progress, including limited facilities and resources, insufficient capacity, inefficient allocation of available resources, and wastage due to high rates of grade repetition and attrition.

The solutions to these problems are varied and extremely complex, and certainly cannot be addressed only, or even chiefly, through assessment. However, assessment policy and practices are critical to any successful educational improvement strategy; assessment data are essential to teaching and learning and are needed to monitor, evaluate, and improve the education system. Although some assessments serve learners, teachers, parents,

and policymakers by providing them with useful information, others focus educational efforts by virtue of the consequences that are attached to learner performance. This dual role leads to the paradox of "high-stakes" assessment as an instrument of change. In the absence of serious consequences, it is difficult for assessment to exert much influence on an education system; however, if performance on an assessment entails serious consequences, it can lead to activities that are educationally unproductive and may actually undermine the integrity of the system.

2.2.2 Considerations for Secondary Education

Secondary education is critical to improving the quality of life in developing nations. This education sector plays a pivotal role in promoting rapid economic growth by preparing learners to enter the world of work or to pursue further education and training (including teacher training), and by preparing young people and at-risk-youth to participate more fully in their own socio-development and the development of society. However, despite the key role of secondary education systems, minimal attention has been paid to this sector in the past few years; instead, greater emphases have been placed on the primary and higher education levels of the system.

By their very nature, secondary schools face greater challenges than primary schools, given the need for learners at the secondary

level to move beyond standard academic content to the acquisition of relevant competencies and skills that would better prepare them to function in society. The real challenge is to incorporate relevant knowledge, skills, and experience into the learning and teaching process in a manner that will address the country's specific growth and development needs. This alone is a daunting task for any nation, one that many developed nations also struggle with. Fortunately, a great deal of thought and a fair amount of work has already been devoted to meeting this challenge.

What is Being Assessed?

Across the secondary school systems of the developing nations that we surveyed, we found both differences and similarities in what was assessed and how the assessments were conducted. The configuration of assessment practices in different countries naturally depended on how the education systems were structured, as well as the nature and delivery of the curriculum.

In the countries surveyed, we found the following:

- Secondary education offers between five and six years of schooling, generally divided into lower secondary (grades seven to nine) and upper secondary (grades ten to twelve).
- In all countries, learners were offered the options of academic, technical, and/or vocational tracks.
- A core curriculum usually includes languages, mathematics, and science, and learners are generally allowed to select additional subjects.
- Some countries specify standards or levels (e.g., the minimum levels of learning), while others have no specifications regarding what learners should achieve.
- Criteria for entrance to secondary school vary substantially. In many countries (e.g., South Africa), assessment results from primary schools are used. In some (e.g., Senegal), the results of national examinations

at the end of primary school are used, while in others (e.g., Columbia), **secondary school** administer their own entrance exams.

- Exit exams are administered at the end of secondary school in all countries surveyed, generally leading to certification. These exams may be administered by the education ministry (e.g., Brazil, China, India, South Africa), by a regional examination board, or outsourced to an international examination board (e.g., Mauritius).

Factors Influencing Assessment Practices at the Secondary Education Level

The secondary education sector of many developing nations can be characterized by inappropriate policies, an inexperienced teaching force, inadequate facilities and limited human and financial resources to effect change, relatively low enrollment rates, inappropriate and inadequate systems and structures to address current needs, and examination systems that have a significant impact on the career paths of learners.

Inappropriate policies. In most developing countries, assessment policies (practices) focus primarily on examinations with little or no emphasis on classroom assessment or on monitoring and evaluation of the system. In instances where specific assessment policies do exist, inadequate attention has been accorded to the impact of assessment on the system. For example, in Chile, where the conduct of national assessments has been a consistent policy of the government for many decades, Schiefelbein notes that these assessments have not created any improvement in the education system. In South Africa, the implementation of outcomes-based education created greater obstacles for teachers, instead of improving the teaching and learning environment. Fortunately, however, this situation was rectified after the Ministry of Education enacted new policies based on the recommendation of a committee empowered to review the implementation of the new curriculum.

Inexperienced teaching force. The shortage of qualified and experienced teachers, as well as the low morale and motivation of the teaching force, has been cited as the key factor for the low performance of the education systems in many developing nations. The implementation of effective teacher development programs, regarded as vital for improvement in the provision of quality education, has been a characteristic of many systems in the last decade.

A key focus of these training programs should be the use of appropriate assessment practices in the classroom and for examination purposes, because most teachers are able neither to conduct adequate assessments in their daily interactions with learners nor to design tests for end-of-year examination or certification purposes. However, limited information is available regarding the content of many teacher development programs.

Inadequate facilities, limited human and financial resources. The lack of adequate facilities and human resources in the education system has had deleterious consequences for many developing nations, and will continue to do so in the near future. For example, the need for more qualified teachers in a number of disciplines adds a burden to the secondary education sector beyond that found in the primary sector. In addition, the education systems of many developing nations are characterized by limited capacity to obtain relevant information for identifying areas in need of intervention, as well as limited financial resources to effect any required change.

Inappropriate and inadequate systems and structures. The manner in which components of an education system are structured and articulated across different levels, as well as with the employment sector, affects the pathways by which learners are able to access higher and further education. These systems have to function efficiently in order to make any positive impact. However, in practice, this is difficult to attain. Bregman and Stallmeister note that support systems and education pathway links are weak or non-existent for many Sub-Saharan schools and advocate the establishment of national frameworks that would provide more

rational choices of subject matter for both learners and parents. The authors also argue that the availability of national frameworks would enable learners to map their career pathways, thereby enhancing motivation and reducing dropout rates.

2.3 CONCEPTUAL FRAMEWORK AND TYPES OF ASSESSMENT

In establishing a framework for discussing the role of assessment, we have identified four essential attributes of an education system: Access, Quality, Efficiency, and Equity, which we will refer to by the acronym AQEE (pronounced "a key"). Figure 1 illustrates the interdependence among these various attributes. While recognizing that these attributes are intimately linked, we provide a separate working definition for each. It is important to note that many different meanings and interpretations of the AQEE concepts have been proposed. Instead, we offer these attributes as a starting point for systematically examining the uses of assessment in an education system.

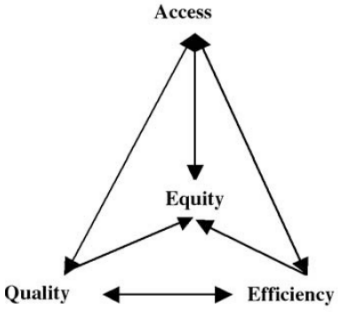


Figure 1: Interdependence of AQEE concepts.

Access

The concept of access generally refers to entry into the formal school system and comprises three aspects:

- Getting to school – how learners travel to school, how far they need to travel, and how long it takes
- Getting into school – obstacles to attending schools (e.g., disability, child labor, safety) and admissions policies (e.g., age/grade limits, fees, restriction to specific catchment areas, admissions tests, and availability of places)
- Getting through school – promotion policies and practices, both influenced by the quality of education provided

Quality

The concept of "education quality" has as many different meanings as it has writers, and generally includes the following:

- What learners should know – the goals of the education system as reflected in missions/value statements and elaborated in the curriculum and performance standards
- Where learning occurs – the context in which learning occurs (e.g., class size, level of health and safety of the learning environment, availability of resources and facilities to support learning such as classrooms, books, learning materials, etc.)
- How learning takes place – the characteristics of learner-teacher interactions (e.g., the roles learners play in their learning, teacher and learner attitudes towards learning, other teacher practices, etc.)
- What is actually learned – the outcomes of education (e.g., the knowledge, skills, competencies, attitudes, and values that learners acquire)

Efficiency

Efficiency refers to the optimal use of educational resources and facilities to improve access to schooling and the quality of education provided. Efficiency generally comprises the following:

- The functioning of the current structures and systems at different levels (e.g., provinces, regions, districts, and schools) – how these are staffed and managed (e.g., district managers, school governing bodies) regarding the formulation, implementation, and monitoring of policy and practice within the system
- The availability, allocation, and use of human and financial resources – how available resources within a system are managed and employed at different levels within the system
- Throughput and repetition rates – the number of learners that enter and leave a system as well as the number of learners that repeat any grades

Equity

The concept of equity is based on the principle that essentially all children can learn and should be provided with an equal opportunity to do so, irrespective of their background. Equity within any education system is generally based on the following principles:

- Inclusivity – the capacity of the education system to address the specific needs of all children irrespective of their language, gender, religion, sexual orientation, (dis) ability, etc.
- Absence of unfair discrimination – the capacity of the education system to actively address unfair discriminatory practices or situations and their consequences for a specific subgroup. (In our view, the use of practices targeted at specific groups to address inequity within the system is both acceptable and necessary; for example, the introduction of additional math and sciences programs specifically for female learners.)

Evidently, there exists a complex interdependence among these attributes. For example, lack of efficiency in the context of limited resources will typically adversely affect access, quality and equity.

Similarly, lack of quality, real or perceived, may well reduce access and equity as those families with fewest resources find the returns inadequate to justify the investments in school related expenses and the opportunity costs incurred.

2.3.1 Assessment Types

The term assessment is generally used to refer to all activities teachers use to help students learn and to gauge student progress. Assessment can be divided for the sake of convenience using the following categorizations:

- Initial, formative, summative and diagnostic assessment
- Objective and subjective
- Referencing (criterion-referenced, norm-referenced, and impassive)
- Informal and formal
- Internal and external

Placement, formative, summative and diagnostic

Assessment is often divided into initial, formative, and summative categories for the purpose of considering different objectives for assessment practices.

- *Placement assessment* – Placement evaluation is used to place students according to prior achievement or personal characteristics, at the most appropriate point in an instructional sequence, in a unique instructional strategy, or with a suitable teacher[4] conducted through placement testing, i.e. the tests that colleges and universities use to assess college readiness and place students into their initial classes. Placement evaluation, also referred to as pre-assessment or initial assessment, is conducted prior to instruction or intervention to establish a baseline from which individual student growth can be measured. This type of an assessment is used to know what the student's skill level is about the subject. It helps

the teacher to explain the material more efficiently. These assessments are not graded.

- *Formative assessment* – Formative assessment is generally carried out throughout a course or project. Formative assessment, also referred to as "educative assessment," is used to aid learning. In an educational setting, formative assessment might be a teacher (or peer) or the learner, providing feedback on a student's work and would not necessarily be used for grading purposes. Formative assessments can take the form of diagnostic, standardized tests, quizzes, oral question, or draft work. Formative assessments are carried out concurrently with instructions. The result may count. The formative assessments aim to see if the students understand the instruction before doing a summative assessment.
- *Summative assessment* – Summative assessment is generally carried out at the end of a course or project. In an educational setting, summative assessments are typically used to assign students a course grade. Summative assessments are evaluative. Summative assessments are made to summarize what the students have learned, to determine whether they understand the subject matter well. This type of assessment is typically graded (e.g. pass/fail, 0-100) and can take the form of tests, exams or projects. Summative assessments are often used to determine whether a student has passed or failed a class. A criticism of summative assessments is that they are reductive, and learners discover how well they have acquired knowledge too late for it to be of use.
- *Diagnostic assessment* – Diagnostic assessment deals with the whole difficulties at the end that occurs during the learning process.

Summative and formative assessment are often referred to in a learning context as assessment of learning and assessment for learning respectively. Assessment of learning is generally summative in nature and intended to measure learning outcomes

and report those outcomes to students, parents and administrators. Assessment of learning generally occurs at the conclusion of a class, course, semester or academic year. Assessment for learning is generally formative in nature and is used by teachers to consider approaches to teaching and next steps for individual learners and the class.

A common form of formative assessment is diagnostic assessment. Diagnostic assessment measures a student's current knowledge and skills for the purpose of identifying a suitable program of learning.

Self-assessment is a form of diagnostic assessment which involves students assessing themselves. Forward-looking assessment asks those being assessed to consider themselves in hypothetical future situations.

Performance-based assessment is similar to summative assessment, as it focuses on achievement. It is often aligned with the standards-based education reform and outcomes-based education movement. Though ideally they are significantly different from a traditional multiple choice test, they are most commonly associated with standards-based assessment which use free-form responses to standard questions scored by human scorers on a standards-based scale, meeting, falling below or exceeding a performance standard rather than being ranked on a curve. A well-defined task is identified and students are asked to create, produce or do something, often in settings that involve real-world application of knowledge and skills. Proficiency is demonstrated by providing an extended response. Performance formats are further differentiated into products and performances. The performance may result in a product, such as a painting, portfolio, paper or exhibition, or it may consist of a performance, such as a speech, athletic skill, musical recital or reading.

Objective and subjective

Assessment (either summative or formative) is often categorized as either objective or subjective. Objective assessment is a form

of questioning which has a single correct answer. Subjective assessment is a form of questioning which may have more than one correct answer (or more than one way of expressing the correct answer). There are various types of objective and subjective questions. Objective question types include true/false answers, multiple choice, and multiple-response and matching questions. Subjective questions include extended-response questions and essays. Objective assessment is well suited to the increasingly popular computerized or online assessment format.

Some have argued that the distinction between objective and subjective assessments is neither useful nor accurate because, in reality, there is no such thing as "objective" assessment. In fact, all assessments are created with inherent biases built into decisions about relevant subject matter and content, as well as cultural (class, ethnic, and gender) biases.

Basis of comparison

Test results can be compared against an established criterion, or against the performance of other students, or against previous performance:

- Criterion-referenced assessment, typically using a criterion-referenced test, as the name implies, occurs when candidates are measured against defined (and objective) criteria. Criterion-referenced assessment is often, but not always, used to establish a person's competence (whether s/he can do something). The best known example of criterion-referenced assessment is the driving test, when learner drivers are measured against a range of explicit criteria (such as "Not endangering other road users").
- Norm-referenced assessment (colloquially known as "grading on the curve"), typically using a norm-referenced test, is not measured against defined criteria. This type of assessment is relative to the student body undertaking the assessment. It is effectively a way of

comparing students. The IQ test is the best known example of norm-referenced assessment. Many entrance tests (to prestigious schools or universities) are norm-referenced, permitting a fixed proportion of students to pass ("passing" in this context means being accepted into the school or university rather than an explicit level of ability). This means that standards may vary from year to year, depending on the quality of the cohort; criterion-referenced assessment does not vary from year to year (unless the criteria change).

- Impassive assessment is self-comparison either in the same domain over time, or comparative to other domains within the same student.

Informal and formal

Assessment can be either formal or informal. Formal assessment usually implies a written document, such as a test, quiz, or paper. A formal assessment is given a numerical score or grade based on student performance, whereas an informal assessment does not contribute to a student's final grade. An informal assessment usually occurs in a more casual manner and may include observation, inventories, checklists, rating scales, rubrics, performance and portfolio assessments, participation, peer and self-evaluation, and discussion.

Internal and external

Internal assessment is set and marked by the school (i.e. teachers). Students get the mark and feedback regarding the assessment. External assessment is set by the governing body, and is marked by non-biased personnel. Some external assessments give much more limited feedback in their marking. However, in tests such as Australia's NAPLAN, the criterion addressed by students is given detailed feedback in order for their teachers to address and compare the student's learning achievements and also to plan for the future.

2.3.2 Challenges in Implementing Systemically Valid Assessment Practices

The assessment system within the education sector comprises all policies and practices related to conducting assessments and evaluations, as well as the structures and organizations established to ensure effective implementation. Assessment and examination policies, examination structures and practices, national assessments, national standards, classroom assessments, certification bodies, and qualifications frameworks are all components of an assessment system. In practice, the assessment systems of countries vary significantly from each other, both in terms of policies, practices, and structures, as well as the capacity for effective implementation. Thus, it is possible for two seemingly identical assessment systems to have very different outcomes.

The effective functioning of an assessment system is determined not only by how this system (or subsystem) articulates with other facets of education, such as curriculum and instruction, but also by how well the various sectors (primary, secondary, higher) and structures within the **education system** articulate with one another. In an ideal context, all components of an assessment system would articulate perfectly and function effectively to produce the desired outcomes. However, this is difficult to attain in practice, and it is more likely that one of the three scenarios outlined below exist.

First, the assessment (sub) system, or components thereof, does not function effectively. For example, the national examination results are not regarded as reliable, or the information generated

is not particularly relevant due either to the poor quality of the test instruments or the limited dissemination of the results, or both.

Second, the education system does not function effectively. In this instance, any assessment system will have little, if any, impact. For example, information from assessments conducted at the end of primary/secondary schooling will have little impact on issues of access if there are not enough places in the next level to accommodate all graduating and qualified learners.

Third, both the assessment and education systems function effectively. In this instance, assessment systems that seem to be functioning effectively can still result in unintended and educationally sub-optimal consequences. *For example*, an effort to implement minimum levels of learning was appropriately accompanied by large-scale teacher training programs. However, within a few years, researchers found that teachers were teaching to the test.

Clearly, the roles and impact of an assessment system are substantially determined by the availability, and appropriate allocation, of both human and financial resources. However, decisions pertaining to the allocation of resources must account for the following:

- The stage of development of the education system;
- The form and function of the different assessments, which change from feedback to monitoring and evaluation as one moves up from the classroom to the school, district, and beyond; and
- The frequency of assessments, which typically tends to decrease as one moves to higher levels of the education system.

In general, one can argue that for those education systems that are at an early developmental stage, less frequent assessments, following a baseline assessment, should be sufficient because many of the issues that need to be addressed are known and a number of years are required for substantial improvement. *For example,* valid assessment is one that measures what it is intended to measure.

It would not be valid to assess driving skills through a written test alone. A more valid way of assessing driving skills would be through a combination of tests that help determine what a driver knows, such as through a written test of driving knowledge, and what a driver is able to do, such as through a performance assessment of actual driving. Teachers frequently complain that some examinations do not properly assess the syllabus upon which the examination is based; they are, effectively, questioning the validity of the exam.

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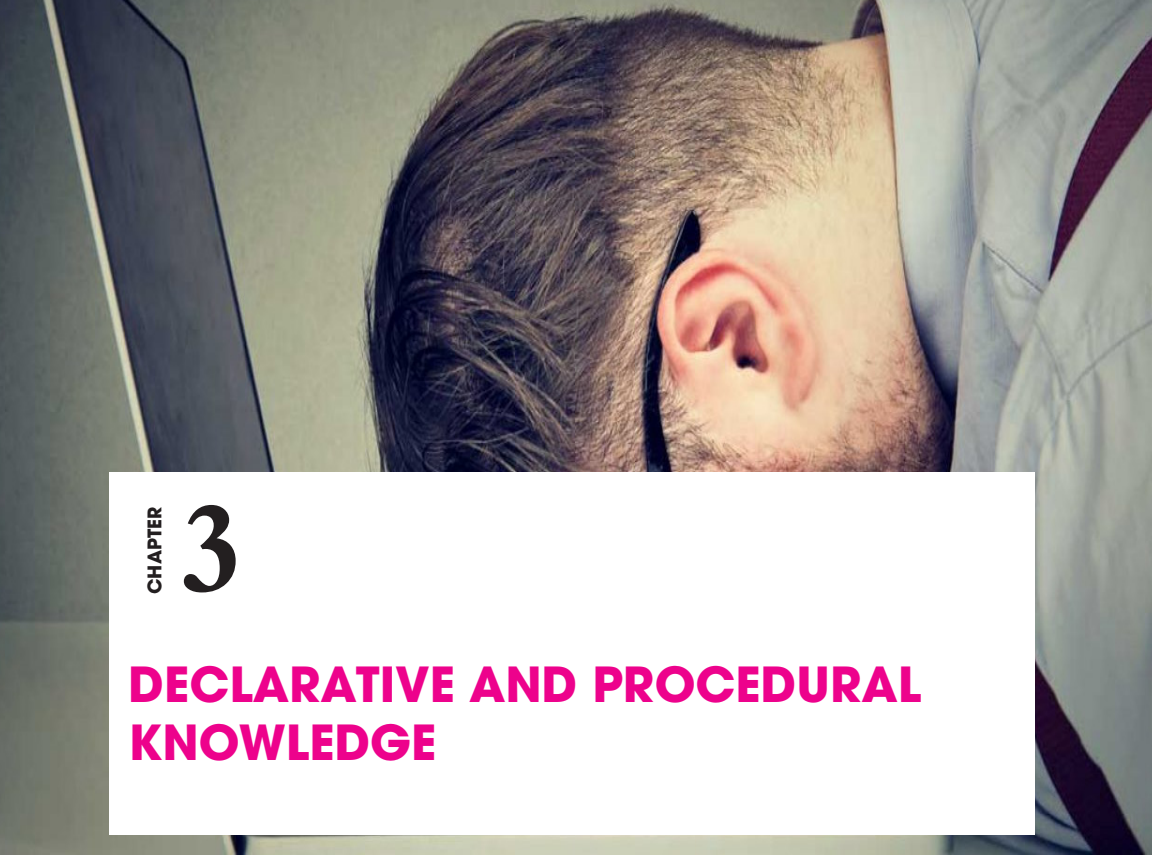


CHAPTER 3

DECLARATIVE AND PROCEDURAL KNOWLEDGE

INTRODUCTION

Declarative knowledge refers to facts or information stored in the memory that is considered static in nature. Declarative knowledge, also referred to as conceptual, propositional or descriptive knowledge, describes things, events, or processes; their attributes; and their relation to each other. It is contrary to procedural, or implicit Knowledge, which refers to the knowledge of how to perform or operate.

Procedural knowledge is the knowledge exercised in the performance of some task. Unlike descriptive knowledge (also known as "declarative knowledge" or "propositional knowledge" or "knowing-that"), which involves knowledge of specific facts or propositions (e.g. "I know that snow is white"), procedural

knowledge involves one's ability to do something (e.g. "I know how to change a flat tire"). A person doesn't need to be able to verbally articulate their procedural knowledge in order for it to count as knowledge, since procedural knowledge requires only knowing how to correctly perform an action or exercise a skill.

3.1 OVERVIEW OF PROCEDURAL KNOWLEDGE

Procedural knowledge (i.e., knowledge-how) is different from descriptive knowledge (i.e., knowledge-that) in that it can be directly applied to a task. For instance, the procedural knowledge one uses to solve problems differs from the declarative knowledge one possesses about problem solving because this knowledge is formed by doing.

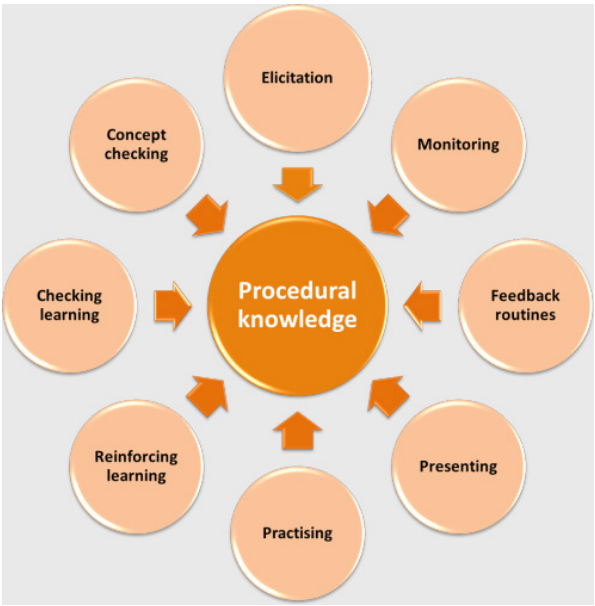
Procedural knowledge is the "know how" attributed to technology defined by cognitive psychologists, which is simply 'know how to do it' knowledge. Part of the complexity of it comes in trying to link it to terms such as 'process', 'problem solving', 'strategic thinking' and the like, which in turn requires distinguishing different levels of procedure. It is the ability to execute action sequences to solve problems. This type of knowledge is tied to specific problem types and therefore is not widely generalizable. Procedural knowledge is goal-oriented and mediates problem-solving behavior.

The term "procedural knowledge" is also widely used in mathematics educational researches. The first one is a familiarity with the individual symbols of the system and with the syntactic conventions for acceptable configurations of symbols. The second one consists of rules or procedures of solving mathematical problems. In order words, they define procedural knowledge as knowledge of the syntax, steps conventions and rules for manipulating symbols. Many of the procedures that students possess probably are chains of prescriptions for manipulating symbols. In their definition, procedural knowledge includes algorithms, which means if one executes the procedural steps in a predetermined order and without errors, one is guaranteed to get the solutions, but not includes heuristics, which are abstract, sophisticated and deep procedures knowledges that are tremendously powerful assets in problem solving.

Therefore, Star (2005) proposed a reconceptualization of procedural knowledge, which suggesting it can be either superficial, like ones mentioned in Hiebert and Lefevre (1986), or deep. Deep procedural knowledge is associated with comprehension, flexibility and critical judgement.

For example, the goals and subgoals of steps, the environment or type of situation for certain procedure, and the constraints imposed upon the procedure by the environment. Researches of procedural flexibility development indicates flexibility as an indicator for deep procedural knowledge.

Individuals with superficial procedural knowledge can only use standard technique, which might lead to low efficiency solutions and probably inability to solve novel questions. However, more flexible solvers, with a deep procedural knowledge, can navigate their way through domain, using techniques other than ones that are over-practiced, and find the best match solutions for different conditions and goals.



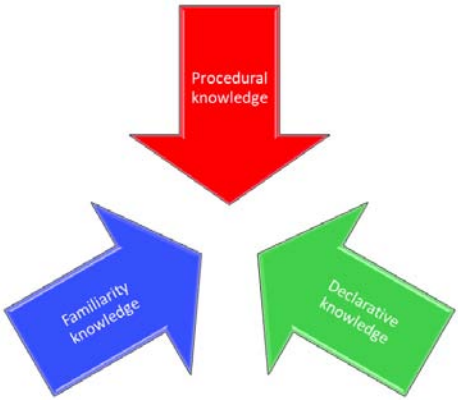
3.2 PROCEDURAL AND DECLARATIVE KNOWLEDGE

3.2.1 Modularity in the Human Brain

Traditionally, cognitive psychology has viewed the human mind as a general information-processing device. On this view, a human being is born with a set of general reasoning capacities that can be used when confronted with any problem. A growing number of researchers are supporting a view of the human brain as an organized collection of specialized modules, each with its own domain-specific knowledge and responses. This approach converges with the related field of knowledge known as evolutionary biology.

The human brain is the most complex system in the known universe. This system, however, has developed according to the principles of evolution. Investigating the origins of the brain might lead to

more comprehension of its functioning. Evolutionary biology can provide us with insights that can be used in this process of disclosure.



Complex systems emerge from simple systems through mechanisms of change and mutation. The best known, and perhaps the only, explanation for the emergence of complex functional designs in organic systems is natural selection. It follows that the brain developed according to the same principles. Therefore, the design of the brain can be expected to reflect the process of adaptation of our ancestors to their environment and the recurrent problems it brought them. There is no plausible reason to assume that the brain has evolved as a 'general-purpose problem-solver'. Additionally, evolutionary biology provides the following arguments:

- In order to discriminate successful from unsuccessful performance, an organism must apply rules for judging success. Since there are many different problems to solve (edge perception, eating), one single rule will not do. It follows that an evolved architecture needs to consist of contentspecific structures to discriminate adaptive success from failure.
- Some problems human beings encounter cannot be solved by general problem-solving strategies, such as language acquisition.

- Different kinds of problems ask for different kinds of solutions. If solutions for two different problems do not concur, one single solution for these two problems will always be inferior.
- Some problems ask for courses of action that cannot be learned by a domain-general system because they depend on statistical relationships which are not observable for individual animals, for example incest avoidance.
- A domain-general system would have to face the problem of combinatorial explosion.

These and other arguments are discussed at length by Tooby and Cosmides (1992), who argue for a rigorous functional adaptive analysis of mental modules. They suggest an approach to human behavior and mentality from four perspectives: (a) the ontogenetic and phylogenetic origins of certain behavior patterns and mental functions; (b) their physiological mechanisms (as can be discovered by, e.g., neuropsychological evidence); and (c) the adaptive functions of these behaviors and of (d) mental functions for the species at the moment of their genesis.

This organizational principle supposedly exists independently of the considered functions and therefore points to a tendency of certain faculties to evolve along the same lines.

3.2.2 Memory

In memory research, many distinctions between different kinds of memory systems have been suggested. Most central, and the most important in the current context, is the distinction between declarative and procedural memory. It is also referred to as a distinction between knowing that (propositional knowledge) and knowing how (skills necessary for operating on the environment).

Procedural Memory

Procedural memory is proposed as the system containing knowledge of how to do things. This kind of knowledge guides both physical activities like cycling or swimming, and (partially) cognitive skills like playing chess or speaking in public. Usually, many trials are needed to acquire procedural knowledge, although one-trial learning does occur. These skills are hard to express verbally, if at all; the only way to show their presence is by means of performance.

It can be argued that procedural memory is relatively autonomous in relation to declarative memory in a number of ways. In certain types of amnesia, such as anterograde amnesia or Korsakoff's syndrome, patients are no longer able to collect or recollect new (declarative) facts. However, they are able to acquire new procedural skills, although sometimes slower and more painfully than normal. This is the case even when the knowledge to be acquired contains declarative components.

Other examples of learning in amnesia patients are conditioning, word complementing and the effect of priming on word recognition. All these tasks have in common that learning takes place by performance and not by conscious recollection of the experience of the learning process; in other words, these are procedural skills. Long-term declarative memory often is not necessary for performance.

This is why playing chess can be considered an example of a partial procedural skill: one gets better while practicing, but is not able to express exactly why this is so. This phenomenon obviously has nothing to do with the declarative knowledge needed for playing chess, for surely the rules of the game do not change as one gets better.

Declarative Memory

Declarative memory is responsible for what cognitive psychologists traditionally consider to be knowledge, that is, storage of facts and events. Declarative knowledge is symbolic knowledge, sometimes subdivided in semantic and episodic memory. Declarative memory affords an individual the capacity to store associations, and to do so in a single trial. It stores information in propositions the truth or falsity of which can be verbalized instantly. The system contains knowledge that can be thought and spoken about explicitly. There are exceptions to this rule, however, as in the case of memory for faces; these are very difficult to describe verbally.

Declarative knowledge can be altered under the influence of new memories. Declarative knowledge is not conscious until it is retrieved by cues such as questions. The retrieval process is not consciously accessible either; an individual can only become aware of the products of this process. It is also a very selective process. A given cue will lead to the retrieval of only a very small amount of potentially available information. Expression of declarative knowledge requires directed attention, as opposed to the expression of skills, which is automatic.

Comparison of the Two Memory Systems

The two kinds of memory appear fundamentally different. First, there is a dissociation between them. Second, one of them (the declarative system) is verbally expressional while the other one is not. Moreover, there are reasons to believe that procedural memory is older, both phylogenetically and ontogenetically. Finally, declarative memory occupies specific regions in the brain (the medialtemporal region, parts of the diencephalic system and the hippocampus) while procedural memory does not; procedural

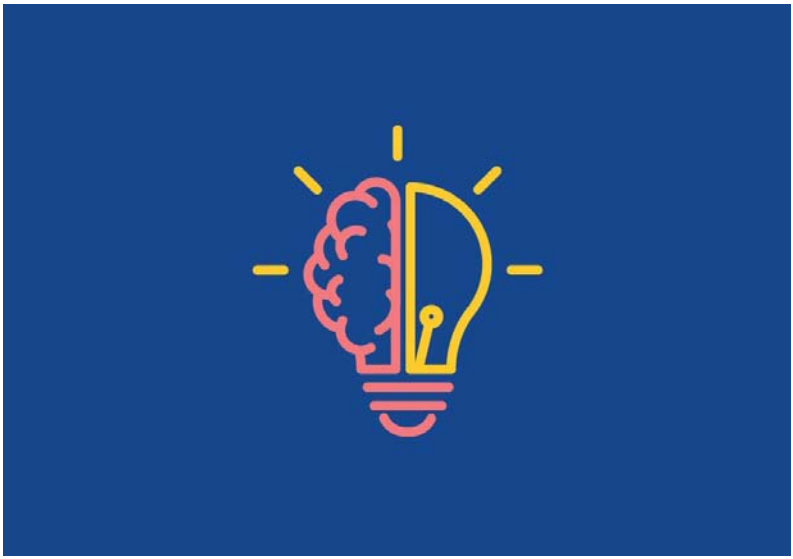
memory is more like a technique applied when necessary than a local module, and as such it is less vulnerable to lesions.

Although some evidence concerning the location of procedural memory can be found, this evidence usually is not at all convincing. Moreover, it often deals with procedural motor skills and seldom considers procedural cognitive abilities. As pointed out before, further subdividing of declarative memory is still a matter of debate. The same goes for procedural memories.

There are many different types of learning and memory tasks which are currently dubbed together as 'procedural', including classical conditioning, motor and perceptual skill acquisition by operant and incidental learning, and others. The proposed common denominator of these learning tasks is a certain acquired 'automaticity' in response; in all probability they represent the output of different types of brain systems.

3.2.3 The Visual System

Another faculty of the human brain is the visual system. The visual system itself has evolved in response to several environmental circumstances. Therefore several subsystems or modules can be expected to be part of the organization of the visual system. Current theories of vision agree on the assumption that at least two subsystems can be distinguished within the cortical part of the visual system. These subsystems are sometimes called the ventral and the dorsal stream of visual analysis. They are supposed to be concerned with, respectively, specification of 'what' is perceived in visual information and 'where' this is located. The ventral stream is assumed to be dedicated to object recognition and the dorsal stream to the perception of motion and stimulus localization. We will first discuss the basic outline of the human visual system, before turning to a more elaborate discussion of these two streams of visual analysis.



Major Connections in the Visual System

The optic nerve carries visual information from the eyes to the optic chiasm. Two neural pathways descend from the optic chiasm: the geniculostriate and the tectopulvinar pathways. In humans, the geniculostriate pathway carries about ninety percent of the visual information. It is relayed via the lateral geniculate nucleus of the thalamus and ends in the occipital lobe.

The occipital lobe is the location of the primary visual cortex, area oc or the striate cortex. In primates, information from the lateral geniculate nucleus of the thalamus enters the striate cortex at level IVc. From this layer, the information is relayed upwards and downwards to the other layers, where it is analyzed according to specific features encapsulated in that information. That is, neural circuitry within the layers combines information from several ganglion cells to detect features larger than the receptive field of a single ganglion cell. Several features like orientation, movement, spatial frequency and texture of the input are extracted in this way.

There are several kinds of cells that analyze the input. However, analysis of information in the modules of the striate cortex yields

no perception; to reach this end, the information delivered by the modules via, among others, the superior colliculi, pulvinar and the thalamus is integrated in the extrastriate region, also called the associative visual cortex. In this system, the tectopulvinar and geniculostriate pathways merge. Studies of the visual system of macaque monkeys, which in many ways is similar to the visual system of humans, have revealed that the associative visual cortex comprises at least 25 different maps, arranged hierarchically. All mapping systems are specialized in filtering particular features, like movement or color. The result of this analysis then passes on to higher regions. However, no 'supervisory map' has been found that coordinates all information yielded this way. The mutual connections between all maps act as a cohesive entirety.

The two pathways differ in the amount of input they receive from two different cytological types of retinal ganglion cells: parvo and magno ganglion cells. These cells differ from each other in anatomy, physiology and function. The parvosystem encodes features needed for object recognition, whereas the magnosystem is concerned with location and movement of objects in the visual field. The geniculostriate pathway receives input from both parvo and magno cells; the tectopulvinar pathway receives input from magno cells only. This suggests that the function of the respective pathways is recognition and localization.

The associative visual area is the starting point of two streams of visual analysis. Both streams start in the striate cortex and begin to diverge in the extrastriate cortex. They lead to regions of the brain where additional maps are found, called the tertiary visual areas. One is the ventral stream, the other is the dorsal stream.

The Ventral Stream

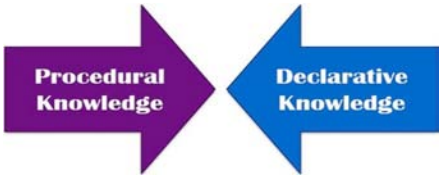
The ventral stream is located in the temporal lobe. In the inferotemporal cortex, neurons are found that are sensitive to size, shape, color, orientation and direction of movement to a fair degree of specificity. In the superior temporal cortex, neurons are

found that respond to, for example, the sight of faces, particular faces, faces moving in a particular way or only the sight of eyes looking in a particular direction.

Current theories suggest that the ventral stream of visual analysis is concerned with object recognition: 'seeing what'. Removal of both temporal lobes causes visual agnosia: vision is still possible, but identifying and categorizing objects by shape is not.

3.3 IMPORTANCE OF THE DISTINCTION BETWEEN DECLARATIVE AND PROCEDURAL KNOWLEDGE

All humans are born with adaptive forms for relevant functions. This is something endowed by nature. The distinction between declarative knowledge and procedural knowledge is so important because it is the most fundamental. Also it is so important because the forms each of the two types of knowledge representation takes are related to how that knowledge is to function.



Specifically, there are two ways of representing declarative knowledge which is static: a) basic units and b) schemas. There is one way of representing procedural knowledge which is dynamic: productions. Declarative knowledge has something to do with facts like proposition (arguments and relation), images, and sequences. Procedural knowledge has something to do with motor skills, cognitive skills and cognitive strategies. As evidence shows, the two forms of knowledge tend to be more distinct than interdependent. The distinction between the two enables us to understand much more clearly the nature of knowledge

representation, its varieties and their functions. These have their own characteristics each adapting themselves uniquely, if not exclusively, to particular relevant functions. How to make the best out of our teaching and learning is the biggest concern of our educators. For teachers working within educational and training institutes, the remarkable implications of this distinction lies in that it brings deeper insight into mental processes, mental strategies, problem-solving, instructional effectiveness, etc. It provides us with the potential to analyze the workings of the human information processing system, so as to help decide what to teach and how to teach, in an attempt to improve human learning more effectively and efficiently in a well-organized way, or to put it bluntly, to optimize the results of teaching and learning.

3.3.1 The Distinction Helps Enhance Teachers' Awareness of the Teaching Methods to Be Adopted

One important reason for varying one's teaching methods (including the motivation and background of the students) is the type of knowledge representation that is the focus of a particular segment of instruction. As is defined by them, Declarative knowledge is knowing that something is the case, namely, knowledge of facts, theories, events, and objects. And procedural knowledge is knowing how to do something which include motor skills, cognitive skills and cognitive strategies. This tells us that to acquire more effectively and efficiently a certain type of knowledge or skills in a way that fits in line with the forms for functions created by nature, we ought to become aware of what sort that type of knowledge or skills into. Namely, is it something belonging to that knowing something is the case or that knowing how to do something? In this sense, the right teaching methods to take will vary, depending on what the teacher's primary goal is, and influenced by the right identification of the type of knowledge a given to-learn-knowledge belongs to. Thus whether or not the type of knowledge for a given subject is right identified does weigh a lot. If it is correct, a right teaching method or strategy may well follow up and much effort can he saved with a better learning

result. Or else, the opposite will be bound to come along. This also accounts partly for the reason why the distinction between the two types of knowledge is so important.

When in a particularly given teaching context, should a teacher keep consciously in mind 'Is the type of knowledge to be instructed to the students something concerning facts, theories, events and objects? Or is it something regarding motor skills, cognitive skills and cognitive strategies? For example, in a language teaching situation where and when you are going to have students learn conununication skills and practice some specific language points, then one should create some situational or semi-authentic simulated contexts in which students can be so arranged in pairs or groups for discussions about something. Through interactions and with repeated errors or inadequate expressions, students may come to be able to use the language correctly and freely step by step. With this primary goal in mind, one may come to see that these skills demand procedural knowledge and decide that it is appropriate to use cognitive skills and cognitive strategies as these may turn out to be more effective and efficient for teaching this type of knowledge.

Conversely, if one wants to have students get some brief understanding of Chinese history, then, perhaps it is more proper, after twenty hours' lecturing to them, for example, to brush up consolidate what they have learned by asking them relevant questions by comparison about the time, places and big events concerning productive level of those major dynasties, etc. It is not appropriate to get them involved in a trip to a place where one of the dynasties was established to make investigations into detailed data on scientific findings as indicators of the productive level at that time (e.g. calculate, or verify some statistics in astronaut research). This demands more of declarative knowledge than procedural knowledge because it is something static that just wants students to know that something is the case instead of something dynamic which requires students to know how to do something (i.e. to experience some practical skills like problem-solving, etc.). It is not necessary, nor is it worthwhile since you do

not have enough time and energy for that and it is not your major concern, although admittedly, contact with elaborate experiences (e.g. study trips) can make declarative acquisition more efficient, i.e. it is 'easier' to learn of things when you have prior meaningful connection to them available via past experience. The effort could be saved for something else.

It is the distinction between declarative knowledge and procedural knowledge that matters greatly because it guides us in the more proper direction of teaching and learning, which is less time-consuming and more effective and efficient. The distinction also implies that it is something instructive for many curriculum decisions and instructional decisions in the domain of education. As far as recently, by some cognitive theorists, it has been admitted as a fact that education decisions in the areas of curriculum and instruction have not been coordinated well enough. Why so? Part of the reason is that, in terms of problem-solving, people do not integrate well the understanding of how different types of knowledge are acquired and how knowledge functions. It is however, distinction between the two types that makes clear the three point characterization of expertise (or knowledge possessed by domain experts), namely automatic basic skills and domain specific strategies (These two forms fall into the type of procedural know ledge) and conceptual understanding of a domain (This is declarative knowledge). This characterization ties together ideas about how knowledge functions in problem-solving with how different varieties of knowledge are learned. This is something significant as this characterization helps understand how knowledge functions and how different types of knowledge are acquired. In this sense, this distinction is so important because «if our understanding of these two areas can be coordinated, then it is likely that educational decisions in the areas of curriculum and instruction will be more coordinated and complementary as well. In other words, traditionally, these two areas of understanding relatively have been standing in isolation, or at least, not so close in association with each other, to say nothing of knitting well in integration. Now, the distinction enables us to see the great importance of the integration of the two, which will be bound

to improve the quality of educational decisions in the areas of curriculum and instruction.

In terms of facilitating students' acquisition of cognitive skills, we may take, for instance, instructional support for learning automated basic skills. We who are engaged as teachers, can do three things to make easier or faster the process of proceduralization and automaticity, or to make it more likely to occur. That is to help students automate prerequisite procedures or subskills, to help them compose small procedures into larger procedures and to help them proceduralize their skills so that they can exploit the goal-subgoal structure of the procedure without thinking about it. If this is done, hopefully, students may be enabled to make rapid progress with relatively less effort. They stressed that proceduralization is particularly desirable when the goal is an automated basic skill.

3.3.2 Bring More Positive Factors of Each of the Two Types of Knowledge into Full Play

Images

The distinction between the two reveals a tendency that in terms of acquisition of declarative knowledge, specifically, we may come to see that imagery instruction is to be greatly encouraged, as Asking students to think of images of what they are studying enhances recall. Statistics do show the advantages of this. According to an experiment conducted by Kulhavy and Swenson in 1975 with 128 fifth and sixth graders, the outcomes turned out to be that the students who received imagery instructions performed better especially on the paraphrase items and it appears that imagery instructions helped students form a more meaningful representation.

There were 128 fifth and sixth graders in the experiment who read a twenty-paragraph passage called The Island of Ako and Its People. In the passage there was a question after each, paragraph

which asked the student to use information in the paragraph just read. Those questions were either verbatim from the passage or paraphrases of passage words. Some students were asked to form mental images of the activities in the paragraph studied before answering the questions given while other students were just asked to study the passage and questions for a test. And the results go as in the Table 1.

Table 1. Effects of imagery instructions on learning

	INSTRUCTIONS			
	NO IMAGE		IMAGE	
	verbatim	paraphrase	verbatim	paraphrase
Received immediate test	11.06	10.89	12.95	14.23
No immediate test	8.94	8.04	8.01	10.93

As shown in Table 1, in the group that received immediate test, instructions for verbatim turned out to be 11.06 (without use of image) versus 12.95 (with image), and instructions for paraphrase turned out to be 10.89 (without use of image) versus 14.23 (with image) respectively; and in the group that received no immediate test, instructions for paraphrase turned out to be 8.94 versus 8.01 (without use of image), and 8.04 versus 10.93 (with use of image). The above indicators demonstrate a significant difference between the students who received instructions with use of image and the students who received instructions without use of image. As we can see, in the group that had immediate test, the percentage of instructions for verbatim with use of image (12.95) is higher than that of instructions for verbatim without image (11.06) by 1.89. The percentage of instructions for paraphrase with use of image (14.23) is much higher than that of instructions for paraphrase without use of image (10.89) by 3.24. In the group that did not have immediate test, the percentage of instructions for verbatim with use of image (8.01) is lower than that of instructions for paraphrase without image (9.94) by 0.93. But the percentage of instructions for paraphrase with use of image (10.93) is higher than that of instructions without use of image (9.04) by 2.89. This experiment shows that it appears that the imagery instructions

helped students form a more meaningful representation, especially on the paraphrase items, and to quite some extent, demonstrates that 'a picture is worth a thousand words' as someone put it. This is one of those desirable ways we can adopt to increase students' use of elaboration and organization processes so as to make things easier. It is important since it leaves students a deeper impression by helping students visualize what is to be learned so as to facilitate the learning processes.

Take interpreting for example, sometimes when a speaker speaks continuously for about one or two minutes, it really makes it very hard for an interpreter to put what has been said into another language. It does overload the brain with so much information to memorize and organize, doesn't it? And yet, a well-trained interpreter does manage to complete the tough task, rarely missing anything. The key point lies in that when transforming the language, very often, the interpreter visualizes the meaning of what the speaker says. The skilled interpreter may report that: there appears, in front of him/her, one picture after another, just like films passing by rapidly. It is the meaning, rather than the actual sentences which string up the meaning, that is the most important. By visualizing the information or message, the brain can manage, to so arrange itself that it stores the information or message much more rapidly into the working memory (WM) and processes it much faster and more effectively and efficiently by retrieving from long memory (LM) prior knowledge or sets, of organized and interlinked mental schemas for its equivalent meaning, sentence patterns, and organization of it in another language. That is to say, those well-organized and arranged pictures or images, are then transformed or represented with their right meaning in another language. Strategically, being able to distinguish between the two types of knowledge equips us with the knowledge and advantage, that use of images will facilitate effectively the storage of information in WM since it is a space-saving device. This is particularly vital for WM as WM is a 'bottleneck' in human processing system.

Why can the skilled interpreter manage to get the job done so quickly and effectively? He or she, as a matter of fact, does it with the help of images. This is more effective and efficient, which makes him/her more competent though the reason behind it concerning how the mechanisms work is yet to be known. With this message, we may be enlightened somewhat that in teaching interpreting, a teacher may preferable teach students to use images for effective memory of information.

A message from modifiability of knowledge between the two types of knowledge. The difference in terms of modifiability of knowledge between declarative knowledge and procedural knowledge also, leads us to see the importance of the distinction between the two. Basic units of declarative knowledge are learned relatively quickly and also can be modified quickly. In contrast to this, procedural knowledge can only be acquired slowly, but once automated it is very hard to modify.

The important implication of this for teachers is that when giving students knowledge of procedural type, we should be very cautious. In reality, we often come up against something, which, due to improper guidance, results in a bad habit. And we do find it hard to rid those students of it. For instance, as far as phonetics teaching is concerned, it is deemed pretty necessary to get language-learning students a qualified teacher with right pronunciation. Otherwise, the bad effect on them from a teacher with poor pronunciation could be enormously disastrous. There can be little chance for remedy.

3.4 THE ROLE OF DECLARATIVE AND PROCEDURAL KNOWLEDGE IN TEACHING FOREIGN LANGUAGE GRAMMAR

Automization is a fundamental component of skill development. A newly learned skill takes up a great deal of conscious attention, or channel capacity. The role of automization in skill learning is to free important channel capacity for the higher-level tasks which

require it. Both ways of memory storage have their advantages and disadvantages and Keith Johnson in his model tries to utilize advantages of each way, as they both may be useful in different language tasks as well as in learning under different conditions and in different environments. Declarative representation has generative character, it is economical as for memory capacity, there is low risk as for an appropriate use, but it is heavy on channel capacity as it requires conscious processes, and therefore is slow in production. Procedural knowledge, on the other hand, is faster in production, light on channel capacity, but it is not in generative form, uneconomical, and there is higher risk that the form will not be used properly and adequately in new situations and contexts.

The detailed explanation of psychological characteristics of declarative and procedural knowledge, of their distinction and relations enables different sequencing of methodological steps when teaching languages in different situations, conditions and contexts. The learning sequence that seems the most suitable to our conditions, i.e. to secondary education in Slovakia is**:**

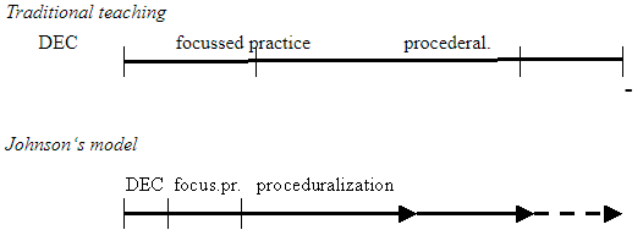
Declarative encoding – procedural encoding – tuning

Declarative encoding means that the information, i.e. an explicit grammar rule, is provided usually through instruction. The aim is for a learner to develop the initial declarative representation of the language structure, which is a starting point for proceduralization.

Procedural encoding is the movement from declarative to procedural, i.e. a change in how knowledge is represented in memory. With practice, the knowledge is converted into a procedural form in which it is directly applied. In that case required information is retrieved from long-term memory and held in working memory. That is, the database specific to the task becomes incorporated into the production. Proceduralization, i.e. changing declarative knowledge to procedural, occurs through the process of automization when learners gradually automate the use of consciously learnt grammar forms so that they can free their channel capacity and concentrate attention on more complex functions such as to convey the proper meaning, semantic relations, the choice of adequate linguistic devices, feedback from an interlocutor or social environment, etc. At the procedural stage three general learning mechanisms operate: generalization, discrimination and strengthening process. These mechanisms together constitute a process of tuning, which is needed in comprehending and conveying meanings clearly. Tuning is a very important long-lasting process that we tend not to be aware of and therefore underestimate. The result of sufficient tuning is that learners fully understand not only the form but mainly the possible meanings and functions of a given structure in various contexts and situations. Particularly obvious it is in the ability to differentiate between similar structures and to use them correctly and appropriately in diverse communicative situations, contexts and discourses. As the results of our research show, this seems to be the key problem of secondary school learners.

However, when the full proceduralization has been achieved, it is necessary to maintaining the declarative representation. There is a tendency for declarative representations to fall away when procedural knowledge is developed. It means that when learners use a structure automatically for a longer time, they tend to forget the initial declarative rule. This should be avoided, as declarative representation always remains important, particularly in some special writing tasks or when full proceduralization has not been achieved.

Comparing Johnson's model with traditional teaching (based on grammar-translation and audio-lingual methods) points to crucial differences in emphasis and the proportion of time devoted to theoretical knowledge and practice, which may be illustrated as follows:



The model also underlines different approaches to practice, providing a thorough specification of how automization takes place and how it can be facilitated so as to result in full proceduralization. The full understanding of the above described characteristics and processes enable educators to sequence the

teaching/learning stages according to their learners´ characteristics, current conditions or different contexts. The described sequence of learning stages is recommended for teaching FL in secondary education and to adult learners. For younger learners different sequence should be adopted, based more on the initial procedural stage. This is due to developmental differences, in particular the level of cognitive development, which is fundamental for the comprehension of abstract linguistic knowledge.

Theoretically speaking, Johnson's conception reformulates the aims of communicative methodology as a shift from "message focus" to "form defocus", which explicitly defines the place of declarative grammar knowledge in communicative teaching. In addition, it justifies and underlines the importance of meaningful practice for the development of communicative competence. The analysis of automization of language forms emphasizes its central place and points to an urgent need to focus much more on appropriate teaching and learning activities. Another important advantage of implementing Johnson's theory to FL teaching in Slovakia is, that it respects our educational traditions which have lead to a relatively high level of metalinguistic awareness as a consequence of the ways of teaching the Slovak language in our schools.

As for declarative knowledge, teachers may use any methods and techniques to present information and assist learners

to consciously create a comprehensible inner representation of a FL grammar system, which is a starting point for proceduralization. In so doing they should bear in mind some basic rules:

- Teachers should not overestimate the importance of theoretical knowledge as it tends to create communication barriers;
- Fundamental is the choice and sequencing of theoretical knowledge, which is normally given in a textbook. However, a teacher should be flexible and adapt the content to learners;
- Learners should learn rules relevant for their communicative needs, otherwise they cannot practice them meaningfully and effectively;
- Learners should not be overloaded at a given time, to avoid creating chaos in their system of grammar knowledge.
- New rules must be connected with the learner's existing system so that permanent restructuring may occur.

As for automization, the crucial is for a teacher to facilitate it and to assist learners so that they can achieve full proceduralization. In so doing it is important to bear in mind that automization is a long-lasting process, which needs time and teacher´s conscious control. It is also a gradual process beginning with the automization of lower subskills that are components of higher-level skills. During this process learnt knowledge needs time for maturation, which must be respected also in the treatment of errors. It is obvious that in any learning activity more structures are automatized at a time. Their different stages of automization should be carefully monitored and systematically coordinated by the teacher, which seems to be the most difficult task.

It is obvious that automization may be facilitated mainly through repetition and "never-ending" practice. There is an urgent need in Slovakia to adopt appropriate teaching and learning activities that facilitate the automization of language forms much more than we have been doing so far. When organizing teaching activities and selecting appropriate techniques, teachers should be aware of

some fundamental principles derived from psychology of learning that underlie the effective practice with long-lasting effect:

- It is better to thoroughly practice less than superficially more.
- It is better to develop in learners self-confident communication at a lower level than to overload them with too many rules, which may create communicative barriers, inhibitions, demotivation and frustration with their ability to use all the rules correctly and fluently.
- Newly practiced knowledge must be permanently connected with the existing system of knowledge. As a result of the cyclical practice of learnt structures, learners will comprehend differences in the usage, meaning, and function of similar structures and gradually use them correctly and fluently in communication.
- For the automization of lower subskills various drills, decontextualized and focussed activities may be effectively used. Learners, however, should not spend too much time on these activities.
- A short period of focussed activities should be followed by extensive practice in communicative and productive activities.
- Real and meaningful communication tasks must be perceived by students as an opportunity to communicate and express themselves, not as an opportunity to practice and revise grammar forms.
- Practice must also be based on the principles of task-based learning in which the tasks are sequenced according to their level of difficulty. A teacher can control the gradation of task difficulty in many ways.
- To make automization more effective, it is vital to promote much more student-centred teaching, an approach that teachers claim to favour though its application is disproved by the research findings as well as by everyday experience.

3.5 PROCEDURAL AND DECLARATIVE KNOWLEDGE REPRESENTATION AND REASONING

3.5.1 Artificial Intelligence (AI)

Artificial Intelligence (AI) is a rapidly advancing technology, made possible by numerous researches that may have significant impacts on our everyday lives in the field of computer science and computer engineering. AI traditionally refers to an artificial creation of human-like intelligence that can learn, reason, plan, perceive, or process natural language. One remarkable aspect of intelligent behavior is that it is clearly conditioned by the ability to learn and perform a very wide range of activities. We make decisions about what to do based on what we know (or believe) about the world, effortlessly and unconsciously. noted that "the term intelligence refers to the ability to acquire and apply different skills and knowledge to solve a given problem. In addition, intelligence is also concerned with the use of general mental capability to solve, reason, and learning various situations". Intelligence consists of both human intelligence and artificial intelligence.

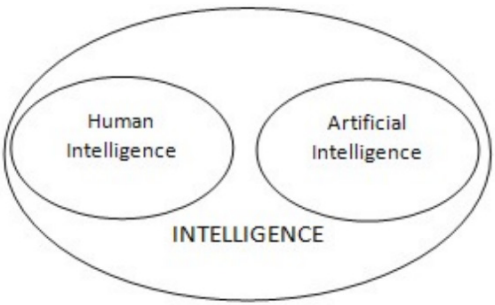


Figure 1. Categories of Intelligence.

Human intelligence concerns itself with problem solving, learning and reasoning while artificial intelligence is all about replicating the human intelligence to solve problems, logic, thinking and reasoning. It's so normal to use what we learn in this way that we

only pay attention to it when it's not there. If we say someone has behaved, like when someone uses a lit match to see if there is any fuel in the gas tank of a vehicle, what we usually mean is not that there is something the person has not understood, but that the person has not been able to use what they have known. We might say: "You weren't thinking!" Indeed, it is that is supposed to bring what is relevant in what we know to bear on what we are trying to do.

One definition of Artificial Intelligence (AI) is that it is the study of intelligent behavior achieved through computational means (…). But how machines do all these things comes under knowledge representation and reasoning. Hence we can describe Knowledge representation as following:

- Representation of information and reasoning (KR, KRR) is the aspect of Artificial Intelligence that involves AI agents learning and how thought leads to agents ' intelligent behavior.
- It is responsible for representing real-world data so that a computer can understand and use this knowledge to solve complex real-world problems such as medical diagnosis or natural language interaction with people.
- It's also a way to describe how artificial intelligence information can be portrayed. Knowledge storage not only stores information in some database, but it also helps a smart machine to benefit from that knowledge and experiences so that it can act smartly as a human being.

Knowledge

Knowledge is the information about a domain that can be used to solve problems in that domain. To solve many problems requires much knowledge, and this knowledge must be represented in the computer. As part of designing a program to solve problems, we must define how the knowledge will be represented. In artificial intelligence, knowledge representation is the study of how the

beliefs, intentions, and value judgments of an intelligent agent can be expressed in a transparent, symbolic notation suitable for automated reasoning. It is the understanding or knowledge with reality, information and circumstances experiences. Following are the types of knowledge in artificial intelligence:

Knowledge representation and reasoning Is an artificial intelligence (AI) discipline dedicated to portraying world information in a way that a computer system can use to solve complex tasks such as diagnosing a medical condition or holding a natural language conversation. Information representation integrates empirical research on how people solve problems and interpret knowledge in order to design formalisms that promote the design and construction of complex systems. Representation of knowledge and reasoning also combines logic results to simplify different types of reasoning, such as the application of rules or sets and subsets relations.

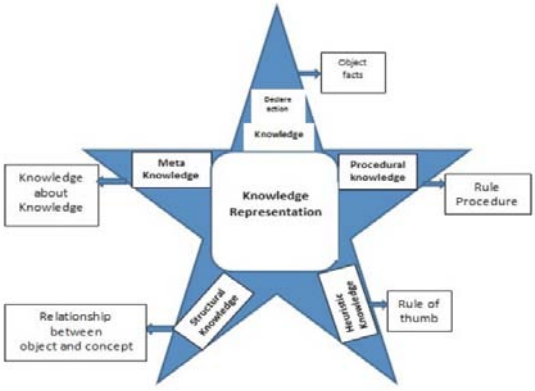


Figure 2. Types of Knowledge Representation and Reasoning.

Robotic technology is now on the rise as it is applicable to many areas such as automobile, medicine, industries, schools, hospitals etc. observed that "AI is an efficient means to make artificial thinking machines and machine control with expert systems which greatly explain users ' intelligent behavior, training, and successful advice. In general, AI is basically known as the ability or potential of robotics to decide, solve problems and reason".

Reasoning

Reasoning is the mental process of deriving logical conclusion from available knowledge, evidence, and beliefs and making predictions. Or we can conclude, "Reasoning is a means of infering information from existing data." It is called reasoning to manipulate symbols to generate results. One way that AI representations differ in traditional languages from computer programs is that an AI representation typically specifies what needs to be calculated, not how to calculate it. We may specify that the agent should find a patient's most likely disease, or specify that a robot should get coffee, but not give detailed instructions on how to do this (Much of AI reasoning involves searching the space of possibilities to determine how a task is to be completed. The reasoning is important in artificial intelligence so that the robot can still think rationally like a human brain and behave like a human being.

Turing Test

To check for artificial intelligence in a system, Alan Turing developed and proposed a game called Turing Test. Joost, et al 2019 further clarified that "it's played with three men, a man (A), a woman (B), and a questioner (C) who can be of either gender. The interrogator, apart from the other two, remains in a house. The object of the interrogator's game is to decide which of the other two is the man and the female. He identifies them by X and Y tags and says either "X is A and Y is B" or "X is B and Y is A" at the end of the game.

3.5.2 Difference between Procedural and Declarative Knowledge Representation

Key Differences between Procedural and Declarative Knowledge Representation and Reasoning

- It is known as procedural awareness when conscious thinking and conscious preparation are involved in learning. On the contrary, he is not aware of declarative information.
- Declarative knowledge is verbalized, shared, copied, processed and easily stored while it is difficult to express procedural knowledge.
- Declarative knowledge is more commonly used among procedural and declarative knowledge.
- Procedural knowledge is acquired through experience, action and subjective insight. Declarative knowledge, on the other hand, is derived from objects, systems, processes and principles.
- Procedural knowledge is in essence process-oriented, whereas data-oriented declarative knowledge.

Table 1: showing the difference between procedural and declarative knowledge representation. Adapted from ()

Procedural knowledge Representation and Reasoning	Declarative knowledge Representation and Reasoning
➢ High efficiency ➢ Low modifiability ➢ Low cognitive adequacy (better for knowledge engineers ➢ Procedural Knowledge i.e means to incorporate on AI systems through procedures like LISP and PROLOG languages ➢ Object facts	➢ Higher level of abstraction ➢ Suitable for indipendent facts ➢ Good cognitive matching (better for domain experts and end-users) ➢ Declarative Knowledge means to incorporate on AI systems through Declarative mechanisms like Semantic Nets, CD Diagrams, Frames and Scripts. ➢ Rule Procedure

The first difference between them is that only the knowledge is specified by the declarative representation, but not the mechanism to implement the knowledge. On the contrary, together with the experience, the procedural representation provides the control information. The concept of "relationship" is a fundamental concept for organizing such structures.

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CHAPTER 4

PREDICT ACADEMIC PERFORMANCE

INTRODUCTION

Educational quality is compulsory in the development of each country. The data amount in education domain is getting increase day by day with the help of admission system, academic information system, learning management system, e-learning etc. The data collected from students are usually used for making simple quires for decision making. But most of the data remain unused due to complexity and large volume data sets. Therefore, to analyze this huge amount of educational data is the great interest to predict student performance. Data mining is the practice of find out useful information from huge sets of data, also known as knowledge discovery in databases (KDD). It has been applied successfully in multiple domains including banking, medical, business and now has been used for educational purposes called Educational Data Mining.

The prediction of student performance is a crucial task which is being researched by using EDM. This task foresees the value of an unidentified variable which describes the students regarding outcome (Pass/Fail), grades, marks etc. Predicting student Attrition, failures, success are the main areas which are discussed in the literature review of this study. Each stakeholder belongs to this domain wants an early warning system to predict learning on early stages. This early warning system not only reduced the learning costs but also time and space requirements.

One of the biggest challenges is to improve the quality of the educational processes so as to enhance student's performance. Instructors can update their teaching methodology to fulfill the requirement of poor performance students and can provide additional guidance to deserving students. The prediction results might help students develop a good understanding of how well or bad they would perform in a course and then can take steps accordingly. Increasing the student retention is a long-term target of any educational institutions around the globe. There are many positive impacts of increased retention such as increased college reputation, ranking and better job opportunities for alumni etc.

To analyze data using classification technique, well known classification algorithms such as Decision tree (DT), Artificial neural networks (ANN), K-neatest neighbor (KNN) and Rule Induction (RI) are being used for prediction purposes. Quality of a predictive classification model is measured by its ability to find out the unknown patterns accurately. This study employed three classification algorithms J48 from DT, NNge from IR and MLP from ANN for experimental purposes. The major objective of the proposed methodology is to build the ensemble classification model that classifies a students' performance as Pass or Fail.

4.1 ACADEMIC PERFORMANCE

Academic performance is the measurement of student achievement across various academic subjects. Teachers and education officials

typically measure achievement using classroom performance, graduation rates and results from standardized tests.

The origins of measuring academic performance in the United States date back to the 1830s. Education advocates Horace Mann and Samuel Gridley Howe used a standardized test to evaluate student progress in Boston. Kansas school administrator Frederick J. Kelly advanced the idea of standardized testing with the Kansas Silent Reading Test in 1914. This multiple-choice test was used to decrease grading time and standardize student evaluations. IBM employee Reynold B. Johnson developed a grading machine in 1934 that could grade test sheets by picking up the electrical current created by pencil marks. Henry Chauncey developed the Scholastic Assessment Test (SAT) in 1934 to evaluate scholarship candidates at Harvard University and University of Iowa Professor E.F. Lindquist created the first version of the American College Test (ACT) in 1959.

The Elementary and Secondary Education Act (ESEA) of 1965 encouraged adoption of standardized testing by all states. This legislation required states to measure student proficiency and develop accountability measures for public schools. The No Child Left Behind Act of 2001 continued the ESEA's focus on accountability by requiring states to ensure minimum proficiency levels in order to receive federal funds.

4.1.1 Method of Measurement

Student performance is measured using grade point average (GPA), high school graduation rate, annual standardized tests and college entrance exams. A student's GPA is typically measured on a scale of zero to four with higher GPAs representing higher grades in the classroom. Graduation rates are collected by state and federal education officials as a baseline measurement of secondary education performance. Each state conducts annual tests at the elementary, middle and high school levels to determine student proficiency in subjects like English and mathematics. These tests are also used to comply with federal education standards. School

districts also track student performance on the ACT and SAT to determine readiness for higher education.

4.1.2 Issues

Achievement gap

The measurement of academic performance reveals achievement gaps in public schools based on race, gender and economic circumstances. The National Center for Education Statistics found that black and Hispanic students fell behind white students by the equivalent of two grade levels on the National Assessment of Educational Progress (NAEP) assessment between 2009 and 2011. A study by MIT economists David Autor and Melanie Wasserman found that female high school students born in 1975 had a 91 percent graduation rate, while male high school students born in the same year had an 88 percent graduation rate. The U.S. Department of Education issued a report in 2011 that found 68 percent of high school seniors in high-poverty schools graduated in 2008 compared to 91 percent of seniors in low-poverty schools

Differences in state testing

Each state develops a unique K-12 testing process intended to determine student proficiency prior to graduation. State control over standardized testing has led to divergence in academic rigor and proficiency requirements in recent years. The National Center for Education Statistics (NCES) found that about 20 percent of states changed annual assessment standards between 2007 and 2009. The NCES determined that 21 of 34 instances where standards were changed led to more rigorous evaluations than previous years. These changes increase the difficulty of assessing changes in academic performance from previous years and comparing state proficiency levels.

4.2 ACADEMIC PERFORMANCE OF UNIVERSITY STUDENTS

Student's academic performance and graduation rates have been the area of interest for higher education institutions. Investigation of factors related to the academic performance of university students become a topic of growing interest in higher educational circle. Many recent studies were carried out to explore factors that affecting university student's academic performance. That Student performance is affected by different factors such as learning abilities, gender and race. That family income level, attending full time, receiving grant aid and completing advanced level classes in high school having statistically significant effects on college persistence among first generation college students. Carried out a study with freshmen college students to evaluate the efficiency of student learning style and other university admission variable in predicting student academic performance and retention. Act composite score, high school class rank, high school core GPA, and learning style were used as predictors. Results showed that core GPA and Act score were best predictors for predicting academic performance of first year of college. A prospective study to explore the psychosocial, cognitive, and demographic predictors of academic performance of first year Australian university students. Results demonstrate that previous academic performance was identified most significant predictors of university performance. Integration into university, self efficacy, and employment responsibilities were also predictors of university performance. A study to find out the factors which affecting college students' performance. In this study researcher mainly focus to explore the factors that associated with performance of students in intermediate examination. This study conclude that attitude towards attendance in classes, time allocation for studies, parents level of income, mother's age and mother's education were main factors that affect performance of students of private colleges.

There are numerous factors which affect the academic performance and retention of students in higher education institutions. We

discuss those important factors which we used in this study. The justification of the factors with existing literature is given below.

4.2.1 Home Environment

Reviewed literature indicated that there is an awareness of the importance of the home environment or family on pupil's/students academic performance. The home has a great influence on the students' psychological, emotional, social and economic state. The state of the home affects the individual since the parents are the first socializing agents in an individual's life. This is because the family background and context of a child affect his reaction to life situations and his level of performance.

Parent's constant disagreement affects children emotionally and this could lead to poor academic performance. Parenting style (nature and control) and parental involvement significantly predicted academic outcomes. In Saudi Arabia, the family financial support, encouragement and following up have positive impact on students' performance as measured by their GPA.

4.2.2 Study Habits

Study habits of students may be relevant to the prediction of grades because it is possible that student's grades may be related to their study habits. That is, students with poor study habits may obtain lower grades than those students with better study habits. The importance of the relationship between grades, instructor ratings and study habits has not been determined.

Study skills and learning approaches include, for example, time management, using information resources, taking class notes, communicating with teachers, preparing for and taking examination, and several other learning strategies. The research shows a significant correlation between such learning behavior and approaches and academic achievement in higher education. Students who create their own study aids are spending time

making them, whereas those who use others' study aids or not. It may also be that the process of creating study aids helps the learner gain more meaningful knowledge through the process of synthesizing disparate pieces of information into new knowledge, as has been shown with note taking. We wondered if students who used study aids made by others rather than making their own might be missing out on the benefits of time-on-task and concept mapping.

A survey of study habits for use with high school and college students. Their study skills index measured three factors for both homework and test situations. Distractibility items assess the degree to which students report being unable to maintain their attention or concentrate on their task. Inquisitiveness items measure how well students try to make sense of the material they are studying- do they look for essential concepts or deeper meaning? Compulsiveness items assess the degree to which students attend to details and try to remember facts.

4.2.3 Learning Skills

Recent research has considered student behavior and learning to be important factors in student's academic success and retention. If we aim to increase student's academic success in higher education institutions, we must focus on interventions directed towards learning strategies, a fact which suggests the need to develop programs of this kind. The influence of learning strategies on academic achievement, on the other hand, has been much less widely investigated, in spite of its theoretical importance and prevalence in international reports. Demonstrated that increased time spent on learning activities yields increased learning, provided that the teacher was competent and that the learning activities were effectively designed and implemented. Another theory that guided us was concept mapping. Concept mapping is a method in which the learner links new knowledge to a framework of relevant concepts that the learner already knows. This linking of new with existing knowledge was a key factor in successful learning and

that it was the difference between meaningful learning and rote learning.

4.2.4 Academic Interaction

Research on college students suggests that activities like advising could increase students' involvement in their college experiences. Colleges and universities could use strategic planning to design advising programs based on relationships of shared responsibility and focused on students' success. Research on positive outcomes of college and on the diverse needs of students making up today's student population suggests that a new look at advising is needed. Findings link academic advising directly and indirectly to contact between faculty and students and persistence in college. For example, involvement influences learning and defines effective institutions as those having the capacity to involve students. Research also indicates that frequent and meaningful contact with faculty members, especially contact focusing on intellectual or career-related issues, seems to increase students' involvement and motivation. These results can be important to advisers, for they have the capacity to increase meaningful contact with students and to encourage them to persist in college. When a broad base of the college community plans for, implements, and evaluates advising services, advising can become a systematic enterprise of the institution that enhances the educational outcomes of college. Another very important factor in establishing high retention rates at a college is the degree to which students establish close and supportive personal and professional relationships with faculty and other significant people on campus.

4.2.5 Material and Methods of Academic Performance

Population

Population of study consisted of all students of social sciences and now studying in 4th semester and who enrolled in 2007. Size of target population in this study is 708 students.

Sample Selection

The students of social sciences (Statistics, Sociology, CSIT, Business Administration, English) are not homogeneous with respect to academic performance across disciplines and programs (BS and MA/Msc). We have used stratified random sampling with proportional allocation method to select a sample.

We Calculated the Sample size using as:

$$n = \frac{N}{1 + Ne^2}$$

where n and N are sample and population size respectively and 'e' is margin of error. Let the e = 0.04 and N = 708 then our required sample size is 300.

Research Instrument

Questionnaire is used for data collection. First part of the questionnaire is designed to obtain information on the demographic characteristics of university students, like gender, age, region, family system, profession of father of respondent. Next part designed to obtain information on some quantitative variables related to student performance. Then there are 39 items that consist of a combination of two categories nominal items, and 37 items using a 5-point Likert-Scale. Items are designed to assess six dimensions associated with student academic performance. (Previous Achievements, Home Environment, Study Habits, Learning Skills, Hardworking, Academic Interaction).

Data Analysis Techniques

Confirmatory Factor Analysis

CFA is used to provide a confirmatory test of our measurement theory. A measurement theory specifies how measured variables logically and systematically represent constructs involved in a theoretical model. In confirmatory factor analysis (CFA), theory

is a systematic set of casual relationships that provide the comprehensive explanation of a phenomenon. In confirmatory factor analysis (CFA), model is a specified set of dependant relationships that can be used to test the theory. In confirmatory factor analysis (CFA), is used to test structural equations. The path diagram shows the graphical representation of cause and effect relationships of the theory. In confirmatory factor analysis (CFA), endogenous variables are the resulting variables that are a causal relationship and exogenous variables are the predictor variables.

In confirmatory factor analysis (CFA), identification is used to test whether or not there are a sufficient number of equations to solve the unknown coefficient. In confirmatory factor analysis (CFA) identifications are of three types: (1) under identified, (2) exact identified, and (3) over-identified. In confirmatory factor analysis (CFA), goodness of fit is the degree to which the observed input matrix is predicted by the estimated model.

Structural Equation Modeling

Structural equation modeling (SEM) is a relatively new analytical tool, but its roots extend back to the first half of the twentieth century. During the late 1960s and early 1970s, the work of Joreskog and Sorbom led to simultaneous maximum likelihood estimation of the relationship between constructs and measured indicator variables as well as among latent constructs.

Structural equation modeling (SEM) is a family of statistical models that seek to explain the relationship among multiple variables. In doing so, it examines the structure of interrelationships expressed in a series of equations, similar to a series of multiple regression equations. These equations depict all of the relationships among constructs (the dependent and independent variables) involved in the analysis. Constructs are unobservable or latent factors represented by a multiple variables (much like variables representing a factor in factor analysis). SEM can be thought of as a unique combination of both types of techniques (interdependence, dependence) because SEM's foundation lies in two familiar

multivariate techniques: factor analysis and multiple regression analysis. SEM is the only multivariate technique that allows the simultaneous estimation of multiple equations.

With large sample sizes, the χ^2 test statistic is known to always reject in any formal test of significance. More focused on the Root Mean Square Error of Approximation (RMSEA), the Goodness-of-Fit Index (GFI), the NonNormed Fit Index, the Comparative Fit Index (CFI) and the Relative Fit Index, and the normed version of the χ^2 test statistic: χ^2 /d.f . For the last index, no clear-cut guidelines exist; values in the range of 2.0 to 5.0 are acceptable, with lower values indicating better fit. For RMSEA, values ≤ 0.05 indicate good fit, values ≤ 0.08 indicate reasonable fit. The indices GFI, NNFI, CFI, and RFI, all normally lie in the range 0.0 – 1.0, with higher values indicating better fit. As a benchmark for good fit, the value 0.90 is often used.

4.2.6 Discussion for Academic Performance of University Students

Descriptive Statistics

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summary statistics about different variables. Descriptive statistics of all the variables are given in table 1 to table 3. Table 1 contains the summary statistics (minimum, maximum, mean and SD) of all quantitative variables. It shows that the average age of students is 20.93 with 1.538 SD. Average father income is Rs. 31738/- with 23411.566 SD, indicating that there is a lot of variation in father income of students it is so because the university and more the parents of students are working abroad and also gujrat is an industrial area. Mean CGPA after two semesters is 2.88 with SD 0.49. Average study time of the students is 145 minutes with 80.068 S.D.

Table 1: Descriptive Statistics of Quantitative Variables

Variables	Minimum	Maximum	Mean	Std.Deviation
Age in years	18	28	20.93	1.538
Father income	3000	200000	31738	23411.566
CGPA at the end of second semester	1.58	3.89	2.8842	0.49566
Study time in minutes	0	360	144.88	80.068

Table-2 contains the percentages of nominal scale variables. Results show that percentage of female respondents (68.7%) is high as compared to male respondents (31.3%). On the basis of these results we can say mostly respondent win educational prizes but scholarship is not offered to them. 19.7% students leave the university before receiving a degree because they accept a good job. 9.7% leave because of financial problems, 17% leave because they get married, 11% leave due to lack of interest, 8.7% leave because lack of academic ability. 34% leave due to some other reasons.

Table 2: Percentages of Nominal Scale Variables

Gender		**Discipline**	
Male	Female	Business Administration	31.3%
31.3%	68.7%	English	11.3%
Program		Statistics	12.7%
BS	MS	CSIT	29.7%
57.3%	42.7%	Sociology	8.3%
Region		Psychology	6.7%
Rural	Urban	**Reasons to leave university**	
44.7%	55.3%	To accept a good job	19.7%
Educational Prize		It would cost more than my family could afford	9.7%
Yes	No		
71.7%	27.3%	Marriage	17%
Scholarship Offers		Lack of interest	11%
Yes	No	Lack of academic ability	8.7%
33%	67%	Other	34%
Father Profession			
Business man	33.3%	Doctor	2.3%
Government employ	10.3%	Late	3.0%
Engineer	5.0%	Others	35.7%
Lawyer	3.7%		

Table 3: Percentages, Mean and Standard Deviation of all Ordinal Scale Variables

Factor/Variables	SA%	A%	N%	D%	S.D%	Mean	S.D
Previous Achievements							
Influence of previous degree marks	24.7	43.3	17	9.3	5.7	3.72	1.10
Reflection of abilities	19	46.7	17.3	11.3	5.7	3.62	1.09
Home Environment							
Support by home environment	50.7	38	6.7	3.7	1.0	4.34	.83
Facilities provided by family	61.7	31.3	5.0	1.0	1.0	4.52	.72
Encouragement by family	62.7	27.7	7.0	2.0	0.7	4.50	.76
Study Habits							
Time management for getting a good grade	31.7	45.3	14.3	6.7	2.0	3.98	.95
Schedule Proper time for study	12	40.3	26.7	16.7	4.3	3.53	2.5
Avoid interference in planned schedule of study	13.7	30.3	29	20	6.7	3.24	1.12
Fully concentrated during study	18.3	52	16.3	11.3	2.0	3.73	.95
Proper revision of notes	13	39.3	21	21.7	5.0	3.34	1.10
Learning Skills							
Critical attitude towards new concepts	15	51.3	24	8.7	1.0	3.71	.86
Presentation skills	17.3	46.7	26	8.7	1.3	3.70	.90
Influence of presentation skills on academic performance	25.3	49.7	17.3	6.7	1.0	3.96	.84
Reading of material on course content	15.7	37	24.3	18.7	4.3	3.48	1.52
Express concept through Writing	27	48.7	17.7	4.3	2.0	3.95	.89
Confidence as UOG student	23.3	43.3	20.7	10	2.3	3.76	.99
Hardworking							
Focus on work during study	20.3	51	17.7	9.3	1.7	3.79	.92
Class participation	22	36.3	24	15.7	2.0	3.61	1.05
Competing environment	20.3	51	20.7	6.7	1.3	3.82	.87
Initiatives in academic activities	9.3	46	32	10.7	2.0	3.50	.87
Academically up-to-date yourself	15.7	43.7	20.7	15.7	4.3	3.51	1.06
Academic Interaction							
Influence of Interpersonal relationship on academic growth	24.3	48	19	8.3	0.3	3.88	.88
Role of Peer group support on academic growth	26	49.3	15	8.7	1.0	3.91	.91
Effect of academic interaction with Students	19	52.7	20.7	6.7	1.0	3.82	.85
Opportunities to meet faculty members	19.3	46.3	19.7	11.7	3.0	3.67	1.01
Interaction with teachers outside the classroom	32.3	41.3	15	7.3	4.0	3.91	1.05
Academic Performance							
Satisfaction with academic performance	13	44.3	16.7	21.3	4.7	3.40	1.10
Performance according to academic abilities	10.7	50	17.7	17.3	4.3	3.45	1.03
Satisfaction with academic experience	11.3	49	24.7	12.3	2.7	3.54	.94
Growth of academic performance	18	5	16.7	12	1.3	3.73	.93
Importance of grades	42	43.7	8.3	4.3	1.7	4.20	.88
Confidence after joining that university	33.7	47.3	11	5.3	2.7	4.04	.94
Ability to convey knowledge	18.7	53.3	19	7.0	2.0	3.80	.89
Faith on own perception	13.7	54.3	22	9.3	0.7	3.71	.84
Critical discussion	18.7	47	23.7	9.3	1.3	3.72	.91

Table-3 depicts the percentages of ordinal scale variables. Table-3 shows that average rank of respondents on the statement that previous degree marks greatly influence your current academic abilities is 3.72, which is close to 4, it means on the average

respondents are agree with that statement. Average rank of the respondents on the statement that previous degree marks really reflect what you can do is 3.62, it means on the average respondents are agree on the above statement. Average rank of respondent on the statement that your home environment supports you to enhance your academic abilities is 4.34, it means on the average respondents are agree with that statement. Average rank of the respondents on the statement that your family provides you facilities which are required for attaining your educational goals is 4.52, it means on the average respondents are Strongly agree with that statement. Average rank of respondents on the statement that your family encourages you on your academic achievement is 4.50, it means on the average respondents are strongly agree with that statement. In the light of above results about the home environment factor that home environment supports the students to enhance their academic performance. Average rank of respondents on the statement that for getting a good grade to organize your time and to set aside time each day for studying is important is 3.98, it means on the average respondents are agree with that statement. Average rank of respondents on the statement that you schedule definite study times and outline specific goals for your study time is 3.53, it means respondents are agree with that statement. Average rank of respondents on the statement that you avoid activities which tend to interfere with your planned schedule of study is 3.24, it means on the average respondents are neutral with that statement. Average rank of respondents on the statement that I am confident with the level of concentration, I am able to maintain in study is 3.73, it means on the average respondents are agree with that statement. Average rank of the respondents on the statement that you take notes in class, refine and study them soon after class, and review them frequently is 3.34, it means on the average respondents are neutral on the above statement. Table-3 also contains the percentages and average rank of other variables; which can be interpreted in similar manner.

Confirmatory Factor Analysis

Confirmatory factor analysis is a special type of factor analysis and is the first part of a complete set of a structural equation model. We confirm all the factors which we considered such as Study Habits, Learning Skill, Academic Interaction, Academic Performance and Home Environment by using confirmatory factor analysis.

Table 4: Model Estimates of Confirmatory Factor Analysis of Different Factors

Variables	Parameter Estimate	Standard Error	T Statistic	Prob. Level
Study Habits				
Time management for getting a good grade	0.454	0.066	6.839	0.000
Schedule Proper time for study	1.105	0.179	6.184	0.000
Avoid interference in planned schedule of study	0.711	0.080	8.927	0.000
Fully concentrated during study	0.421	0.067	6.316	0.000
Proper revision of notes	0.607	0.077	7.867	0.000
Learning Skills				
Critical attitude towards new concepts	0.309	0.061	5.049	0.000
Presentation skills	0.531	0.066	8.072	0.000
Influence of presentation skills on academic performance	0.560	0.063	8.868	0.000
Reading of material on course content	0.441	0.109	4.039	0.000
Express concept through Writing	0.286	0.063	4.564	0.000
Confidence as UOG student	0.358	0.071	5.051	0.000
Hardworking				
Focus on work during study	0.409	0.064	6.424	0.000
Class participation	0.580	0.072	8.036	0.000
Competing environment	0.579	0.061	9.520	0.000
Initiatives in academic activities	0.454	0.060	7.561	0.000
Academically up-to-date yourself	0.430	0.074	5.847	0.000
Academic Interaction				
Influence of Interpersonal relationship on academic growth	0.395	0.057	6.928	0.000

Effect of academic interaction with Students	0.526	0.053	9.863	0.000
Opportunities to meet faculty members	0.755	0.064	11.795	0.000
Interaction with teachers outside the classroom	0.675	0.066	10.159	0.000
Academic Performance				
Performed Academically	0.392	0.072	5.443	0.000
Confidence After Joining that University	0.518	0.065	7.918	0.000
Ability to Convey through Knowledge	0.538	0.062	8.703	0.000
Faith on own Concepts	0.426	0.058	7.342	0.000
Critical Discussion on Concept	0.497	0.063	7.864	0.000
Home Environment				
Support by Home	0.554	0.053	10.550	0.000
Facilities by Family	0.530	0.047	11.391	0.000
Encouragement by Family	0.524	0.049	10.792	0.000

Table-4 shows the model estimates of confirmatory factor analysis of all the factors. Goodness of fit measures for all the factors is given in table-5. Table-4 contains the model estimates of confirmatory factor analysis of Study Habits. p-values of all the items are significant so we reject the null hypothesis that all items are not confirm for that factor. So we conclude that all items of that factor are confirmed for that factor. Individual parameter estimates exhibited that proper study time has a parameter estimate value of 1.105, which is high as compared to other variables in the factor; it means that variable is most important for the factor. In other words giving proper time to studies is an essential variable for the development of student's study habits. Concentration level has a parameter estimate value of .421, which is low as compared to other variables in the factor; it means that variable is less important for the factor. Goodness of Fit measures is used to assess the model fitness. Almost all goodness of fit measures meets the recommendation level for this factor. So, goodness of fit measures supports our estimated model.

Table-4 also contains the model estimates of other factors; which can be interpreted in similar manner. After Confirmatory Factor Analysis our next step is to fit the structure equation model on those factors (including items) that are confirmed by Confirmatory Factor Analysis.

Table 5: Measure of Goodness of Fit of CFA Model of Different Factors

Factors	χ^2	d.f	p-value	χ^2 /d.f	GFI	AGFI	RMSEA
Study Habits	9.50602	5	0.09	1.90	.98	.96	0.05
Learning Skills	17.1534	9	0.04	1.90	.98	.95	0.05
Hardworking	12.9228	5	0.02	2.58	.98	.94	0.07
Academic Interaction	2.93344	2	0.23	1.46	.99	.97	0.03
Academic Performance	35.204	5	0.00	7.04	.95	.86	.14
Recommended				≤ 3	≥ .90	≥ .90	≤ 0.08

4.2.7 Structure Equation Modeling

We use Structure Equation Modeling to develop the academic performance model of students of social sciences at University of Gujrat. We use Home environment, Study Habits, Learning Skills, Hardworking, Academic Interaction, and Academic Performance as a constructs.

A structure model involves specifying Structural relationships between latent constructs. Table-6 contains the Parameter estimates of Structure equation model. p-values of all the parameters are significant so we reject the null hypothesis that the coefficients are zero. So we conclude that all relations are significant and positive.

Table 6: Model Estimates of Structure Equation Model

Structural Relationships	Parameter Estimate	Standard Error	T Statistic	Prob. Level
Home Environment-->Learning Skills	0.447	0.142	3.141	0.002
Home Environment-->Academic Interaction	0.315	0.101	3.126	0.002
Study Habits-->Academic Interaction	0.213	0.048	4.396	0.000
Learning Skills-->Academic Performance	0.425	0.130	3.267	0.001
Academic Interaction-->Academic Performance	0.562	0.134	4.197	0.000

Goodness of Fit measures of is used to assess the fitness of structure equation model. p-value of Chi-Square test is significant. So our model is fit. Recommended value of (χ^2 /d.f) is less than 3. In this case, the value of (χ^2 /d.f) is 2.42 that is less than 3. So it also supports our estimated model. In this case, GFI value is .94 the value of AGFI is .90, which supports our estimated model. In this model, the value of RMSEA is .06 that is less than .08. So

RMSEA is supported to fitted model. All the important Goodness of fit measures indicates that our estimated model is best fitted.

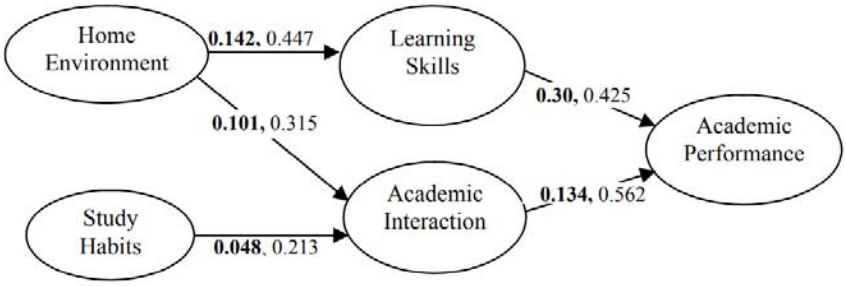


Figure 1: Fitted Structural Equation Model.

The fitted possible equations for estimating academic performance form figure 1 can be written as:

Academic Performance = .447 (Home environment) + .425 (Learning skills)

Academic Performance = .315 (Home environment) + .562 (Academic interaction)

Academic Performance = .213 (Study habits) + .562 (Academic interaction)

Form figure 1, the fitted model shows that academic performance depends on learning skills and learning skills depends on home environment. Also academic performance depends on academic interaction and academic interaction depends on study habits and home environment. It means academic performance can be estimated for any student by its home environment and learning skills and also by its academic interaction, study habits, and home environment. By examining the three possible paths of estimating academic performance, the strongest path is the home environment which affects the learning skills and ultimately learning skills lead to affect the academic performance.

4.3 ACADEMIC PERFORMANCE PREDICTION USING SUPERVISED LEARNING TECHNIQUES

To address the common issues of above literature review such as class imbalance, data hi-dimensionality and classification errors, this study has proposed a model which have following phases. Figure 1 shows the main steps of proposed methodology

4.3.1 Data Collection

A student performance data set used in this study has collected from UCI Machine Learning Repository. The data was collected for academic session 2005-2006 of two schools of Alentejo region Portugal. It includes 1044 instances with 33 attributes including student grades, demographic, social and school related features.

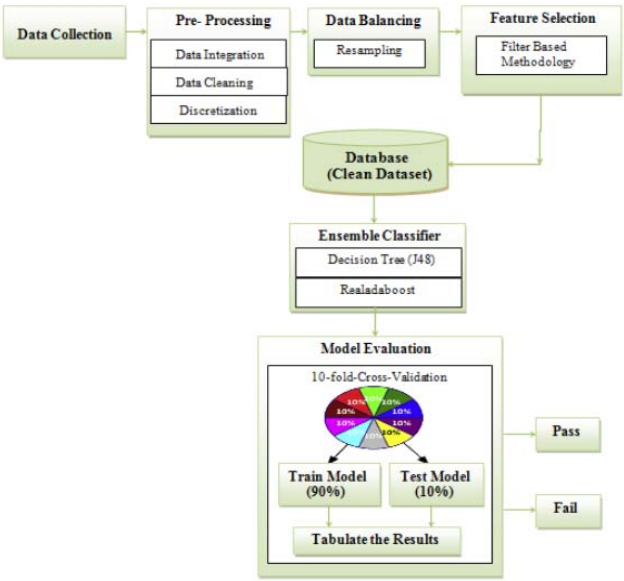
4.3.2 Data Preprocessing

Pre-processing plays an important in data mining. Its purpose is to convert raw data into a suitable form which can be used by mining algorithms. Following tasks are performed in this phase.

Data integration: Data Integration means to gather the data from the multiple sources into single repository. Redundancy is the common problem occurred when integrating data. The dataset consists of two comma separated values files which were taken from UCI Machine learning repository. These files contained the performance data of two courses (Portugal Language holds 395 instances and Mathematics holds 649 instances) which were studied by Portuguese Students. In this step, multiple files are integrated into one file. In order to perform consolidation, an attribute (Course) is added to describe the course such as (P for Portugal or M for Mathematics).

Data cleaning: In this phase, missing and noisy data is handled to achieve data consistency. The dataset occupied by this study not have any missing and outliers etc.

Discretization: The discretization mechanism is used to transform the desire data from numerical values into nominal values. Some classifiers are not applicable on continues data. That's why target attribute G3Grade has converted into nominal. Such as other countries, Portuguese education system follows the 20 point grading scale. In which 0 shows the lowest and 20 is the perfect score. The student availed grade points of three sessions have converted into binary target nominal intervals by applying following rule. Declared Pass as P, if points are greater than ten and declared Fail as F, if points are less than or equal to ten. The target variable (Class Label) is G3Grade which describes whether student is pass or fail.



4.3.3 Class Balancing

In this phase, data balancing approach is applied after data pre-processing for solving the class imbalance problem. The class

imbalanced problem arises when the number of instances in one class is much smaller than the number of instances in another class or other classes. Traditional classification algorithms provide high accuracy for majority classes when data is un-balance because during classification, they have much intension towards majority class instances and have less intension for minority class instances. In the collected dataset, 22.03% of students failed the course, resulting in a serious class imbalance problem. The adjustment of the ratio of two class samples can improve the machine's learning performance. Therefore, we employed a class balancing method known as re-sampling in this phase.

Figure 2 shows the class distribution.

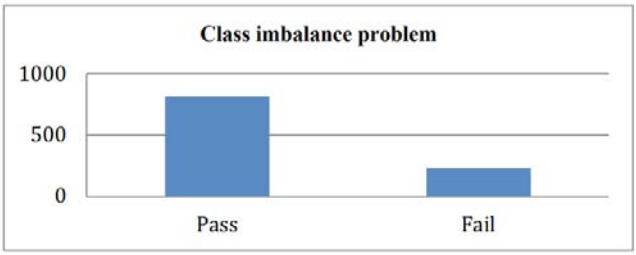


Figure 2: Class Distribution on Scale.

After re-sampling on the training set, 50% PASS and 50% FAIL students are obtained.

4.3.4 Feature Selection

The student performance dataset may contain many attributes, which may be inappropriate for classification purposes. The problem of data high dimensionality arises when included large amounts of student's characteristics which can influence student performance such as educational background, social, demographics, family, socioeconomic status etc. This issue can be resolve by selecting important features from the dataset.

The purpose of feature selection is to select an appropriate subset of features which can efficiently describe the input data, which reduces the dimensionality of feature space and removes irrelevant data. Feature selection methods are mainly categorized into wrapper-based and filter-based methods. Filter method is searching for the minimum set of relevant features while ignoring the rest. It uses variable ranking techniques to rank the features where the highly ranked features are selected and applied to the learning algorithm.

This study applied filter method using information gain-based selection algorithm to evaluate the feature ranks. It's checking which features are most important to build students' performance model. During feature selection, a rank value is assigned to each feature according to their influence on data classification. The highly ranked 12 out of 33 features have selected while others are excluded.

Table 7: shows the list of some selected features as sample features after filter-based evaluation.

Sr. #	Selected Attribute	Description	Ranked Values
1	G2Grade	Pass / Fail in 2nd Term	0.5936
2	G1Grade	Pass / Fail in First Term	0.4921
3	Failures	No of failures in past class	0.4747
4	AbsRate	Absence rate in class	0.4038
6	Fedu	Father qualification	0.3331

4.3.5 Model Construction

The literature review recommends that in general there is no single classifier that works best in all contexts to provide good prediction.

Student's performance prediction model is build using ensemble method. Ensemble method is a learning approach that combines multiple models to reduce their classification errors as well as to enhance the accuracy of weak classifiers. The predictions made by ensembles are usually more accurate than predictions made by a single model.

Generally, there are following two types of Ensemble approaches:

- ***Homogeneous ensembles:*** A combination of one ensemble learning (Meta model) such as Bagging, Boosting and one base model.
- ***Heterogeneous ensembles:*** An ensemble that combines at least two different base methods.

4.4 LITERATURE REVIEW OF ACADEMIC PERFORMANCE

There is a wide research available on the academic performance prediction using data mining techniques and machine learning that have been carried out for the development of new world.

The comparison on different data mining techniques with neural network, Bayesian classifier, and by the help of decision trees. The neural network has solved the problem of classification. It provides various pattern accuracy methods and recognized process as well as approximate function for prediction was compared with the help of Bayesian classifiers. The weka software is used; different algorithms provide different results; average is the best solution to consider the result. For this purpose, MLP, NB and J48 produce good results. This paper is not considering demographics data and distinctive attributes of students. It needs more experiments for valuable and accurate results. Used real data of six hundred and seventy students of Zacatecas, school located in Mexico and data of Barcelona university. They used the machine learning, white box method of classification, decision tree algorithms and rules of induction. Three hypothesis-based experiments conducted to find failure ratio and the dropout student's rate in school. They used the feature selection method, out of seventy-seven attributes, only fifteen have been considered, which are considered best in education systems. The dimensional modeling and statistical techniques are also implemented in this work. Weka tool is used, and results are not represented in a graphical form for better understanding. The data imbalanced problem is solved efficiently.

In order to predict the student's performance based on pre-university and personal characteristics. The datasets to analyze data by data mining algorithms, two rule for learner. In which two main Bayes classifiers, a decision tree classifier, and nearest neighbor classifier have been used. Weka is used for implementations, the data of 10330 students and 20 parameters are considered. Weka classification filters are applied on datasets by an algorithm, in which J48 and JRip are reliable and provides excellent results. The kNN classifier and Bayes classifiers are not efficient. Another method proposed by Ahmed and his colleagues used to predict the performance of students, classifications methods, clustering, artificial intelligence, neural networks, regression, associate rules, generic and the decision tree included, ID3 methods have been used. Some attribute were collected for the prediction of results of students. For these purposes data sets of 1547 record used to predict the performance. Weka is used for decision tree implementation. This method does not check the attributes like attendance, mood effect, and environmental factors. Another proposed model is based on longitudinal data derived from Gwinnett County Public Schools data, those students who entered in class 8 assessment in Math's and science subjects are done. For missing values, means imputation is used, logistics regression, decision trees and naïve Bayes are the techniques for implementation. They use weka and SPSS modeler and several demographics factors are considered. From all of these techniques logistic regression provides the best results. There was an issue in missing values filling method. It produces the noise in predictions and one classifier is not enough for entire data of students. The grouping should be feasible option for yielding the optimal risk prediction of student performance. The behavioral data and enrollment related factors should also considered. The neural network approach to predict the marks of students. A function radial basis is used, to map the inputs by Gaussian method. The information related to grades data of students of the years 2010 to 2011 and 2011 to 2012 totally based on the marks obtained in last past years are helpful to predict the present marks. The record

consists of more than thousand student's data and it covers two hundred and fifty subjects. The prediction parameters are not sufficient to predict the performance for next years. No proper algorithm and practical implementations is described. To find out the master's student performance, the method helps the students to divide into clusters with their academic performance. The extraction of classification rules and the clustering have been implemented by use of c4.5 and k- means algorithm. By this implementation, the students can choose the area of interest in the best subject, as this platform is not too much efficient. Lime survey had been used and the number of participant was very less about 277 in this survey. Due to these flaws, it does not provide successful way to find the performance of the students. Another better approach had been used. The NBtree classification algorithm is used for predicting the student's performance by Christian and his colleagues work. The datasets consist of academic, education, admission data as well as personal data during their studies. Weka toolkit for data mining is used. The paper is used for building a model of classification for checking the performance of students; gender attribute, GPA, credit, and test score as an important attribute are also used. It is more efficient to use the datasets of higher education institutions to get the model for performance of the students. It is better to use artificial intelligence techniques for more efficient results. A method to check the student's learning mechanism as well as semantic rules; it helps in guessing the performances of students. For the improvement of education, delivering qualities and the learning activities, semantic rules and ontologies are also used. Various artificial intelligence methods are used for adaptive learning. An efficient approach of decision tree is used to answer the fail or pass percentages in advance for the artificial intelligence course. Weka is used for experiments. The above-described approach does not provide a larger scale evaluation for understanding the performance of a system. The work is not analyzing the performance of gender-related rules, as well as the mistakes happened in examination tests. The missing data is not properly manage in this approach. A simple model of linear regression is used to predict the cumulative GPA proposed work. It is a new method to automatically infer the study and

social behaviors, using passive sensing from smartphones. It used the analysis of behaviors as input to sketch the model. The behavioral slope and breakpoints are used for the representation of patterns, least absolute shrink and selecting operator act as model of prediction. This is an efficient approach, because no work had been done by the use of passive sensor data and time series analysis from smart-phones as a predictor. The longitude measure of living, style and behaviors of students are used for prediction of the performances. To predict the course based data from Washington State University is available for the course. A normalized programming state model based on empirical study, a formula is calculated. This model is unreachable in novice programming environments. It is explanation of how a learner online social behavior produces an impact on capabilities of prediction of the normalized programming state model. The work of Carter and his colleagues is specified for programming skill and learning; other studies are ignored for prediction of performances. According to study based on developing a computer-based prediction tool. A model was built based on a large dataset collected from grade-8 students; they participated in Kenya certificate of primary education exam. The record consisted of 2426 students. The mean imputation is used to treat the missing values. For preprocessing steps, filters are used in feature selection technique, machine learning techniques, and data mining algorithms have been used for building models of prediction. The logistic regression, multilayer perceptron, sequential minimal optimization algorithm, Bayesian network classifiers, naive Bayes classifier, random forest classifier and J48 algorithm are used. The datasets has been taken from the rural environment is not feasible to provide efficient results for urban education systems as the attributes are taken according to rural factors. This method is not providing the accurate results in some cases as in urban based student analysis of college or university students. Student personal information and family relevant information of expenditures are considered very helpful in finding the performance in advance as discussed. The main purpose of this term paper is to predict performance of learners/students, by comparative study of previous work in form of survey. In which data mining algorithms,

classifiers, artificial intelligence techniques and statistical based methods are discussed. This is summarization of different techniques used for performance prediction. From 2012 to present studies are discussed for student's performance attributes, as well as it describes the best predicting techniques which are not clearly mention in previous surveys. This is also focusing on those important attributes, which affects the performance of student's in academic results.

4.4.1 Performance Methods of Prediction

The purpose of this paper is to find out the mostly used attributes which are used for prediction of performance and determine which algorithm and parameters are best to improve the prediction mechanism in educational system.

Educational Data mining: In order to predict the performance of students, brief description of various data mining algorithms is necessary; this section will discuss the basis of data mining algorithms with their impact on various attributes of students. The flow diagram of prediction model is described in Figure 3.

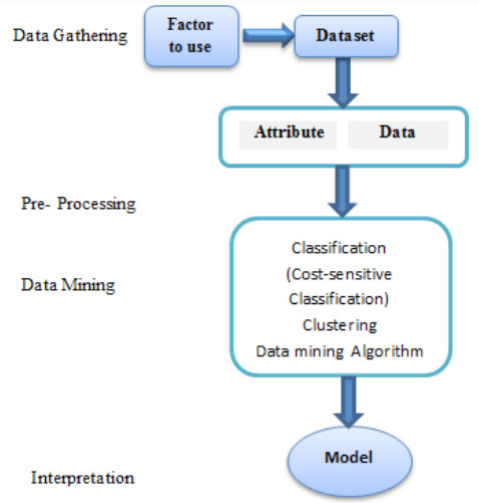


Figure 3: Process for Predication.

Evaluation Parameters: These parameters are based on two perspectives, one is based on the dimensions, on which the data mining algorithms are applied for results of prediction. The second is based on how we evaluate which algorithm is better for predicting the performance.

- *Student related variables:* The following evaluation criteria is considered in state of art as described in below Table 8. In which we use the student demographics information, previous class results, social information, extracurricular activities and other factors are considered.

Table 8: Major evaluation dimensions based on student data

Criteria	Details
Student demographic information	Age, gender, region, residence, guardian info
Previous Results	Cleared certificates, scholarships and Results
Grades	Recent all Assessments results, Quizzes, Final exam, CGPA, Attendance,
Social Network Details	Interaction with social media websites
Extra-Curricular Activities	Games partitions, sports, hobbies
Psychometric Factor	Behavior, absence, Remarks[7, 9-15]

- *Algorithms based parameter:* The following are the algorithms based parameter:
- Accuracy: describes the correctness of value
- Probability Threshold: Presents the True Positive and True Negative rates.
- Execution Time: Time of running the algorithm on dataset.
- Precision: (number of true positive)/(number of true positive +False positives)
- Recall: [(number of true positive)/(number of true positive/ number of false negatives)]
- Number/Size of Rules
- ROC Area: (Receiver operating characteristics) used alternative to accuracy [12].

- F-measures: 2*[(precision*recall)/(precision + recall)]
- Geometric Mean

4.4.2 Data Mining Algorithm and Their Impact with Student's Attributes

The following described algorithms and classifications techniques are analyzed for predictions:

A. ***Decision Tree:*** Decision tree is a method, which is used to predict the performance of students in literature work. It is simple flow chart structure, it consists of internal nodes and leaf nodes, used to put the values and check the values/attributes. Its classifier consists of two steps; one is preparing phase. Other is prune phase. The pruning phase helps to reduce the data and fit it in the decision tree. For decision tree, three algorithms are mostly used that are ID3, C4.5 and ADT.

B. ***Iterative Dichotomies 3 (ID3):*** The algorithm consists of two phases, build and pruning phase. Hunts algorithm is the base of the ID3. In order to split the attributes and dimensions, it uses the information gain. ID3 does not mostly provide accurate results, when data is not properly preprocessed. The noise is mostly present in data. This method uses categorical attributes for building a tree.

C. ***C4.5:*** For building, a decision tree mostly used the continuous, categorical attributes and various dimensions. It splits the values on some threshold percentage or value. In tree structure, children are created on above and below threshold values. To remove the extra branches, it uses pessimistic type prune. The accuracy can be efficiently improve by using this method.

D. ***Alternative Decision Tree (ADT):*** It consists of various predictions and decision tree nodes. It is different from ID3 and C4.5. The tree is not differentiated into parent

and child nodes. Treat the whole tree for interpretation. By using Join nodes sets, it is evaluated.

Table 9: Prediction parameter results with Decision Tree

Methods	Attributes	Accurate Results (%)
Decision Tree	Final Exam	85
	CGPA, demographic, Background info, and Scholarship information's	91
	(Internal) exam, CGPA, and Extra activities	66
	Exam (internal), CGPA, and extra activities	65
	Exam (internal), demographic, and extra activities	90
	Psychological factors, extra activities, knowledge Skills	88

E. ***Naive Bayes algorithm (NB):*** It is simple algorithm for the prediction of performance based on classification method by using the probability theory; this method makes the problem very simple by use of assumptions. Like no other attributes affects the prediction process any more. It is considered to be an efficient algorithm.

Table 10: Accuracy based results with Naive Bayes algorithm

Methods		Attributes	Accurate Results (%)
Naive Bayes	Algorithm	Background and demographic info	50
		CGPA	75
		Exam results, CGPA, and Extra activities	73

F. ***Multilayer Perceptron Algorithm (MLP):*** The Neural network uses this algorithm mostly. An input layer is formed by some elements, which contains the sensory information, for purpose of approximation in classification function. An advance multilayer perceptron algorithm is used. It consists of neurons, which are known as nodes. It is used to approximate the nonlinear functions.

Table 11: Prediction parameter results with neural network

Methods	Attributes	Accurate Results (%)
	Exam data (external)	97
	Background and demographic info	72
	Psychometric	69

Neural Network	Exam results	75

G. ***Logistic Regression:*** By use of the logic function, we can also build a model and estimate the results. It is basically a statistical method used for prediction and the estimations.

H. ***K-Nearest Neighbor (KNN):*** It is considered one of the best simple and accuracy based algorithm for performance-based prediction. Support Vector Machine (SVM) is also used for classification purpose.

Table 12: Prediction parameter results with K-Nearest and SVM

Methods	Attributes	Accurate Results (%)
K-Nearest Algorithm	Exam(internal), CGPA, Extra activities	83
	Psychometric attributes	69
Support Vector Machine (SVM)	CGPA, exam (internal) , Extra activities	80

According to prediction attributes and classification techniques, we have concluded some useful results as in Figure 4 we have seen that major accurate results are analyzed from the neural network algorithms based on final exam and CGPA, which is 97% accurate.

The best results are obtained from decision tree algorithm by use of the CGPA, demographic, background and scholarship related information, which is 91% and 90% based on exam (internal), demographic, and the extra activities. On the other

side psychological factors, extra activities, and knowledge skills are also considered as the important factors. The prediction of the results with decision tree algorithm is 88% accurate. The naive Bayes provides 75% accurate results based on CGPA. K-nearest neighbour provides 83% results, because of these factors; Exam (internal), CGPA, Extra activities. The support vector machine provide 80% results accurate, on basis of CGPA, exam (internal) and Extra activities. We have concluded from this survey that education system should use Exam (Internal, External), CGPA, background information and extra activities for prediction of the performance to get best results. The neural network and decision tree algorithms are to be preferred. To predict the performance in advance will help the education system to improve the quality and results as well as reduce the failure rates. The Figure 4 shows the graphical representation of accuracy, which is analyzed on multiple attribute for prediction of performance. This section is about details of the prediction results of the work done in recent studies for determining the performance of students by using data mining algorithms and techniques as described in Table 13 as well as in Figure 4. All the major attributes, which are used for prediction, are mentioned clearly. We have achieved our goal of prediction of the best algorithms based on accuracy results of previous studies. The highest prediction accuracy is seen in Table 13 work by use of ADTree algorithm, the classification results provides 97.3% accurate which will work efficiently in future for prediction purpose. This prediction is based on all attributes. It includes internal and external Exam information, the background information, extra-curricular activities, social interaction, and psychological behavior of student as well as CGPA etc. If we considered the most important attributes then the classification results are improved to 99% for ADTree algorithm. The 2nd highest accuracy is obtained on a datasets of 77 attributes and 670 students is used, in which the best attributes results are shown in Table 13 is obtained by ADTree is 97.2%.

It provides 95.4% accuracy and JRip, NNge provide 96% to 97% accuracy. The 3rd highest accuracy is achieved by comparison of classifiers by use of twenty two features. In which the best accuracy

is achieved by Logistic algorithm is 83.88% and Bayes Net, SMO and Lazy algorithms also provides nearly 80% of accurate results of classifiers. If we reduce the features to eight, the results are vary and 83% accuracy has been seen in many algorithm results, if we use the most influential features for comparison then the accuracy is reduce in mostly algorithms to 70%. It does not provide efficient results.

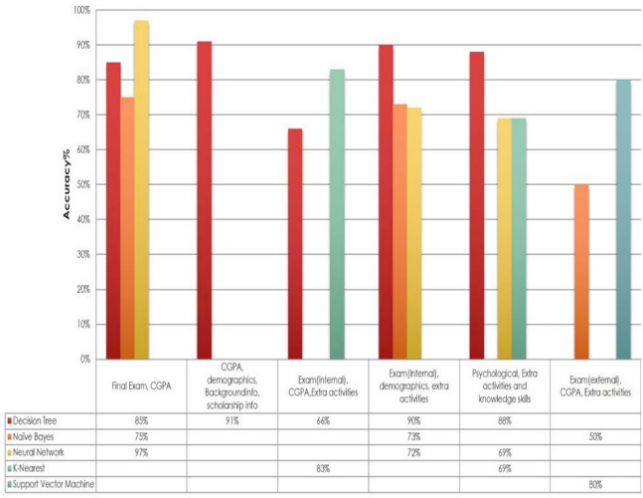


Figure 4: Prediction Accuracy with Algorithms.

Table 13: Comparisons of Evaluation Parameters and their impact on Techniques

Techniques	Accuracy %	TP Rate	TN Rate	Execution Time	Precision/ Recall	Number/ Size of Rules
Classifiers						
NB	77%	0,500 0,851	0,149 0,500		0,500 0,851	197
MLP	71%	0,371 0,821	0,397 0,804	Null	0,371 0,821	183
J48	74%	0,290 0,882	0,118 0,710		0,290 0,882	190

Classifiers					68.2%	
ID3 algorithm	72%			0.12	06.4%	
C4.5	**74%**	Null	Null	0.08	70.4%	432
					09.6%	students
ADT	72%			0.06		
					82.8%	
					11.4%	
Algorithms						
ID3	**75.145%**			47.6		
		Null	Null		Null	182
C4.5	**75.145%**			39.1		students

Classification Algorithms		97.7	65.0			
JRip	94.8	98.7	78.3			
NNge	96.9	88.8	88.3			
OneR	88.8	99.8	37.1			
Prism	94.7	97.9	70	Null	Null	Null
Ridor	95.4	98.2	86.7			
ADTree	**97.2**	96.7	75			
J48	94.8	96.1	68.3			
RandomTree	93.6	96.5	75			
REPTree	94.6	96.4	76.7			
SimpleCart	94.6					

(Based on Best attributes)		97.7	78.3			8.0
JRip	95.7	98.5	73.3			31.0
NNge	96.1	98.9	41.7			2.0
OneR	93.7	99.5	25.0			76.0
Prism	93.7	96.6	65.0			4.0
Ridor	93.1	99.7	76.7			21.0
ADTree	**97.3**	97.4	53.3	Null	Null	31.0
J48	93.9	95.7	48.3			212.0
RandomTree	94.9	98.0	56.7			44.0
REPTree	94.5	97.7	65			5.0
SimpleCart	95.1	94.3	90.0			2.0
ICRM v1	92.1	97.5	75.0			7.6
ICRM v2	94.9	84.4	93.3			4.0
ICRM v3	76.7					

Classifiers		90.5	23.8			
Naïve Bayes		90.0	24.7			
Decision Tree	Null	90.7	28.8	Null	Null	Null
Decision Table		90	20			
Logistic						
Regression						

Algorithms(22 features)	83.47					
Lazy	79.76					
Multi. perception	**83.88**					
Logistic	82.60	Null	Null	Null	Null	Null
Tree(J48)	81.32					
Random Test	83.26					
Bayes Net	73.99					
Naïve Bayes	83.38					
SMO						

Rule Induction Algorithms						
JRip	80					
OneR	83.3					
Ridor	79					
Decision Tree Algorithms		Null	Null	Null	Null	Null
ADTree	**83.4**					
J48	82.3					
Random Tree	75.7					
REPTree	77.9					
SimpleCart	80					

An overall 79.2% accuracy is seen, which is achieve by use of the student performance in university, social behavior, personal data, background information, educational background and the current status of student so the results are gained by rule induction and decision tree algorithms with original data is 79.2% by use of JRip algorithm and standard deviation is 4.354. The accuracy is achieved 80% by the SMOTE on original dataset. In work predict the students risks by use of Naïve Bayes, decision tree and logistic regression the ROC area. The maximum gained is 1.0 by logistic regression and minimum by Naives bayes, which is 0.5. For prediction of student performance used of NB, MLP and J48 algorithms, the best results had been obtained from MLP algorithm. They provided 74% accurate predication results. This method takes 4.13 sec to build a model. The work of [24] used the ID3, C4.5 and ADT algorithms. It also provides a survey based research work results and best accuracy is obtained from C4.5, which is 74.416 %, and precision for this algorithm is 70.4.

Another approach in which comparison of two algorithms is presented by use of ID3 and C4.5 algorithms. The both algorithms give the accuracy of 75.145% but the execution time varies from 39.1 to 47.6 mile-seconds. They get from 173 to 130 are the corrected prediction about the performance of students. After the deep study of literature the best result are presented in graphical representation by using Figure 5.

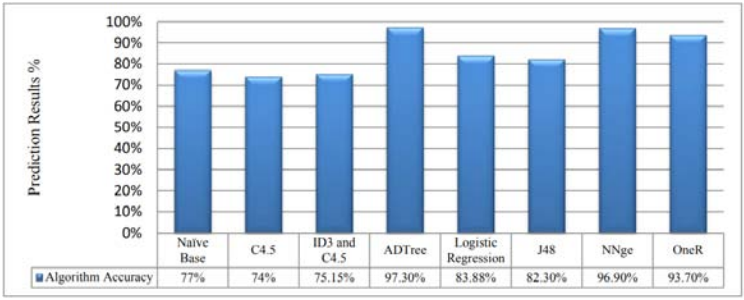


Figure 5: Algorithm accuracy based graphical representation 2012-2017.

The prediction of student's performance in advance is very important issue. We concluded after deep studies that various datasets of student provides different results with different attributes. This is the reason that the results are vary with different evaluation measures like accuracy, precision and geometric mean. We concluded after these studies that every data mining approach and algorithm results are varied according to the dataset and variable attribute used for prediction. However, if we use the decision tree algorithms, ADTree, JRip, Ridor, logistic regression and neural network approach, according to our requirements these algorithms provide extra ordinary accurate results for future prediction and help in the betterment of education system. In this way, we can improve the prediction methods and performance of education system. This research will implement in future by use of real datasets of Fast University and take the student's attributes. In order to determine the effects of best predictive algorithm (Decision Tree/Neural Network) and other techniques will evaluate by statistical and empirical studies. In this way, we can compare the results of students with previous semester results. The best techniques are selected based on accuracy.

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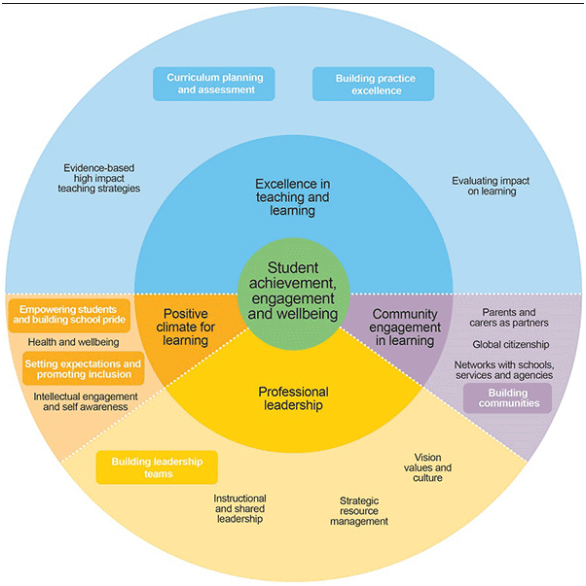
CHAPTER 5

TYPICAL INTELLECTUAL ENGAGEMENT

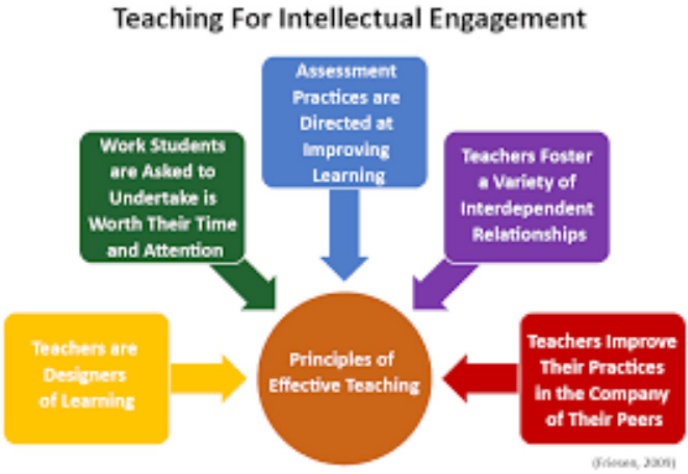
INTRODUCTION

Cognitive functioning is particularly sensitive to the effects of aging: A number of cross-sectional and longitudinal studies have shown that, on average, cognition declines in old age. This finding, however, has to be differentiated in two respects. First, the amount of cognitive decline depends on the cognitive ability examined: Different cognitive abilities show a different course of development. An important issue then is why different individuals show more or less pronounced decline in different cognitive abilities. In this regard, during the last two decades a number of explanatory approaches have been proposed. A common feature of these approaches is that they do not cross the domain of cognition, i.e., the proposed explanatory variable of cognitive aging is itself a cognitive ability, oftentimes considered more basic or fundamental such as, e.g., reduced working memory capacity or processing speed.



5.1 FOCUS ON TYPICAL INTELLECTUAL ENGAGEMENT

A comprehensive explanatory approach of cognitive aging has been proposed by Phillip Ackerman in terms of his PPIK theory (for intelligence as-process, personality, interests, and intelligence-as-knowledge). An important component of the PPIK theory is the role of non-ability attributes, because the theory integrates intellectual functioning with personality and interests to explain intelligence development throughout the adult lifespan. A basic assumption of the PPIK theory is, that in accordance with Cattell's (1987) investment hypothesis, fluid intelligence cumulatively invested in a specific domain ultimately transforms into crystallized intelligence. The intensity and direction of fluid intelligence investment over a longer period of time is determined by motivation, interests, and personality traits, which, in their interplay, constitute Typical Intellectual Engagement.

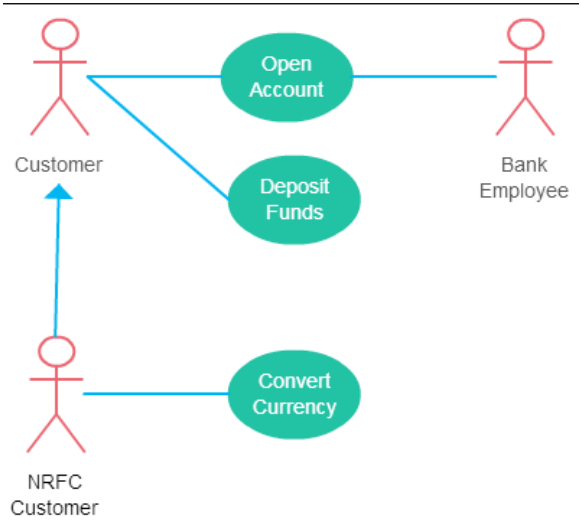


Briefly, the construct of TIE refers to the degree to which individuals prefer to engage in cognitively demanding or challenging leisure tasks and activities, such as problem solving, debating, and philosophizing, and, thus, captures an enduring pursuit of intellectually demanding activities. If so, TIE should be related to acculturative and purposeful development and the expression of certain intellectual abilities that belong to the domain of crystallized intelligence.

From the definition of TIE outlined above, one might hypothesize that fluid intelligence acts as a mediating variable between TIE and crystallized intelligence. Specifically, the direct effect of TIE on crystallized intelligence should be reduced, i.e., partially mediated, once individual differences in fluid intelligence are taken into account.

In terms of measurable outcomes, TIE should influence the choices people make as to which domain of knowledge receives intellectual investment and to what degree of intellectual investment is made. Regarding cognition, the significance and practical importance of TIE thus stems from the fact that individuals that prefer to engage in cognitively demanding activities might be able to maintain a comparatively higher level of crystallized intelligence than individuals who invest less time in activities emanating of TIE.

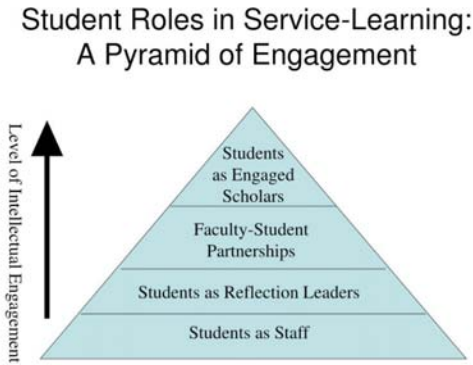
A straightforward explanation of the relation between those activities and cognitive functioning is that, in order to perform activities that are cognitively demanding, certain cognitive abilities are needed, which might result in the maintenance or even enhancement of these cognitive abilities.



5.2 MEASUREMENT OF TYPICAL INTELLECTUAL ENGAGEMENT

Empirically, TIE is usually measured using a questionnaire developed by Goff and Ackerman. While Problem-Directed Thinking involves problem solving, responsibility, depth of learning and complexity, Abstract Thinking covers an interest in thinking for its own sake, as in thinking about concepts or problems with no solution, or pleasure from deliberative thinking. The first factor, labelled Reading, comprised items about the amount of reading as well as about the kind of reading material. The second factor, termed Intellectual Curiosity, captured intellectual engagement not directed to concrete problem-solving, but rather driven by curiosity, while the third factor, Contemplation, encompassed intellectual performance that is not goal-oriented but is motivated by a desire for a deeper understanding of the

world. To summarize, in student samples previous analyses have led to different, although partly overlapping, solutions regarding the factorial structure of the TIE scale. While Reading emerged in all three studies conducted so far, other factors require enhanced evidence.



The majority of the existing validation work with TIE has focused on associations between the sum score of the TIE scale and cognition and personality traits. The difference in results is possibly due to sample differences: in the study of Ackerman, all participants had obtained an education at least at the baccalaureate level, whereas in the study of Wilhelm et al. the sample was more heterogeneous with respect to education.

5.2.1 Typical Intellectual Engagement in Old Age

Although the framework of Ackerman's PPIK theory is broadly developmental, TIE has been examined mainly in persons from early through middle adulthood, provoking questions about TIE and its relations to other variables in old age.

With respect to the measurement of TIE, an important issue would be which factorial structure the TIE scale exhibits in old age and whether findings on some of the previously reported factors can be replicated in the elderly. Specifically, from studies one might derive that there are three, four, or five factors underlying the TIE scale. For the present study, we selected 16 items of the original 59-item TIE scale in order to form an abridged TIE scale. Item

selection was based on two different, but intertwined criteria. First, we aimed at establishing a congeneric model, i.e., a model where each item loads on one factor only. Hence, only items with major loadings on one factor were chosen from previous studies. This led us, second, to the assumption that a four-factor model might describe a 16-item TIE scale, comprising Reading, Problem Solving, Abstract Thinking, and Intellectual Curiosity.

TIE scale would be of interest also for those variables, e.g., crystallized intelligence, that have previously been reported to correlate with the total score of the TIE scale. Therefore, the first aim of this study was to examine the factorial structure of an abridged TIE scale in a sample of older adults, aged between 65 and 81 years. More specifically, a model of four first order factors (see above) and general TIE as a second order factor was investigated.

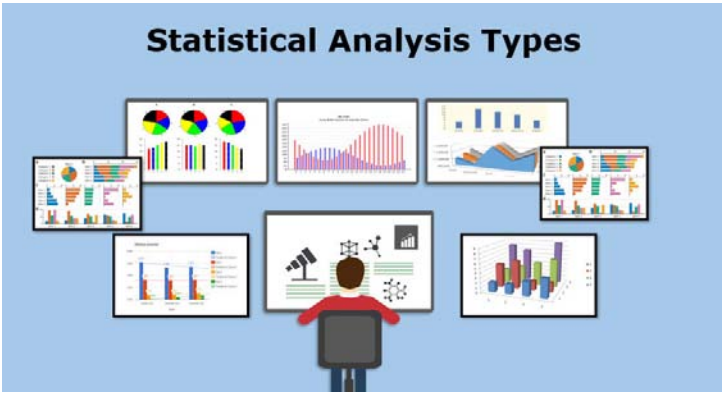
Regarding socio-demographic variables, education is expected to correlate with TIE in old age, because although formal education is a distal variable in the elderly, as a lifestyle variable it influences occupational status, interests, and, leisure activities. One might assume that in old age years of education even play a more important role than in young age, because lifestyle differences due to educational differences have more time to manifest themselves.

With respect to cognition, in terms of the PPIK theory TIE affects the intensity and direction of developing crystallized intelligence out of fluid intelligence. Across the life-span, then, individual differences in the development of crystallized intelligence may result from individual differences in how persons purposefully and typically engage in cognitively demanding activities.

Similar to above, one might even predict that the associations between TIE and intellectual functions become stronger in old age, due to their intertwined development across the lifespan. The third aim of this study was, therefore, to examine the relation between TIE and cognition, namely crystallized and fluid intelligence. In line with the theoretical approaches outlined, we expected that TIE is associated crystallized intelligence to a considerable amount due to the longer time knowledge can be established, whereas we supposed the association between TIE and fluid intelligence to be less pronounced.

5.2.2 Statistical Analyses

Measurement invariance was examined as a prerequisite for the analyses of different types of change on the latent level. Measurement invariance describes the degree of stability of the psychometric characteristics of a questionnaire. Changes at the latent level can then be interpreted without confounding measurement errors. Three degrees of measurement invariance were tested in the present analyses. We examined configural invariance, weak invariance, and strong invariance. According to Meredith and Horn, configural invariance implies constraining the items to load on the same factor across time, indicating that the same items can be assigned to the same theoretical construct across time. Weak invariance requires the factor loadings to be equal across time.



This indicates that the information that every item contributes to the assessment of a construct remains the same across time. Strong measurement invariance requires the item intercepts to be equal across time. Strong measurement invariance indicates that differences in latent factor means are not confounded by differences in item-specific intercepts.

For the analyses of change in TIE, first, structural stability was assessed by examining the invariance of factor covariances across time. Structural stability indicates that a construct and the relations between the subfactors remain stable across time.

Thirdly, mean level changes were assessed in constraining latent factor means to be equal across time. No significant decrement in model fit would indicate that on average, no change emerged. Change of divergence was then measured by constraining the factor variances to be equal across time. A significant decrease in model fit would imply that the sample became substantially more or less homogeneous. Hence, variances indicate the homogeneity of a sample. Finally, specific versus general change was assessed by correlating longitudinal change scores.

As criteria for model fit, the root mean square error of approximation (RMSEA) with its 90% confidence interval, the CFI, and the root deterioration per restriction (RDR) are reported as fit indices. RMSEA values below 0.06 denote a good model fit, and values up to 0.08 denote an acceptable fit, whereas for the CFI, values above 0.90 indicate a well-fitting model.

The estimated means and variances for the change parameters should be interpreted in comparison with the estimates at T1. We used maximum likelihood estimation for our analyses. Analyses were conducted using SPSS 18 and SAS.

Analyses started with specifying a four-factor model separately for each time point.

The model with the four factors, reading, abstract thinking, problem solving, and intellectual curiosity, fitted almost equally well at both measurement occasions (see Table 1). This leads to the conclusion that longitudinal analyses of stability and change were warranted.

Note that the errors of the manifest variables were allowed to be correlated across time to improve model fit, and because in a longitudinal design, the same individuals are repeatedly measured, which implies that specific factors of the items can also be correlated across time. Then different degrees of measurement invariance were analyzed. The configural invariance model evinced a good fit (Table 1). Second, we imposed weak measurement invariance. As can be seen from Table 1, this, in terms of fit indices (CFI = 0.99; RDR = 0.066; RMSEA = 0.049), did not lead to a decrement in fit. Hence, we accepted this model. Next, strong measurement invariance was tested for. This, again, did not lead to a significant decrease in model fit (CFI = 0.99; RDR = 0.056; RMSEA = 0.049); hence, we accepted the strong measurement invariance model. When measurement invariance holds, changes on the latent level can be ascribed to changes in the underlying theoretical construct. They are not confounded by systematic changes in the responding behavior.

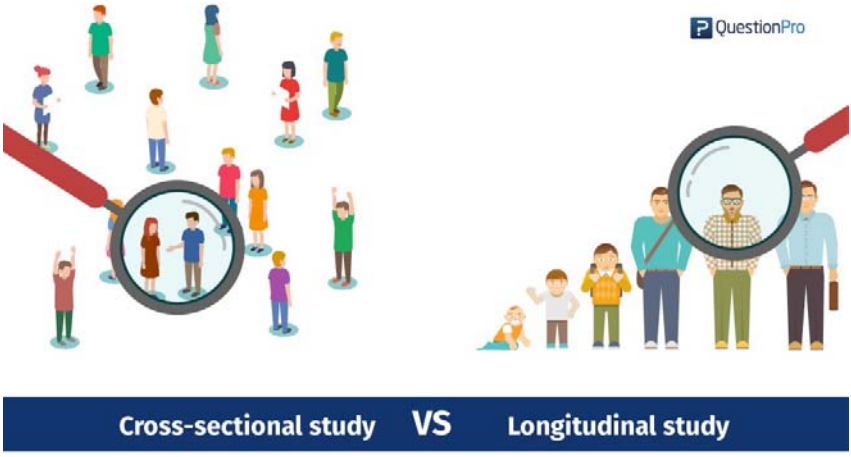


Table 1. Estimated Models

Model	χ^2	df	$\Delta\chi^2$	Δdf	RDR	CFI	RMSEA	90% CI
Four-factor T1	236.12*	112			—	0.99	0.069	0.057–0.081
Four-factor T3	205.77*	112			—	0.99	0.060	0.047–0.073
Configural MI	735.71*	480			—	0.99	0.048	0.041–0.055
Weak MI	764.25*	494	28.54*a	14a	0.066	0.99	0.049	0.042–0.055
Strong MI	787.05*	507	22.8*b	13a	0.056	0.99	0.049	0.042–0.055
Structural	790.56*	513	3.51c	6	0.000	0.99	0.048	0.042–0.055
Differential	887.37*	511	100.32*b	4	0.321	0.82	0.060	0.0.54–0.066
LCS	787.05*	507			—	0.99	0.049	0.042–0.055
Absolute	795.87*	511	8.83c	4	0.071	0.99	0.049	0.042–0.056
Divergence	791.49*	511	4.45c	4	0.021	0.99	0.049	0.042–0.055

Next, structural stability was analyzed. Constraining the covariances between the subfactors to be equal at T1 and T3 did not lead to a significant decrease in model fit ($\Delta\chi^2$ = 3.51, Δdf

= 6, nonsignificant; CFI = 0.99; RDR = 0.000; RMSEA = 0.048). Structural stability was also tested with constraining the interfactor correlations to be equal. In doing so, possible differences in factor variances are also taken into account. However, this did not alter the result (see Table 1, structural), indicating that the structure between the four factors was stable across a 5-year interval. The factors most strongly related were abstract thinking and problem solving (T1: r = .83; T3: r = .80), whereas the weakest relationship emerged between reading and problem solving (T1: r = .25; T3: r = .24; see Table 2).

Table 2. Factor Correlations

	(1)	(2)	(3)	(4)
(1) Reading	**.88**a	.43a	.25a	.26a
(2) Abstract thinking	.37a	**.84**a	.83a	.58a
(3) Problem solving	.24a t	.80a	**.83a**	.65a
(4) Intellectual curiosity	.26a	.67a	.66a	**.81**a

To assess differential change across time, test–retest correlations were estimated for the factors. Perfect differential stability is indicated by a test–retest correlation of r = 1. To test this, a model with across-time factor correlations being constrained to 1 was estimated. As Table 1 shows, this led to significant decrease in model fit ($\Delta\chi^2$ = 100.32, Δdf = 4, $p < .05$; RDR = 0.321; RMSEA = 0.060). The CFI dropped down to 0.82, implying that there were significant interindividual differences in the amount of change. At least for one subfactor, the across-time correlation had to be less than r = 1.00. As can be seen from Table 2, although all subfactors showed rather strong differential stability, in sum, shifts in rank order emerged. This result indicates that individuals differ in the amount of change in TIE across 5 years. The individual developmental trajectories do not run parallel but are specific for different individuals. Mean-level change is independent from this construct.

For the analyses of mean level changes, changes in variances and general versus specific changes, we reparameterized the strong measurement invariance model and estimated a latent change score model. Means and variances were fixed to 0 and 1, respectively, in the level factor in order to identify the model. Hence, means and variances in the change factor can be directly interpreted as differences from the level estimates.

To test changes on the mean level, all factor means were constrained to be equal across time. This did not lead to a significant overall decrease in model fit ($\Delta\chi^2 = 8.83$, $\Delta df = 4$, $p > .05$; RDR = 0.071; RMSEA = 0.049). However, when examining each mean individually, a small but significant decrease for intellectual curiosity and an increase for problem solving emerged. The change scores indicate that, on average, individuals engage significantly more in problem solving but significantly less in intellectual curiosity. The no significant changes in reading and abstract thinking indicate that on group level, both subfactors remain stable across 5 years. When latent change means were freely estimated, values were 0.108 (*SE*: 0.055; $p < .05$) for problem solving and −0.155 (*SE*: 0.075; $p < .05$) for intellectual curiosity. The changes in reading −0.002 (*SE*: 0.044) and in abstract thinking −0.028 (*SE*: 0.058) were not significant.

To analyze change of divergence, that is, the extent to which the sample homogeneity changes, variances were constrained to be equal across time. This did not lead to a significant decrease in model fit either ($\Delta\chi^2 = 4.45$, $\Delta df = 4$, $p > .05$; RDR = 0.021; RMSEA = 0.049), indicating that the amount of interindividual differences remained stable. Stability of divergence implies that across 5 years, overall differences between individuals do not become larger.

In a last step, general versus specific changes were investigated. This aimed at examining whether change in TIE could be subscribed to one underlying mechanisms or if the subfactors change rather independently. First, correlations between the change factors were estimated. Results are shown in Table 3. Positive correlations indicate that change in one factor goes along with change in the other factor. The actual direction of change is indicated by the means. For two of the four factors, non-significant mean changes

emerged; hence, the direction cannot be reliably inferred for abstract thinking and reading. The positive change correlation between intellectual curiosity and problem solving (r = .48) shows that change above average in one factor is accompanied by change above average in the other factor. This means that individuals who increase above average in problem solving tend to decrease less (or even increase) in intellectual curiosity. In turn, a person who decreases more than average (i.e., has a more pronounced increase) in intellectual curiosity tends to increase less in (or even decrease) in problem solving.

Overall, medium to large change correlations emerged, with the correlation between abstract thinking and reading being the weakest (r = .31) and with problem solving being the strongest (r = .73). Hence, the amount of shared variance ranged from 9% between changes in reading and abstract thinking up to 50% between changes in abstract thinking and problem solving. The results indicate that although changes in all factors were significantly related, a substantial amount of variance in change for each factor remains independent from changes in the other factors. Note that fitting a model with a general change factor did not exhibit an acceptable fit. This underscores that different mechanisms underlie the changes in the TIE factors.

Table 3. Level and Change Correlations

	Reading	Abstract thinking	Problem solving	Intel-lectual curiosity	(5)	(6)	(7)
(5) D_ reading	**−.34**[a]	−.23[a]	−.24[a]	−.24[a]			
(6) D_ abstract thinking	−.19	**−.50**[a]	−.33[a]	−.22	.31[a]		
(7) D_ problem solving	−.06	−.35[a]	**−.35**[a]	−.16	.44[a]	.73[a]	
(8) D_intel-lectual curiosity	−.22	−.18	−.19	**−.36**[a]			

Although TIE is one coherent construct, change in the subfactors is, to a substantial amount, driven by different mechanisms. Correlations between level and change are also shown in Table 3. Negative correlations here indicate that higher levels of TIE at T1 are associated with less change. As the largest effect, a medium negative correlation emerged between the level of abstract thinking and the change in problem solving (r = −.35) and vice versa (r = −.33). No significant relationships emerged between the level factor of reading and the change factors of the other factors. All other interfactor level–change correlations did not exhibit a systematic pattern and were either small or nonsignificant (Table 3). Finally, correlations between level and change within a factor were estimated. Negative relationships in the medium to large range emerged (see Table 3). This indicates that, overall, higher levels of the respective factor at T1 were associated with less change. That is, the higher on TIE an individual rated herself, the smaller was the change in TIE for this person. We also tested age and gender as covariates to examine whether they accounted for unexplained variance in level and change. However, the covariates did not explain additional variance.

In the present study we, first, examined the factorial structure of the TIE scale by testing configural, weak, and strong measurement invariance, and second, we analyzed the change of TIE across 5 years. Strong measurement invariance was found to hold as well as structural stability across 5 years. Hence, the findings can serve as a replication of the structure of the TIE questionnaire. Finding measurement invariance as well as structural stability underlines that TIE as a construct can be reliably measured across time.

We then addressed differential stability. Profound differential change emerged for all the TIE factors, that is, reading, abstract thinking, problem solving, and intellectual curiosity. Because stability was modeled on the latent level, it is less affected by measurement error. Correlations less than one suggest that individuals change differently. Allemand and colleagues (2008) found $r = .69$ for Openness to Experience across 12 years. Hence, the tendency of less than perfect differential stability is known from the literature on personality development. Note that the higher correlations in TIE still fit into the literature as the study cited above covers 12 years, whereas TIE was measured across a 5-year period. Generally, research on critical life events, where nonnormative events affect some individuals, has shown to lead to different developmental trajectories. Hence, it might be that changes in rank order can be partly explained by individual changes in the living conditions. A limitation of the present study is that life events were not included into the analyses.

Even within the boundaries that are provided by biological constraints in personality development, motivational influences are possible as well. Research on motivational selectivity has shown that individuals tend to restrict oneself to few personal goals that are regarded as highly important for life satisfaction. In the course of cognitive resources becoming more restricted, differences between individuals concerning the importance of intellectual activity become more pronounced. One individual might enjoy engaging in intellectual activities but still value social interaction higher when she is forced to decide in the presence of declining resources. Hence, we conclude that profound changes

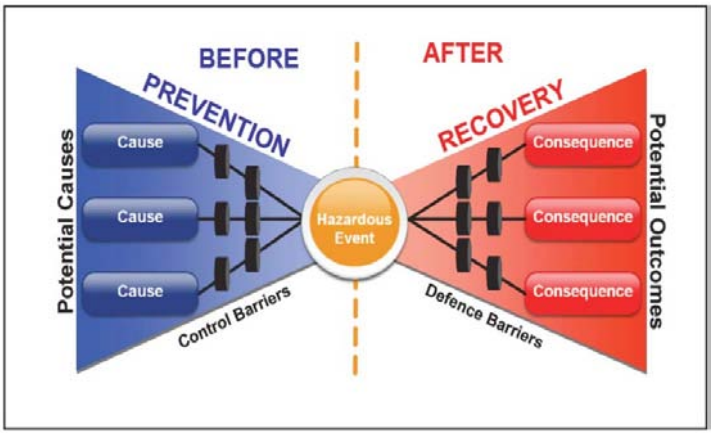
in rank order could reflect motivational selectivity and focusing on different priority goals.

Parameters that describe a construct on the group level are means and variances. In the present study, small significant mean-level changes only emerged for intellectual curiosity and problem solving. No changes in variances emerged. We propose the following explanation for the results of the present study. Participating in a longitudinal study on cognitive aging might have a unique effect on interests and intellectual activities itself. Not only are people who are highly interested in cognitive activity more likely to participate in psychological studies, participating in a study that assesses age-dependent developmental changes in intellectual activities and interests could itself influence the development. Hence, the slight increase in problem solving could reflect peculiarities of the study. In ZULU, different kinds of cognitive tests are administered. Tests such as the digit symbol test, number series, or the standard progressive matrices could have roused the participants' interest to solve for example Sudoku's in their free time. This could have resulted in a perceived increase in problem solving across the time period of 5 years.

Also, intellectual curiosity was assessed comparatively unspecific. Hence, individuals might rate their global interest in engaging in new topics as decreased. Attending a talk on a new topic outside the home could be complicated by physical deficiencies. The self-evaluation could then be confounded by perceived health issues.

We have two explanations for the stability of divergence. First, it seems possible that for significant changes in variances to occur, 5 years were too short. This explanation is in line with recent research on personality development. Small and colleagues (2003) found stability of divergence across 6 years. Hence, the 5-year interval in the present study might have been too short to exhibit changes in variances. Another explanation aims at sample selectivity. All participants were highly educated ending up in a comparatively homogeneous group with respect to intellectual interests and activities, which may lead to rather homogeneous developmental trajectories across a 5-year interval. This idea is supported by the

significant negative level–change correlations that emerged for the factors, indicating that individuals scoring high on TIE at T1 experience the least change across a 5-year period. With most of the participants being intellectually engaged, one may conclude that this imposed a restriction on the level variance in the first place and in combination with the negative level–change correlations led to a nonsignificant development of variances across 5 years in the TIE factors.



In a last step, we analyzed change correlations between the four subfactors. The highest change correlation emerged between problem solving and abstract thinking. Both factors describe more abstract aspects of intellectual engagement, which may help explain a large amount of coupled development. Among all change correlations, change in reading was the change least correlated with all other three factors. The factor "reading" aims at a highly trained, overlearned specific activity that is conceptually different from abstract thinking, problem solving, and intellectual curiosity. Because the TIE questionnaire does not assess what kind of books a person reads, reading does not necessarily imply much cognitive activity besides the activity itself. Hence, even if intellectual engagement decreases, reading as highly trained activity could remain unaffected. Likewise, if the frequency of reading decreases, the general interest in intellectual activity may remain unaffected. The positive change correlation between problem solving and intellectual curiosity implies that the

increase in problem solving provides protection against decline in intellectual curiosity. Individuals who manage to maintain their level of problem solving also benefit from less decrease in intellectual curiosity. Because correlations do not imply causality, it is also possible to interpret the results the other way around: Individuals who manage to remain intellectually curious could also benefit in a way that problem solving even increases in older age.

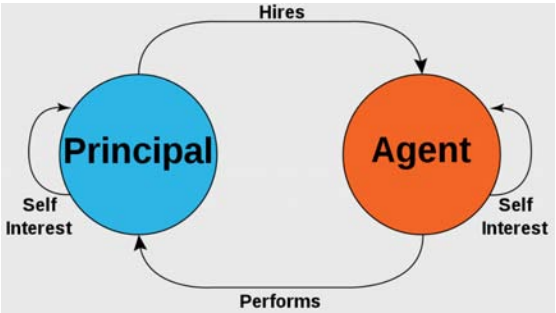
To summarize, what do the results of the present study tell us about TIE in old age? First, the structure of TIE as a construct remained stable across 5 years. Second, differential but no mean-level change emerged for all subfactors of TIE across 5 years. This demonstrates that in order to understand the development of a given construct, it is necessary to investigate different aspects of development because individual differences may be masked by change or stability on the group level.

Third, the change correlations between the four subfactors vary in magnitude, indicating different underlying mechanisms that drive change in TIE. Although the present study added important information to the literature on TIE concerning its development in older age, open questions remain to be addressed in future research.

The relation between TIE and cognition needs to be further examined. Also, the question of a causal relationship between the constructs remains unanswered. This question could be addressed only longitudinally, including more than two measurement occasions to enable cross-lagged latent analyses. Another yet equally important aspect would concern the development of TIE in middle adulthood or, generally, across the life span. Also, the specific mechanisms that cause interindividual changes in TIE need to be the objective of future studies. Because TIE is conceptualized as influencing typical intellectual performance, another area of research could engage in the question if TIE could be trained in different settings or different stages across the life span.

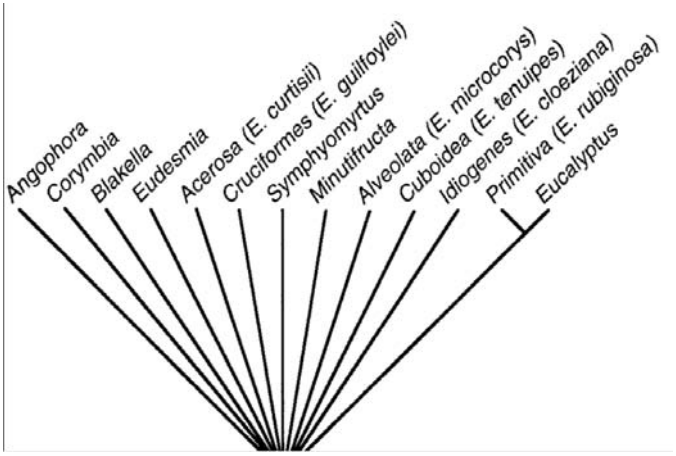
5.3 STATEMENT OF PRINCIPAL FINDINGS

We examined the effects of typical intellectual engagement on individual differences in rates of decline on two cognitive measures: the digit symbol substitution test to capture changes in mental speed, and the auditory-verbal learning test to follow changes in verbal memory performance. In our statistical models, we introduced possible confounders available from early life and life course, including scores of childhood intelligence, duration of formal education, and crystallized ability. We also controlled for practice effects associated with repeated testing.



Our results revealed correlations between subtypes of typical intellectual engagement score and late life cognition. For the problem solving domain of typical intellectual engagement and overall typical intellectual engagement, significant associations remained after adjustment for age, sex, and test practice effects. Although typical intellectual engagement was associated with cognitive ability levels in late adulthood, it had no effect on the trajectory of decline over time, which would draw into question one interpretation of the "use it or lose it" conjecture, if "losing it" is interpreted as being functionally inferior to the past. An alternative interpretation would be to define "losing it" as falling below an absolute functional threshold. Here, one could argue that the conjecture may be supported by the main effect of the problem solving domain score on the intercept of cognitive performance scores in later life. Our life course findings are consistent with other studies that have shown associations between typical intellectual engagement and cognition in cross sectional analyses.

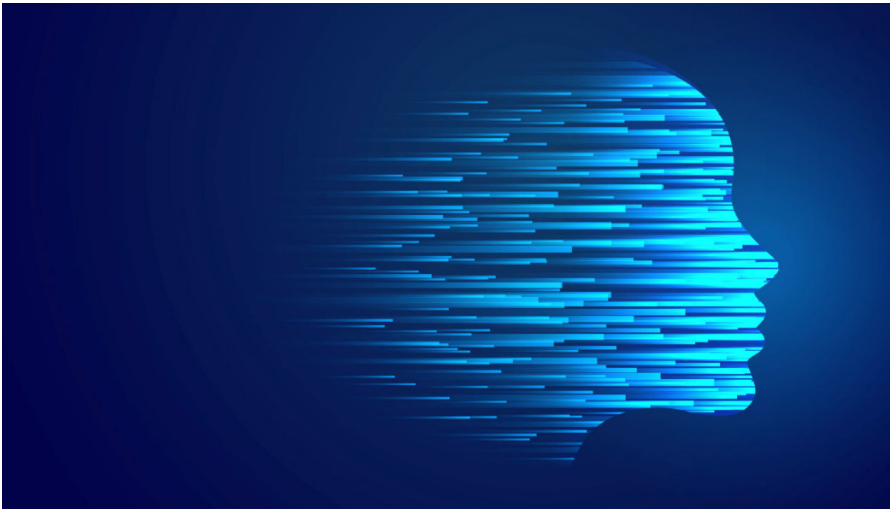
Engagement in problem solving is an independent contributor to late life cognition and has a unique effect over and above the effect of other life course variables (education, childhood intelligence, and crystallized ability). As expected, age related cognitive decline was observed for both memory and speed of performance.



5.3.1 Strengths and Weaknesses of the Study

A particular strength of the current study lies in the generalizability of its results, from a population based volunteer sample with good rates of recruitment (75%) among those eligible. However, recruitment to and retention in cognitive ageing studies is also affected by self-selection to volunteer among better educated individuals who are ageing well, which is also true of our study. Thus, the findings might be biased towards those individuals with higher cognitive performance. The availability of childhood intelligence test scores lies at the heart of our research programme. These archived data remain rare among those individuals now at increased risk of age related cognitive decline. The introduction of the effects of practice is rarely undertaken in cognitive ageing studies, and probably strengthened our design and confidence in our interpretation of results.

Although we were able to gain access to early life mental ability archives, and participants provided details of early life experiences, these data are retrospective and impossible to corroborate in most instances. As life course studies mature in later born cohorts, those currently under investigation will yield observational data collected contemporaneously in a family setting with follow-up over the life course that will reduce the reliance on recollection. Generally, all ageing studies of this type are hindered by participant dropout, and those individuals who are cognitively declining are more likely not to return for retesting, which could attenuate any age×TIE interaction effect and could be responsible for our null result.



5.3.2 Strengths and Weaknesses in Relation To other Studies

Cross sectional studies have shown that routine exercise of intellectual capacities is associated with cognitive advantage. It is, however, impossible for a causal effect to be inferred, and it is possible that cognitive advantage and engagement may be brought about by a shared origin. Here, we were able to postulate and test original ability (and education) as this shared origin, and found that engagement in problem solving is independently associated with cognition in later life. This association suggests that engagement adds to an individual's cognitive reserve —that is, individuals who engage in regular problem solving activities might require greater age related neuropath logical burdens before clinical thresholds of impairment are crossed and symptoms of cognitive decline are reported. These results indicate that engagement in problem solving does not protect an individual from decline, but imparts a higher starting point from which decline is observed and offsets the point at which impairment becomes significant. The other domains of typical intellectual engagement and the total typical intellectual engagement score are explained by sex and practice gains and early ability measures, indicating that they might not add to passive reserve in the same way.

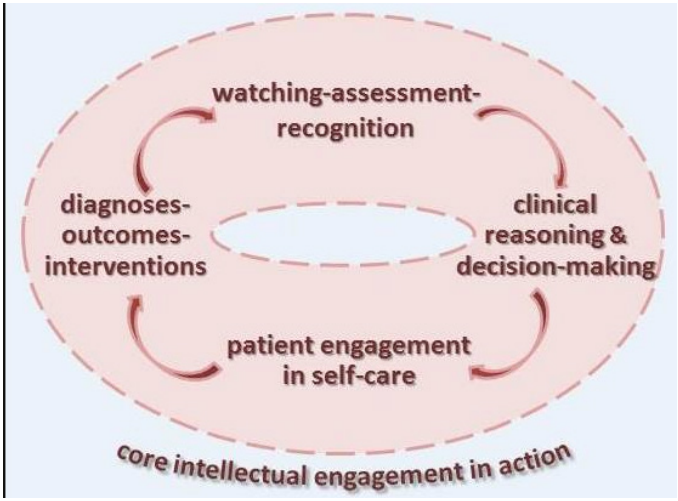
High scores on the problem solving questions requires a greater level of comfort with novelty which may influence cognitive ageing. For example, Hultsch and colleagues reported that activities reflecting novel information processing were more predictive of cognition than was overall activity level. More recently, Parisi and colleagues reported a positive relation between self-reported measures of

alertness to novelty and intellectual complexity and performance on tests of fluid intelligence. Their findings also suggested that a predisposition towards mental engagement (including a need for cognition engagement, mindfulness, and openness to experience) and activity engagement are distinct constructs that independently contribute to fluid ability. This possible conclusion highlighted the importance of the predisposition towards mental engagement, as well as the habitual tendency to participate in activities that positively influence cognitive ability throughout life.

5.3.3 Meaning of the study: Possible Explanations and Implications for Clinicians and Policymakers

Our study has several implications concerning the possible role of intellectual engagement in intervention programmes to improve resilience in cognitive ageing studies. Our results indicate that later life intervention to increase activity might not influence the trajectory of decline. The results also suggest that investment in problem solving throughout life could enhance cognitive performance, providing an individual with a higher cognitive point from which to decline.

It is difficult to judge how best to introduce our main findings to those who develop and promote cognitive training programmes to boost cognitive reserve, with the aim of buffering age related cognitive decline. Evidence for the efficacy of these programmes is limited so far, but the intentions appear laudable with no apparent ill effects. Studies in child developmental psychology have sought to link research findings modelling normal patterns of development with interventions designed to foster cognitive development and successful social adjustment. Similarly, we believe that a comparable life course approach would be advantageous, such that early interventions to slow or prevent cognitive ageing would capitalise on the covariates identified here and encourage the early acquisition of mentally effortful pursuits and their enduring exercise throughout adulthood.



5.3.4 Unanswered Questions and Future Research

It is difficult to know whether many older people can increase their brainpower by doing things such as crosswords and Sudoku. Better tests would work out how much intellectual commitment each individual makes when playing and the intensity of that commitment.

Personality could govern how much effort older people put into such activities and why. How personality and mental effort are related and how their combined influence affects cognitive performance is unclear.

As with all such findings, replication of our results in other samples is essential. In longitudinal analyses of cognitive development (and decline), the "use it or lose it" conjecture can affect the intercept (that is, an individual's entry level performance) as well as the slope of cognitive functioning (that is, an individual's rate of decline) in late adulthood. Future work in the area should clarify the analytical focus of the conjecture, and engagement might be hypothesised to influence the intercept, slope, or both indicators of cognitive performance in late life.

Finally, for those of you struggling to come up with good ideas for Christmas presents for the "developing" adults in your life—although a shiny new chess board, 1000 page Sudoku puzzle book, or all-inclusive tickets to the museum of modern art's quiz night might not influence trajectories of cognitive decline, have no fear. If family and friends give you a disappointed look on opening their Christmas present, remind them that investment in intellectual activities throughout life could provide them with a higher cognitive point from which to decline. Surely, this is as good a gift as any!

What is already known on this topic?

- The "use it or lose it" conjecture refers to the belief that cognitive function can be maintained or enhanced by exercising that function, offsetting cognitive decline in later life
- The conjecture is widely accepted by healthcare professionals and the public

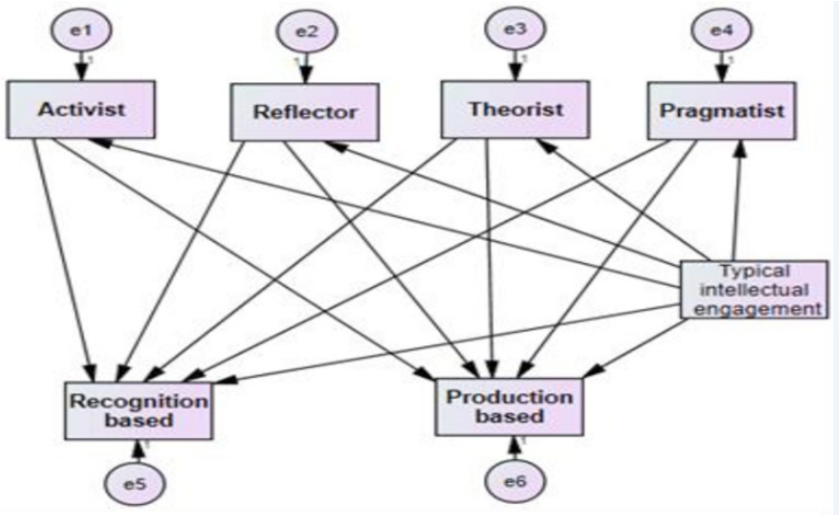
What this study adds

- This study used repeated cognitive measures in a well characterized sample of volunteers drawn from one birth year (1936)
- Self-reported intellectual engagement had no influence on the trajectory of decline of memory and processing speed
- Engagement in intellectual stimulating activities was associated with early life ability, but also had no association with the trajectory of decline in later life
- Engagement in problem solving activities had the largest association with life course cognitive gains

5.4 ASSOCIATIONS WITH TYPICAL INTELLECTUAL ENGAGEMENT

Typically, three learning approaches are differentiated: deep, achieving and surface learning. Deep learners seek to explore a topic to the greatest possible extent, aiming for a better understanding of the subject matter and its wider context. Achieving learners study to obtain the rewards that are attached to high academic results, such as a prestigious job offer or monetary rewards. Surface learners only learn those facts that are indispensable to pass, thereby applying minimum but highly targeted.

In line with this, research studies have shown that deep and achieving learning lead to better grades while surface learning tends to precede lower marks. However, the empirical evidence for the association between learning approaches and academic performance is often inconsistent.



Learning approaches overlap conceptually and empirically with broad personality traits, i.e. the Big Five that span Neuroticism, Extraversion, Openness to Experience, Agreeableness and Conscientiousness, with shared variances ranging from 25% to 45%.

A recent review showed that Neuroticism is positively related to surface learning and negatively to deep learning; Extraversion and Conscientiousness are positively associated with deep and achieving learning; and Openness is strongly linked to deep learning.

TIE refers to individual differences in typical intelligence or investment, that is, the desire to engage with and understand the world or the need to know, which is conceptually very similar to deep learning. It is unclear to what extent variances in learning approaches are accounted for when considering the Big Five, TIE and intelligence we hypothesized that (1) surface learning is negatively associated with Openness and TIE but positively with Neuroticism; (2) deep learning is positively related to Extraversion, Openness, TIE and Conscientiousness, and negatively to Neuroticism; (3) achieving learning is positively associated with Extraversion and Conscientiousness and not meaningfully with Openness or TIE; (4) Agreeableness and intelligence are unrelated to learning approaches; (5) and personality traits and ability account for the majority of variance in learning approaches.

Study process questionnaire

This 42-item questionnaire assesses three learning motives, i.e. why students learn, as well as three learning strategies, i.e. how students learn. These are divided into surface (a reproduction of what is taught to meet the minimum requirement), deep (a real understanding of what is learned), and achieving learning (aiming to maximize the grade). Thus there are six subscales (surface motive, surface strategy, deep motive, deep strategy, achieving motive, and achieving strategy) with seven items each.

Example items are ''I test myself on important topics until I understand them completely''. for deep learning; ''I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra''. for surface learning; and ''I believe that society is based on competition and schools and universities should reflect this''. for achieving learning.

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CHAPTER 6

EDUCATIONAL ATTAINMENT

INTRODUCTION

Educational attainment refers to the degree or level of completed education of a person on the basis of the followings: elementary, high school, technical vocational, Bachelor's degree in college, Masterate in Graduate School and Doctorate in Post Graduate Studies.

6.1 EDUCATIONAL ATTAINMENT OF YOUNG ADULTS

The gender gap in the percentage of 25- to 29-year-olds who had attained a bachelor's or higher degree widened from 2 percentage points in 2000 to 6 percentage points in 2019 with a higher percentage of females obtaining bachelor's or higher degrees than males.

Educational attainment refers to the level of education completed (reported here as high school completion or higher, an associate's or higher degree, a bachelor's or higher degree, or a master's or higher degree). Between 2000 and 2019, educational attainment rates among 25- to 29-year-olds increased at each attainment level. During this time, the percentage with high school completion or higher increased from 88 to 94 percent, the percentage with an associate's or higher degree increased from 38 to 49 percent, the percentage with a bachelor's or higher degree increased from 29 to 39 percent, and the percentage with a master's or higher degree increased from 5 to 9 percent.

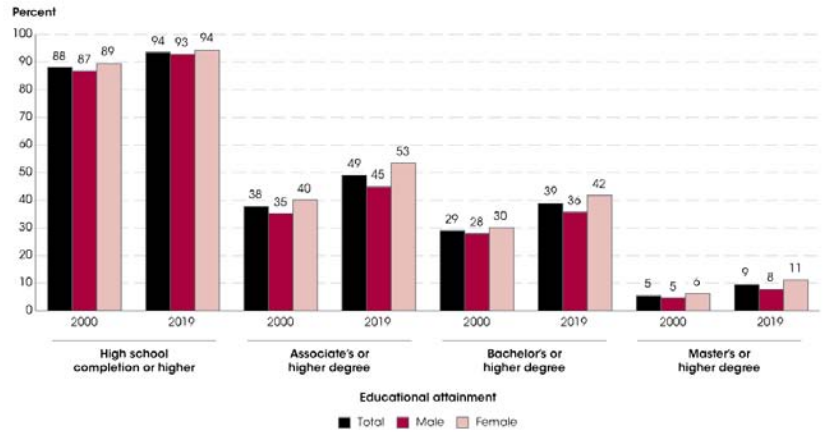

Figure 1. Percentage of 25- to 29-year-olds, by educational attainment and sex: 2000 and 2019.

Between 2000 and 2019, educational attainment rates increased for both female and male 25- to 29-year-olds across all attainment levels. During this period, attainment rates for this age group were generally higher for females than for males, and the difference between the attainment rates for females and males (also referred to in this indicator as the gender gap) widened at all attainment levels except for the high school completion or higher level. For example, at the bachelor's or higher degree level, the gender gap widened from 2 percentage points in 2000 to 6 percentage points

in 2019. Similarly, at the master's or higher degree level, the gender gap widened from 1 percentage point in 2000 to 3 percentage points in 2019. However, the gender gap at the high school completion or higher level in 2019 (2 percentage points) was not measurably different from the gap in 2000.

Gender gaps in educational attainment rates were observed across racial/ethnic groups in 2019. For White and Hispanic 25- to 29-year-olds, attainment rates were higher for females than for males at most attainment levels in 2019. For example, the Hispanic gender gap was 9 percentage points at the associate's or higher degree level and 5 percentage points at the bachelor's or higher degree level. The only exception was that there was no measurable gender gap at the high school completion or higher level for White 25- to 29-year-olds. In addition, the Black attainment rates were 5 percentage points higher for females than for males in 2019 at the master's or higher degree level, and for those who were American Indian/Alaska Native, attainment rates were 14 percentage points higher for females than males at the bachelor's or higher degree level. There was no measurable gender gap at any attainment level in 2019 for those who were Asian and for those of Two or more races.

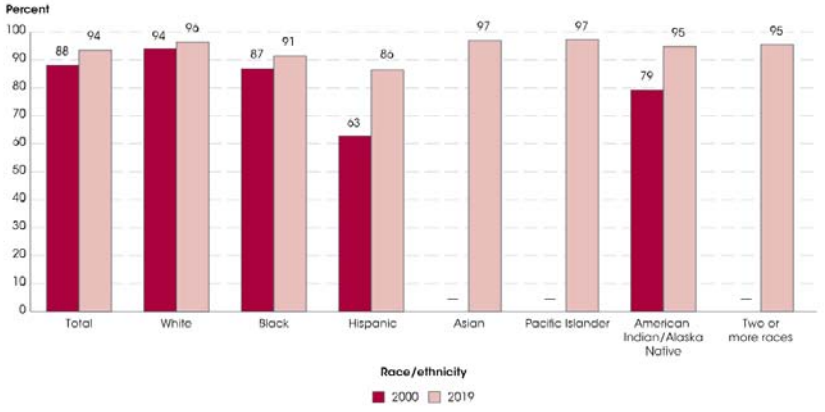

Figure 2. Percentage of 25- to 29-year-olds with high school completion or higher, by race/ethnicity: 2000 and 2019.

In 2019, the percentage of 25- to 29-year-olds with high school completion or higher was higher for those who were Asian (97 percent) and White (96 percent) than for those who were Black (91 percent) and Hispanic (86 percent). Between 2000 and 2019, the percentages with high school completion or higher increased for those who were White (from 94 to 96 percent), Black (from 87 to 91 percent), Hispanic (from 63 to 86 percent), and American Indian/ Alaska Native (from 79 to 95 percent). In addition, the percentage of Pacific Islander 25- to 29-year-olds with high school completion or higher was higher in 2019 (97 percent) than in 2003 (82 percent), the first year for which separate data on individuals who were Pacific Islander, Asian, and of Two or more races were available. The percentages who were Asian (97 percent) and of Two or more races (95 percent) with high school completion or higher in 2019 were not measurably different from the corresponding percentages in 2003.Between 2000 and 2019, the percentage of White 25- to 29-year-olds with high school completion or higher remained higher than the percentages of Black and Hispanic 25- to 29-year-olds who had attained this educational attainment level. The White-Black attainment gap at this level in 2019 (5 percentage points) was not measurably different from the corresponding gap in 2000. However, the White-Hispanic gap at this level narrowed from 31 to 10 percentage points, primarily due to the increase in the percentage of Hispanic 25- to 29-year-olds with high school completion or higher.

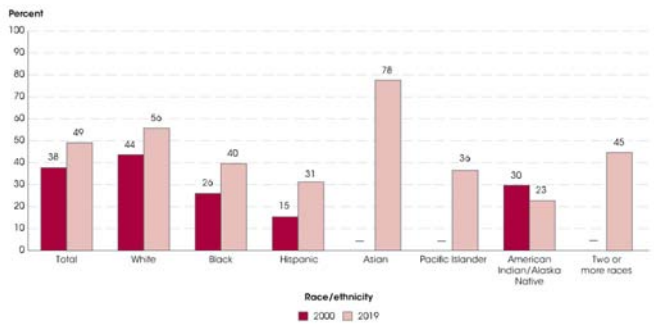

Figure 3. Percentage of 25- to 29-year-olds with an associate's or higher degree, by race/ethnicity: 2000 and 2019.

Similar to the pattern observed at the high school completion or higher level, the percentage of 25- to 29-year-olds who had attained an associate's or higher degree was higher for those who were Asian (78 percent) and White (56 percent) than for those of any other racial/ethnic group in 2019.

In addition, the percentage was higher for those who were Black (40 percent) than for those who were Hispanic (31 percent) and American Indian/Alaska Native (23 percent).

From 2000 to 2019, the percentages who had attained an associate's or higher degree increased for those who were White (from 44 to 56 percent), Black (from 26 to 40 percent), and Hispanic (from 15 to 31 percent). In addition, the percentage of Asian 25- to 29-year-olds who had attained an associate's or higher degree increased from 2003 to 2019 (from 67 to 78 percent).

The percentage of American Indian/Alaska Native 25- to 29-year-olds (23 percent) who had attained an associate's or higher degree in 2019 was not measurably different from the percentage in 2000.

Similarly, for those who were Pacific Islander or of Two or more races, the percentages with an associate's or higher degree in 2019 (36 percent and 45 percent, respectively) were not measurably different from the corresponding percentages in 2003.

The gap between the percentages of White and Black 25- to 29-year-olds who had attained an associate's or higher degree in 2019 (16 percentage points) was not measurably different from the corresponding gap in 2000, while the gap between the percentages of White and Hispanic 25- to 29-year-olds with an associate's or higher degree in 2019 (24 percentage points) was smaller than the corresponding gap in 2000 (28 percentage points).

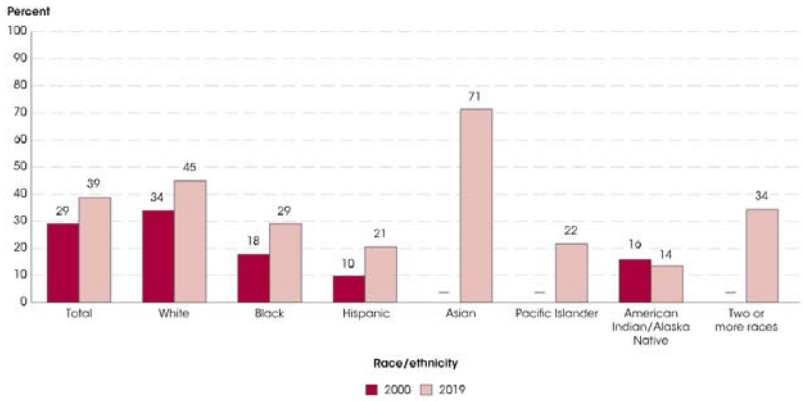

Figure 4. Percentage of 25- to 29-year-olds with a bachelor's or higher degree, by race/ethnicity: 2000 and 2019.

In 2019, among 25- to 29-year-olds, the percentages who had attained a bachelor's or higher degree were higher for those who were Asian (71 percent) and White (45 percent) than for those of any other racial/ethnic group. From 2000 to 2019, the percentages of 25- to 29-year-olds who had attained a bachelor's or higher degree increased for those who were White (from 34 to 45 percent), Black (from 18 to 29 percent), and Hispanic (from 10 to 21 percent). Similarly, the percentages of 25- to 29-year-olds who had attained a bachelor's or higher degree increased between 2003 and 2019 for those who were Asian (from 62 to 71 percent) and of Two or more races (from 22 to 34 percent). The percentage of American Indian/Alaska Native 25- to 29-year-olds who had attained a bachelor's or higher degree in 2019 (14 percent) was not measurably different from the percentage in 2000, and the percentage of Pacific Islander 25- to 29-year-olds who had attained a bachelor's or higher degree in 2019 (22 percent) was not measurably different from the percentage in 2003.

The gaps between the percentages of White and Black 25- to 29-year-olds and between the percentages of White and Hispanic 25- to 29-year-olds who had attained a bachelor's or higher degree in 2019 (16 percentage points and 24 percentage points, respectively)

were not measurably different from the corresponding gaps in 2000.

Similar to the pattern observed at the bachelor's or higher degree level, the percentage of 25- to 29-year-olds who had attained a master's or higher degree was higher for Asian 25- to 29-year-olds (29 percent) than for those of any other racial/ethnic group in 2019. In addition, the percentage was higher for those who were White (10 percent) than for those who were Black (6 percent) and Hispanic (3 percent). From 2000 to 2019, the percentages who had attained a master's or higher degree increased for those who were White (from 6 to 10 percent), Black (from 4 to 6 percent), and Hispanic (from 2 to 3 percent). In addition, the percentage of Asian 25- to 29-year-olds who had attained a master's or higher degree increased from 2003 to 2019 (from 19 to 29 percent). The percentage of 25- to 29-year-olds of Two or more races with a master's or higher degree in 2019 (10 percent) was also higher than the percentage in 2003 (4 percent).

The gap between the percentages of White and Black 25- to 29-year-olds who had attained a master's or higher degree in 2019 (4 percentage points) was not measurably different from the gap in 2000. However, the White-Hispanic gap at the master's or higher degree level widened during this time, from 4 to 7 percentage points.

6.2 INTERNATIONAL EDUCATIONAL ATTAINMENT

Across OECD countries, the average percentage of 25- to 64-year-olds with any postsecondary degree was 37 percent in 2018, an increase of 15 percentage points from 2000. During the same period, the percentage of U.S. 25- to 64-year-olds with any postsecondary degree increased 11 percentage points to 47 percent.

The Organization for Economic Cooperation and Development (OECD) is a group of 37 countries whose purpose is to promote trade and economic growth. The OECD also collects and publishes

an array of data on its member countries. This indicator uses OECD data to compare educational attainment across countries using two measures: *high school completion* and *attainment of any postsecondary degree.* In the United States, "high school completion" refers to individuals who have been awarded a high school diploma or an equivalent credential, such as the GED. "Attainment of any postsecondary degree" refers to individuals who have been awarded an associate's or higher degree.

Among the 34 countries for which the OECD reported 2018 data on high school completion rates, the percentages of 25- to 64-year-olds who had completed high school ranged from less than 40 percent in Mexico to more than 90 percent in the United States, the Slovak Republic, Canada, Poland, Lithuania, and the Czech Republic. Twenty-one countries reported that more than 80 percent had completed high school as of 2018. Additionally, among the 35 countries for which the OECD reported 2018 data on postsecondary attainment rates, the percentages earning any postsecondary degree ranged from less than 20 percent in Mexico and Italy to more than 50 percent in Japan and Canada. Twenty-six countries reported that more than 30 percent in this age range had earned any postsecondary degree as of 2018.

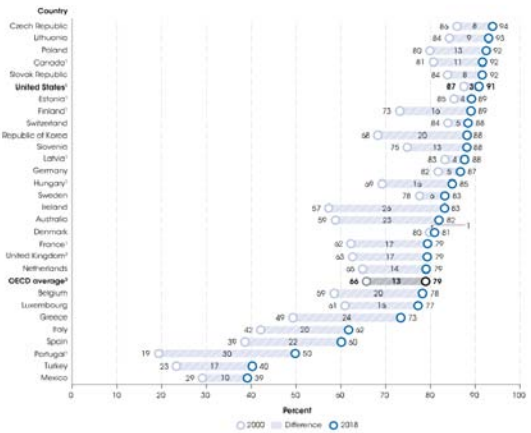

Figure 5. Percentage of the population 25 to 64 years old who had completed high school in Organization for Economic Cooperation and Development (OECD) countries: 2000 and 2018.

In each of the 29 countries for which the OECD reported data on high school completion rates in both 2000 and 2018, the percentage of 25- to 64-year-olds who had completed high school was higher in 2018 than in 2000. The OECD average percentage of those with a high school education rose from 66 percent in 2000 to 79 percent in 2018. Meanwhile, in the United States the percentage who had completed high school rose from 87 to 91 percent during this period. For 25- to 34-year-olds, the OECD average percentage who had completed high school rose from 76 to 85 percent between 2000 and 2018, while the corresponding percentage for the United States increased from 88 to 92 percent. The high school completion gap between the United States and the OECD average was narrower in 2018 than in 2000 in this age group. In 2018, the rate of high school completion among in this age group in the United States was 8 percentage points higher than the OECD average, while the gap in 2000 was 12 percentage points.

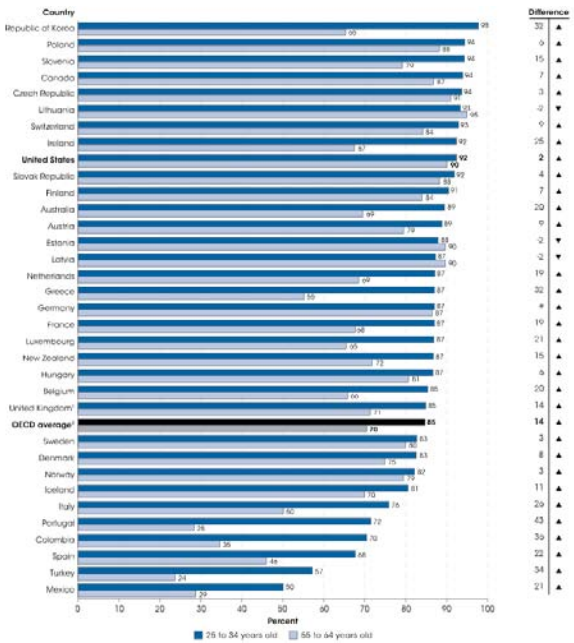

Figure 6. Percentage of the population who had completed high school in Organization for Economic Cooperation and Development (OECD) countries, by selected age groups: 2018.

In 31 of the 34 countries for which the OECD reported 2018 data on high school completion rates, higher percentages of 25- to 34-year-olds than of 55- to 64-year-olds had completed high school. Across OECD countries, the average high school completion percentage was higher for younger ages (85 percent) than for the older ages (70 percent). The three exceptions were Latvia, Estonia, and Lithuania. In 28 countries, including the United States, 80 percent or more of the younger age group had completed high school in 2018. In comparison, the percentage of the older age group who had completed high school was 80 percent or more in only 13 countries, including the United States.

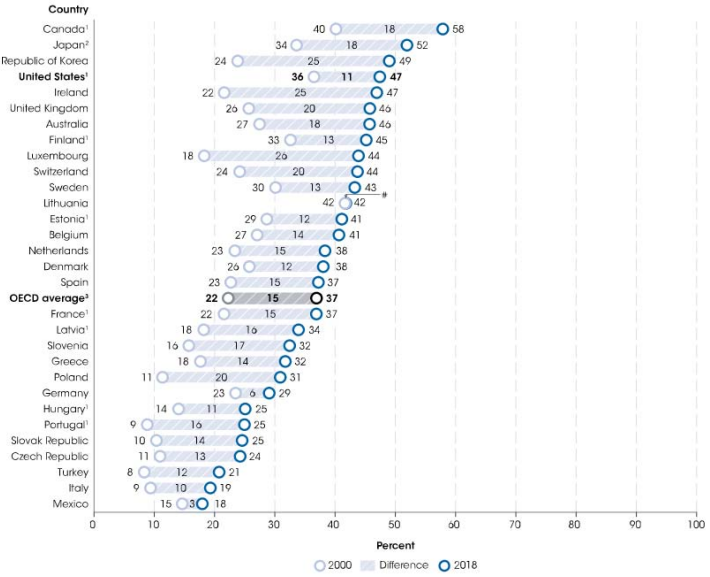

Figure 7. Percentage of the population 25 to 64 years old who had attained any postsecondary degree in Organization for Economic Cooperation and Development (OECD) countries: 2000 and 2018.

In 29 of the 30 countries for which the OECD reported data on postsecondary attainment rates in both 2000 and 2018, the percentage of 25- to 64-year-olds who had earned any postsecondary degree was higher in 2018 than in 2000. Lithuania was the only country that did not follow this pattern. During this period, the OECD

average percentage of those with any postsecondary degree increased by 15 percentage points to 37 percent in 2018, while the corresponding percentage for the United States increased by 11 percentage points to 47 percent.

For 25- to 34-year-olds, the OECD average percentage with any postsecondary degree rose from 26 percent in 2000 to 44 percent in 2018. The corresponding percentage for this age group in the United States rose from 38 to 49 percent. The postsecondary attainment gap between the United States and the OECD average narrowed in this age group between 2000 and 2018 as a result of the relatively larger increases in postsecondary degree attainment across the OECD countries. The postsecondary attainment rate in this age group in the United States was 12 percentage points higher than the OECD average in 2000; by 2018, this gap had decreased to 5 percentage points.

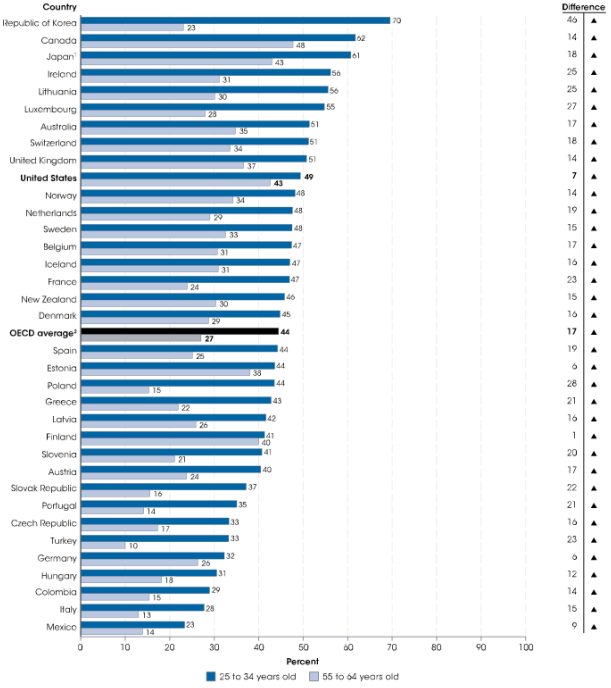

Figure 8. Percentage of the population who had attained any postsecondary degree in Organization for Economic Cooperation and Development (OECD) countries, by selected age groups: 2018.

Postsecondary attainment rates were higher among 25- to 34-year-olds than among 55- to 64-year-olds in all 35 countries for which the OECD reported 2018 data on postsecondary attainment rates. The OECD average percentage of the younger ages who had earned any postsecondary degree (44 percent) was higher than the corresponding percentage of the older ages (27 percent). In the United States, 49 percent of the younger age group had earned any postsecondary degree compared with 43 percent of the older age group. Finland (40 percent), Japan (43 percent), and Canada (48 percent) were the only other countries where 40 percent or more of the older age group had earned any postsecondary degree. In comparison, there were 24 countries in which 40 percent or more of the younger age group had earned any postsecondary degree.

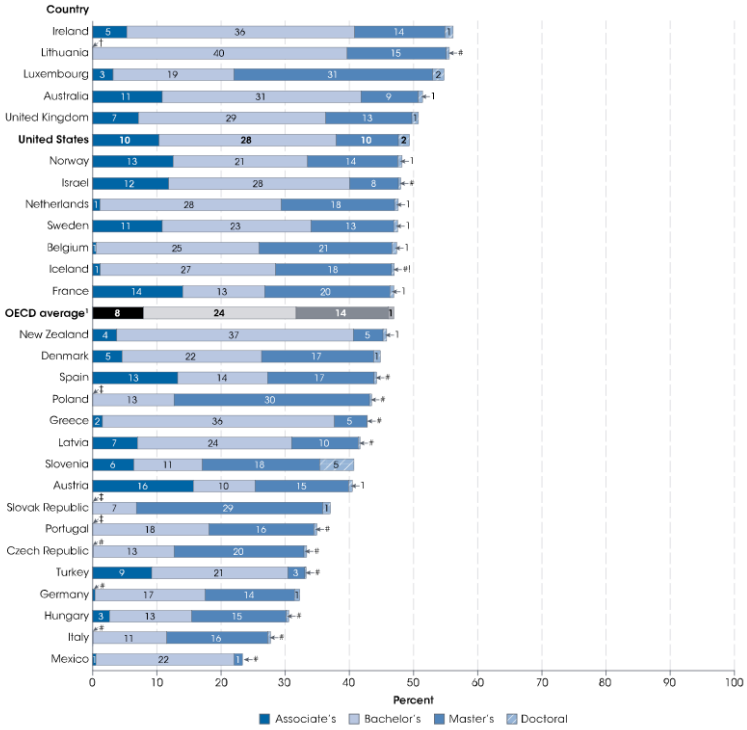

Figure 9. Percentage of the population 25 to 34 years old who had attained a postsecondary degree in Organization for Economic Cooperation and Development (OECD) countries, by highest degree attained: 2018.

The percentage of 25- to 34-year-olds who had attained specific postsecondary degrees (e.g., associate's degrees, bachelor's degrees, master's degrees, and doctoral degrees) varied across OECD countries in 2018. Among the 29 countries for which the OECD reported 2018 data for all attainment levels, the percentage of those whose highest degree attained was an associate's degree ranged from less than 1 percent in Italy, the Czech Republic, Germany, Mexico, and Belgium to 16 percent in Austria. The percentage of those whose highest degree attained was an associate's degree in the United States (10 percent) was higher than the OECD average (8 percent). The percentage of this age group whose highest degree attained was a bachelor's degree ranged from 7 percent in the Slovak Republic to 40 percent in Lithuania. In the United States, the percentage of those whose highest degree attained was a bachelor's degree (28 percent) was higher than the OECD average (24 percent). The percentage of those whose highest degree attained was a master's degree ranged from 1 percent in Mexico to 31 percent in Luxembourg. The percentage of this age group in the United States whose highest degree attained was a master's degree (10 percent) was lower than the OECD average (14 percent). Finally, the percentage in this age group who attained a doctoral degree did not vary as widely across OECD countries: with the exception of Ireland (just above 1 percent), the United States and Luxembourg (both 2 percent), and Slovenia (5 percent), all countries reported that 1 percent or less of 25- to 34-year-olds had attained this level of education.

6.3 TRENDS IN EMPLOYMENT RATES BY EDUCATIONAL ATTAINMENT

The employment to population ratio, also referred to as the employment rate, represents the proportion of the civilian population that is employed, and it is used as a measure of labor market conditions and the economy's ability to provide jobs for a growing population. In 2012, the employment rate was 69 percent for young adults (those ages 20-24) and 74 percent for 25- to

34-year-olds. Between 1990 and 2012, employment rates for adults with at least a bachelor's degree were higher than employment rates for adults without a bachelor's degree. This pattern was consistently observed for young adults, 25- to 64-year-olds, and 25- to 34-year-olds (a subset of 25- to 64-year-olds).

The *employment to population ratio*, also referred to as the employment rate, represents the proportion of the civilian population that is employed, and it is used as a measure of labor market conditions and the economy's ability to provide jobs for a growing population. In this indicator, *employment to population ratio* and *employment rate* are used interchangeably.

The employment to population ratio and unemployment rate are related. Movements in the unemployment rate reflect net changes in the number of people who are looking for work but are unable to find it, while movements in the employment to population ratio reflect whether the economy is generating jobs fast enough to provide employment for a constant proportion of the population.

Further, changes in the employment to population ratio for a particular subgroup (e.g., male high school dropouts) indicate the economy's performance in providing jobs for that particular group.

This spotlight examines employment rates between 1990 and 2012 for three age groups: young adults (those ages 20-24), 25- to 34-year-olds, and 25- to 64-year-olds. In 2012, the employment rate was 69 percent for young adults and 74 percent for 25- to 34-year-olds.

The employment rate for 25- to 64-year-olds overall (72 percent) was higher than the employment rate for young adults, but lower than the employment rate for 25- to 34-year-olds. This indicator also examines employment rates by educational attainment, which refers to the highest level of education achieved (i.e., less than high school completion, high school completion, some college, or a bachelor's degree or higher).

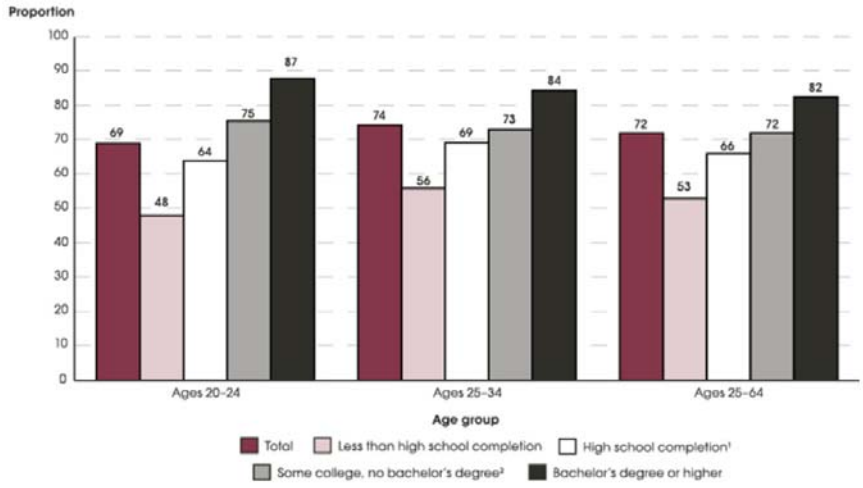

Figure 10. Employment to population ratios, by age group and educational attainment: 2012.

Between 1990 and 2012, employment rates for adults with at least a bachelor's degree were generally higher than employment rates for adults without a bachelor's degree.

This pattern was consistently observed for young adults, 25- to 34-year-olds, and 25- to 64-year-olds. In 2012, for example, the employment rate for young adults was 87 percent for those with at least a bachelor's degree, compared with 75 percent for those whose educational attainment was some college, 64 percent for high school completers, and 48 percent for those who did not complete high school. The employment rate for 25- to 34-year-olds was higher for those with at least a bachelor's degree (84 percent) than for those with some college education (73 percent), those who were high school completers (69 percent), and those who did not complete high school (56 percent). This pattern of higher employment rates corresponding with higher levels of educational attainment also generally held across males and females for each age group from 1990 to 2012.

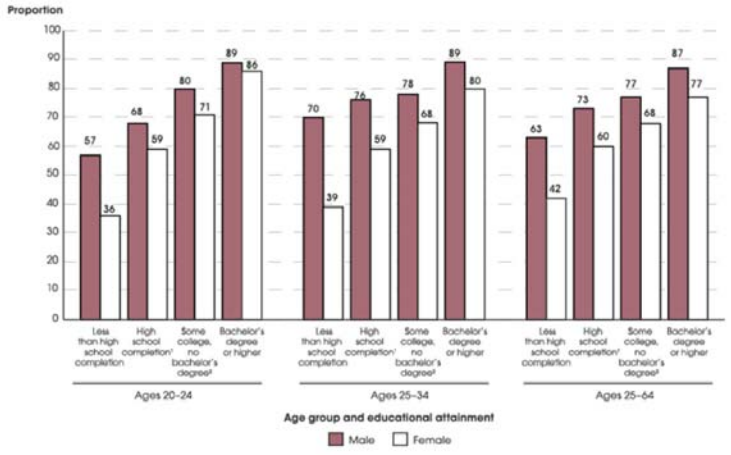

Figure 11. Employment to population ratios, by age group, educational attainment, and sex: 2012.

Among young adults, males without a bachelor's degree generally had higher employment rates than their female counterparts between 1990 and 2012. In 2012, for example, the employment rate for young adults whose educational attainment was less than high school was 57 percent for males and 36 percent for females, and the employment rate for young adults whose educational attainment was high school completion was 68 percent for males and 59 percent for females. The employment rate for male young adults with some college education was 80 percent in 2012, while it was 71 percent for their female counterparts. In most years during the period, however, employment rates for female and male young adults who had at least a bachelor's degree were not measurably different. For 25- to 64-year-olds, as well as for its subset population of 25- to 34-year-olds, the employment rate for females was lower than that for males at each level of educational attainment between 1990 and 2012. For example, in 2012 the employment rate was 39 percent for female 25- to 34-year-olds who did not complete high school, compared with 70 percent for their male counterparts.

When there was a male-female gap in employment rates, it was generally wider for those who completed high school, as well as those who did not, than for those who attained at least a bachelor's

degree. This pattern was observed for every age group examined between 1990 and 2012. For example, for 25- to 34-year-olds, the male-female gaps in 2012 were 31 percentage points for those who did not complete high school and 17 percentage points for high school completers, compared with an 9-percentage-point gap for those who had at least a bachelor's degree. For 25- to 64-year-olds, the male-female gaps were 21 percentage points for those who did not complete high school and 13 percentage points for high school completers, while the gap was 10 percentage points for those who had at least a bachelor's degree.

During the most recent economic recession, employment rates generally declined across age groups and educational attainment levels. The magnitude of change in employment rates varied by sex and by educational attainment. In general, the recession had a less marked effect on the employment rate of males with at least a bachelor's degree than on the rate of males with less than a bachelor's. For females, the magnitude of change in the employment rate was not measurably different across educational levels. And although the economy was recovering in 2010, the employment rate for females, in general, did not change measurably from 2010 to 2012. Compared with the employment rate in 2008, the employment rate in 2012 was either lower or not measurably different for both males and females across the age groups and educational achievement levels examined.

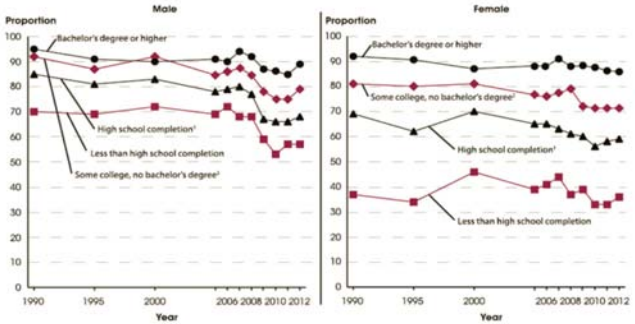

Figure 12. Employment to population ratios of persons 20 to 24 years old, by sex and educational attainment: Selected years, 1990 through 2012.

The employment rate for young adult male 20- to 24-year-olds was lower in 2010 than in 2008 at each level of educational attainment. However, from 2008 to 2010, the 6-percentage-point decrease (from 92 to 86 percent) for males who had at least a bachelor's degree was smaller than the 15-percentage-point decrease (from 68 to 53 percent) for males who did not complete high school.

For female 20- to 24-year-olds, the employment rate declined from 2008 to 2010 for those with some college education (from 79 to 71 percent) and for high school completers (from 61 to 56 percent).

Though the economy was recovering from 2010 to 2012, the employment rate did not change measurably for either male or female 20- to 24-year-olds at any level of educational attainment except for the rate for males who had some college education (which increased from 75 percent in 2010 to 80 percent in 2012).

Over the entire four year period from 2008 to 2012, the employment rate decreased for male young adults who did not attain a bachelor's degree:

For those who had some college education, the employment rate was 80 percent in 2012 vs. 85 percent in 2008; for high school completers, it was 68 percent in 2012 vs. 77 percent in 2008; and for those who did not complete high school, it was 57 percent in 2012 vs. 68 percent in 2008.

The employment rate for young adult males with at least a bachelor's degree in 2012, however, was not measurably different from that in 2008. The 2012 employment rate for young adult females with some college education (71 percent) was lower than the corresponding 2008 employment rate (79 percent). However, employment rates in 2012 were not measurably different from those in 2008 for female young adults at any of the other three levels of educational attainment examined.

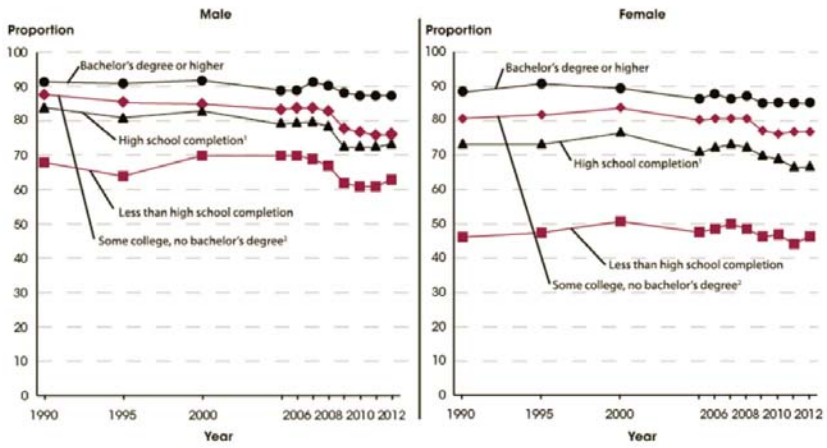

Figure 13. Employment to population ratios of persons 25 to 64 years old, by sex and educational attainment: Selected years, 1990 through 2012.

For 25- to 64-year-olds, male and female employment rates decreased from 2008 to 2010 at each level of educational attainment examined. In addition, the 3-percentage-point decrease (from 90 to 87 percent) for males with at least a bachelor's degree was smaller than the 6-percentage-point decrease (from 83 to 77 percent) for males with some college education and the 7-percentage-point decrease (from 78 percent to 72 percent) for male high school completers. Although the employment rate declined for females who did not complete high school (from 44 to 42 percent), female high school completers (from 65 to 62 percent), females with some college education (from 73 to 69 percent), and females with at least a bachelor's degree (from 79 to 77 percent) during this period, the magnitudes of decrease were not measurably different between these levels of educational attainment.

From 2010 to 2012, the employment rate did not change measurably, generally speaking, for either males or females at any of the levels of educational attainment examined, with the exception that the employment rate continued to decline for female high school completers (from 62 to 60 percent) and females with some college education (from 69 to 68 percent).

Over the entire four year period, employment rates for both male and female 25- to 64-year-olds were generally lower in 2012 than in 2008 at each level of educational attainment.

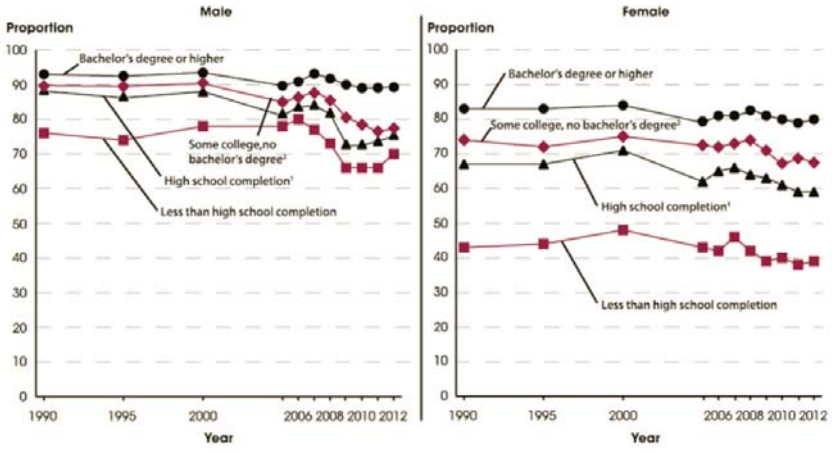

Figure 14. Employment to population ratios of persons 25 to 34 years old, by sex and educational attainment: Selected years, 1990 through 2012.

Regarding the 25- to 34-year-old age group, male employment rates were lower in 2010 than in 2008 at each level of educational attainment. From 2008 to 2010, the employment rate decrease was 2 percentage points (from 92 to 89 percent) for males with at least a bachelor's degree, compared with 8 percentage points (from 86 to 79 percent) for males with some college education, 9 percentage points (from 82 to 73 percent) for male high school completers, and 7 percentage points (from 73 percent to 67 percent) for males who did not complete high school. The female employment rate in 2010 was lower than in 2008 for those with at least a bachelor's degree (80 vs. 83 percent) and for those whose educational attainment was some college (68 vs. 74 percent). Between 2010 and 2012, the employment rate did not measurably change for females at any level of educational attainment, and the employment rate only changed for males who were high school completers—their employment rate was higher in 2012 (76 percent) than in 2010 (73 percent). For both males and females, the 2012 employment rates

remained lower than they were in 2008 at each level of educational attainment except for those who did not complete high school. For both males and females who did not complete high school, the seemingly lower employment rates in 2012 were not statistically different from the rates in 2008 due to relatively large sampling errors.

6.4 DISABILITY RATES AND EMPLOYMENT STATUS BY EDUCATIONAL ATTAINMENT

About 16 percent of 25- to 64-year-olds who had not completed high school had one or more disabilities in 2015, compared to 11 percent of those who had completed high school, 10 percent of those who had completed some college, 8 percent of those who had completed an associate's degree, 4 percent of those who had completed a bachelor's degree, and 3 percent of those who had completed a master's or higher degree. Differences in the employment and not-in-labor-force percentages between persons with and without disabilities were substantial, amounting to about 50 percentage points each. Among those who had obtained higher levels of education, the differences were smaller.

Persons with disabilities have lower employment rates than persons without disabilities, according to reports produced by the Bureau of Labor Statistics (BLS). For all age groups, BLS found that the 2015 employment-population ratio was lower for persons with disabilities than for those with no disability. This spotlight indicator looks at the employment of persons with disabilities in the context of educational attainment. For the purposes of this analysis, individuals are classified as employed, unemployed (individuals without jobs who are actively looking for work), or not in the labor force (individuals without jobs who are not actively looking for work). This indicator finds that, on average, disability rates are higher among persons with lower levels of education and that individuals with disabilities have lower levels of employment than persons who do not have disabilities. The comparatively lower level of employment for persons with disabilities overall

reflects both the generally lower level of employment for persons with less education and the lower level of employment for people with disabilities within each level of educational attainment.

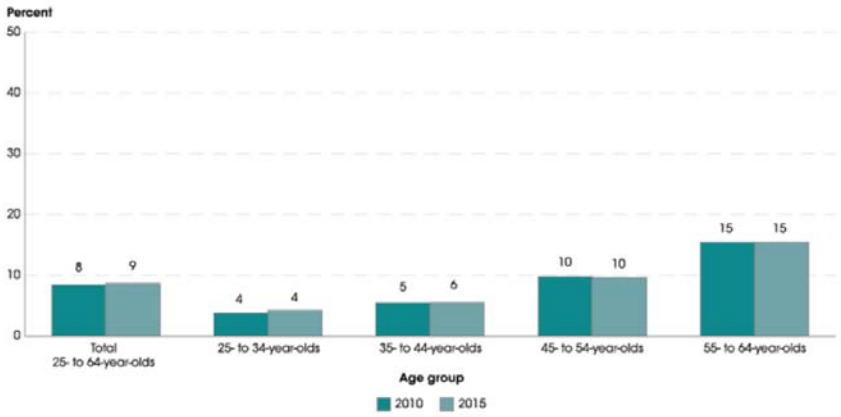

Figure 15. Percentage of 25- to 64-year-olds with disabilities, by age group: 2010 and 2015.

6.4.1 Percentages of Persons with Disabilities

In this indicator, persons were classified as having one or more disabilities if they reported having any of the following characteristics: deafness or serious difficulty hearing; blindness or serious difficulty seeing even when wearing glasses; serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional condition; serious difficulty walking or climbing stairs; difficulty dressing or bathing; and difficulty doing errands alone such as visiting a doctor's office or shopping because of a physical, mental, or emotional condition. Overall, 14.4 million, or 9 percent, of the 25- to 64-year-old population reported at least one of these disabilities in 2015. The number of 25- to 64-year-olds with disabilities was higher in 2015 than in 2010 (13.6 million). To some extent, this change reflects population growth between 2010 and 2015, as there was no measurable change over this period in the percentage of persons with disabilities.

A higher percentage of older persons had disabilities compared to younger persons in 2015. For example, the disability rate was 15 percent for 55- to 64-year-olds, compared to 10 percent for 45- to 54-year-olds, 6 percent for 35- to 44-year-olds, and 4 percent for 25- to 34-year-olds. The disability rate for 25- to 34-year-olds was higher in 2015 (4.2 percent) than in 2010 (3.7 percent). For other age groups, the disability rate in 2015 was not measurably different from the rate in 2010.

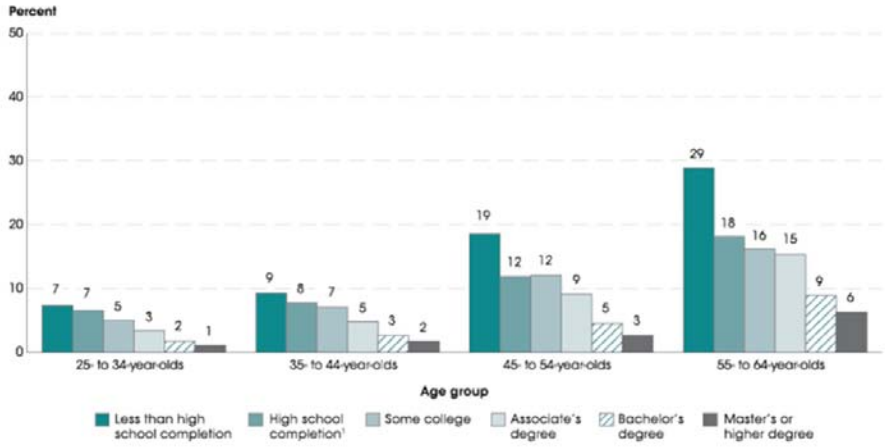

Figure 16. Percentage of 25- to 64-year-olds with disabilities, by age group and educational attainment: 2015.

In 2015, the disability rate was higher for persons with less education than for those with higher educational attainment, both overall and within each age group. The disability rate was 16 percent for 25- to 64-year-olds who had not completed high school, compared to 11 percent for those who had completed high school, 10 percent for those who had completed some college, 8 percent for those with an associate's degree, 4 percent for those with a bachelor's degree, and 3 percent for those with a master's or higher degree. These patterns were generally observed within each age group, with few exceptions. For example, among 25- to 34-year-olds, there was no measurable difference between the disability rates for those who had not completed high school and

those who had completed high school (both 7 percent), but both were higher than the disability rates for those with more education.

The gap in disability rates between the lowest and highest educational attainment groups is larger for the oldest group (55- to 64-year-olds) than for the youngest group (25- to 34-year-olds).

Specifically, among 55- to 64-year-olds, the disability rate was 23 percentage points higher for persons who had not completed high school (29 percent) than for those with a master's or higher degree (6 percent).

In contrast, among 25- to 34-year-olds, the disability rate was 6 percentage points higher for those who had not completed high school (7 percent) than for those who had completed a master's or higher degree (1 percent).

While disability rates are generally higher for older adults than for younger adults, the gaps by educational attainment within each age group are large enough that the disability rate for 25- to 34-year-olds who had not completed high school was not measurably different from the rate for 55- to 64-year-olds who had completed a master's degree.

There was no measurable difference between the disability rates for male and female 25- to 64-year-olds in 2015 (both were 9 percent). However, there were differences by race/ethnicity.

Among 25- to 64-year-olds, disability rates were lower for those who were Asian (3 percent), Pacific Islander (5 percent), and Hispanic (7 percent) than for those who were White (9 percent), Black (12 percent), of Two or more races (14 percent), and American Indian/Alaska Native (15 percent).

The pattern of higher disability rates for persons who had not completed high school compared to those with a bachelor's or higher degree was observed across all racial/ethnic groups with available data in 2015 (White, Black, Hispanic, Asian, and Two or more races).

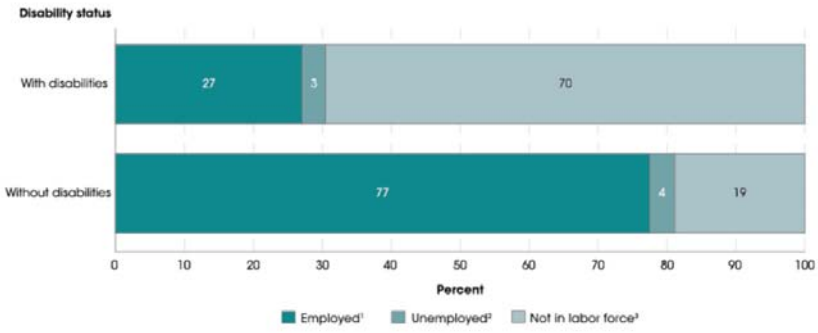

Figure 17. Percentage distribution of 25- to 64-year-olds with and without disabilities, by labor force status: 2015.

6.4.2 Employment of 25- to 64-Year-Olds with and Without Disabilities

Studies by BLS have found that persons with disabilities participate in the labor force at lower rates than persons without disabilities. The analysis below builds on those findings by examining patterns in labor force outcomes (percentages of individuals who were employed, unemployed, or not in the labor force) by educational attainment.

Overall, 27 percent of 25- to 64-year-olds with disabilities were employed in 2015, compared to 77 percent of those without disabilities. On the other hand, 70 percent of those with disabilities were not in the labor force, compared to 19 percent of those without disabilities. There was no measurable difference between the overall unemployment percentages for individuals with and without disabilities (3 and 4 percent, respectively). Note that the unemployment percentage presented here is not comparable to unemployment rates produced by BLS, which exclude individuals not in the labor force.

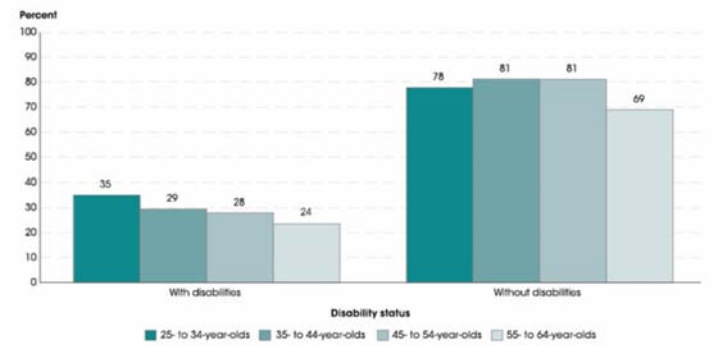

Figure 18. Employment percentage of 25- to 64-year-olds with and without disabilities, by age group: 2015.

In 2015, among each age group examined in this indicator, employment percentages were higher for persons without disabilities than for those with disabilities. The gap ranged from 43 percentage points for 25- to 34-year-olds to 53 percentage points for 45- to 54-year-olds. Among persons with disabilities, a higher percentage of 25- to 34-year-olds were employed (35 percent) than of 35- to 44-year-olds (29 percent), 45- to 54-year-olds (28 percent), and 55- to 64-year-olds (24 percent). The pattern of employment by age group was somewhat different for persons without disabilities. Although the percentage of 25- to 34-year-olds who were employed (78 percent) was higher than the percentage for 55- to 64-year-olds (69 percent), it was lower than the percentages for 35- to 44-year-olds and 45- to 54-year-olds (both 81 percent).

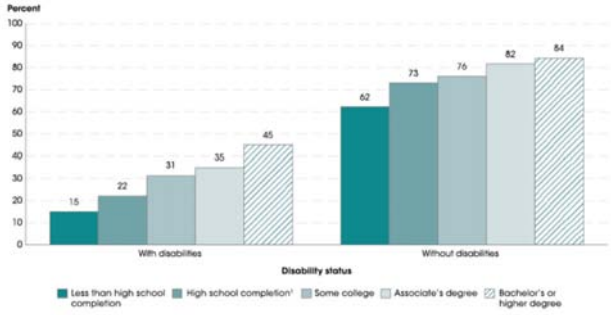

Figure 19. Employment percentage of 25- to 64-year-olds with and without disabilities, by educational attainment: 2015.

In 2015, lower levels of educational attainment were associated with lower employment percentages both for persons with and without disabilities. Among 25- to 64-year-olds with disabilities, employment percentages for those who had not completed high school (15 percent) or had completed only high school (22 percent) were lower than for those who had completed some college (31 percent), an associate's degree (35 percent), or a bachelor's or higher degree (45 percent). Similarly, among those without disabilities, employment percentages for those who had not completed high school (62 percent) or had completed only high school (73 percent) were lower than for those who had completed some college (76 percent), an associate's degree (82 percent), or a bachelor's or higher degree (84 percent). The gap in employment percentages between those with and without disabilities was smaller for those with a bachelor's or higher degree (39 percentage points) than for those with an associate's degree (47 percentage points), those with a high school credential (51 percentage points), and those who had not completed high school (47 percentage points).

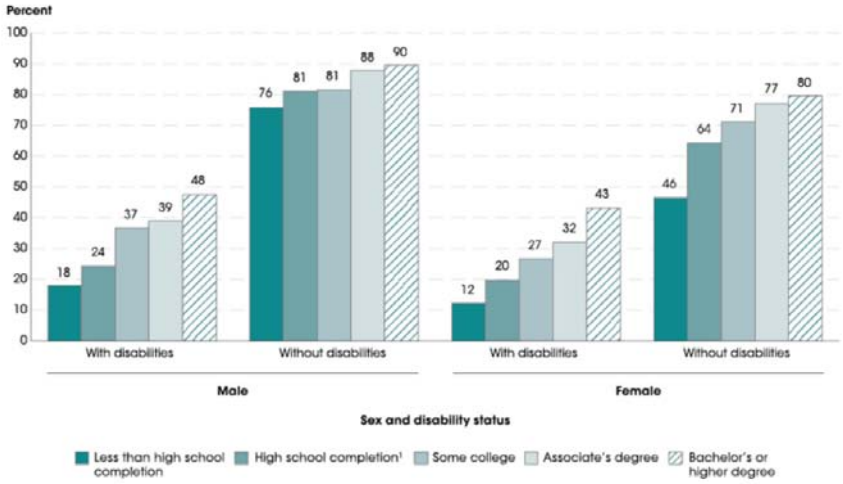

Figure 20. Employment percentage of 25- to 64-year-olds with and without disabilities, by sex and educational attainment: 2015.

Among 25- to 64-year-olds in 2015, the employment percentage for males was higher than for females, regardless of disability

status. The male-female gap in employment percentages was smaller for persons with disabilities (5 percentage points) than for those without disabilities (13 percentage points). This pattern was also observed among those who had not completed high school and those who had a high school credential. For example, among persons who had not completed high school, the male-female gap in employment percentages was 6 percentage points for those with disabilities and 29 percentage points for those without disabilities.

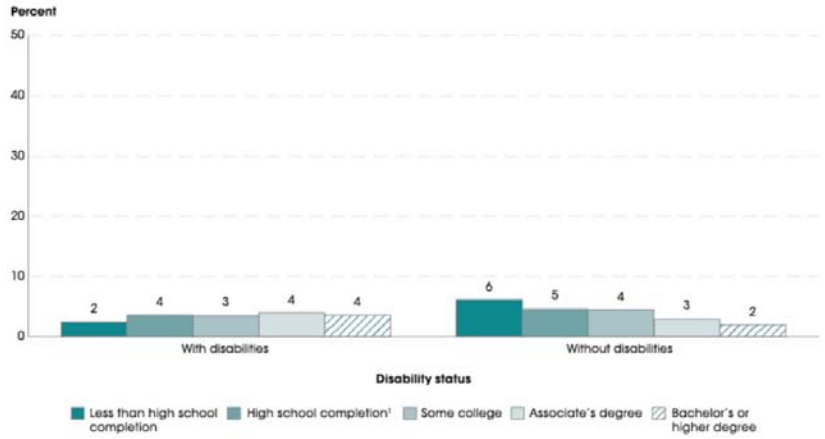

Figure 21. Unemployment percentage of 25- to 64-year-olds with and without disabilities, by educational attainment: 2015.

6.4.3 Unemployment Percentages for 25- to 64-Year-Olds with and Without Disabilities

In 2015, the percentage of 25- to 64-year-olds with disabilities who were unemployed (3.4 percent) was not measurably different from the unemployment percentage of those without disabilities (3.6 percent); however, there were differences by educational attainment. It is important to keep in mind when interpreting these unemployment percentages that the employment percentage is lower for 25- to 64-year-olds with disabilities than for those without disabilities. Thus, the number of unemployed persons relative to employed persons (i.e., the unemployment rate as

defined by BLS) is higher for 25- to 64-year-olds with disabilities (11.0 percent) than for those without disabilities (4.5 percent).

For persons without disabilities, higher educational attainment was often associated with lower unemployment percentages. For example, those who had completed an associate's degree and those who had completed a bachelor's or higher degree had lower unemployment percentages than those who had not completed high school. Among those who had not completed high school, the unemployment percentage for persons with disabilities (2.4 percent) was lower than for persons without disabilities (6.1 percent). In contrast, among those who had completed a bachelor's or higher degree, the unemployment percentage was higher for persons with disabilities (3.5 percent) than for those without disabilities (2.0 percent).

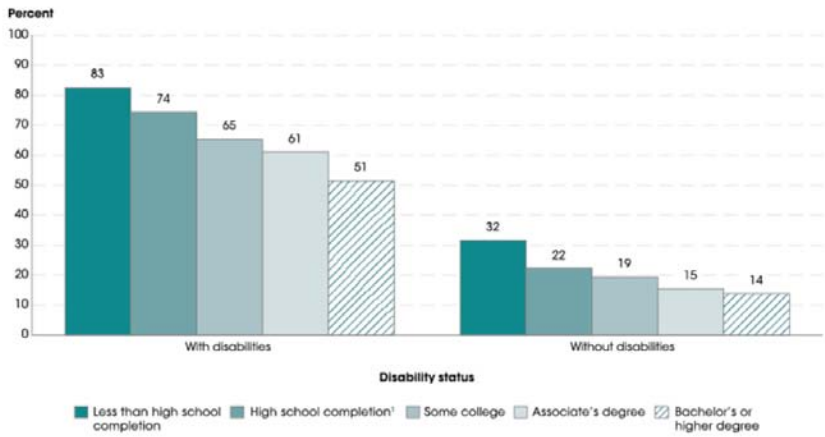

Figure 22. Not-in-labor-force percentage of 25- to 64-year-olds with and without disabilities, by educational attainment: 2015.

6.4.4 Not-In-Labor-Force Percentages for 25- to 64-Year-Olds with and Without Disabilities

Since there was no measurable overall difference in unemployment percentages in 2015 between those with and without disabilities,

the differences in not-in-labor-force percentages between persons with and without disabilities largely reflected the relative percentages of persons employed. The percentage of 25- to 64-year-olds with disabilities who were not in the labor force (70 percent) was higher than the percentage for those without disabilities (19 percent).

While higher percentages of persons with disabilities were not participating in the labor force for all educational attainment groups in 2015, the largest differences were observed among those with lower levels of educational attainment. For example, among those who had not completed high school, the percentage of persons with disabilities not in the labor force (83 percent) was 51 percentage points higher than the percentage for those without disabilities (32 percent). The differences in the percentages for those not participating in the labor force were smaller at higher levels of educational attainment. For example, among those who had completed a bachelor's or higher degree, the not-in-labor force percentage for persons with disabilities (51 percent) was 38 percentage points higher than the percentage for those without disabilities (14 percent).

In summary, this indicator finds that in 2015, higher percentages of 25- to 64-year-olds with lower levels of education had disabilities compared to those with higher levels of education. Differences in the employment and not-in-labor-force percentages between persons with and without disabilities are substantial, amounting to about 50 percentage points each. Among those who had obtained higher levels of education, the differences were smaller.

6.5 WHY EDUCATIONAL ATTAINMENT IS CRUCIAL TO IMPROVING POPULATION HEALTH

The two major premises underlying all of the discussions in this workshop were that education is an important determinant of health and that any successful effort to improve health at a population level will depend on improving the overall education

level of the American public. In the workshop's first keynote presentation, Steven Woolf, director of the Center on Society and Health and professor of family medicine and population health at Virginia Commonwealth University, reviewed the evidence base for the strong relationship between education and health. He also discussed a strategy for getting the public health and education policy communities working together toward common goals.

"It is clear that education is a big deal in terms of public health outcomes, and it is appropriate for the Roundtable on Population Health Improvement to make this a priority topic," Woolf said at the start of his presentation.

The data show, for example, that by age 25, U.S. adults without a high school diploma can expect to live 9 fewer years than college graduates.

Similarly, those individuals with less than a high school education are almost twice as likely to die in a given year as those with a professional degree, and even those who have completed college with a bachelor's degree are 26 percent more likely to die than those with professional degrees (see Figure 23).

Woolf noted that evidence accumulated since the 1960s indicates that the impact of educational attainment on health appears to be growing.

"This is not a static problem," he said, "and in our knowledge economy, the difference in health between educated and non-educated Americans has progressively widened." Woolf added that while this appears to be a problem in all industrialized countries, it is especially so in the United States. The data also show that while there are steadily increasing benefits to getting more education, there is a major jump in the health benefits—what Woolf described as a "step-like benefit"—associated with high school graduates also graduating from college (see Figure 24).

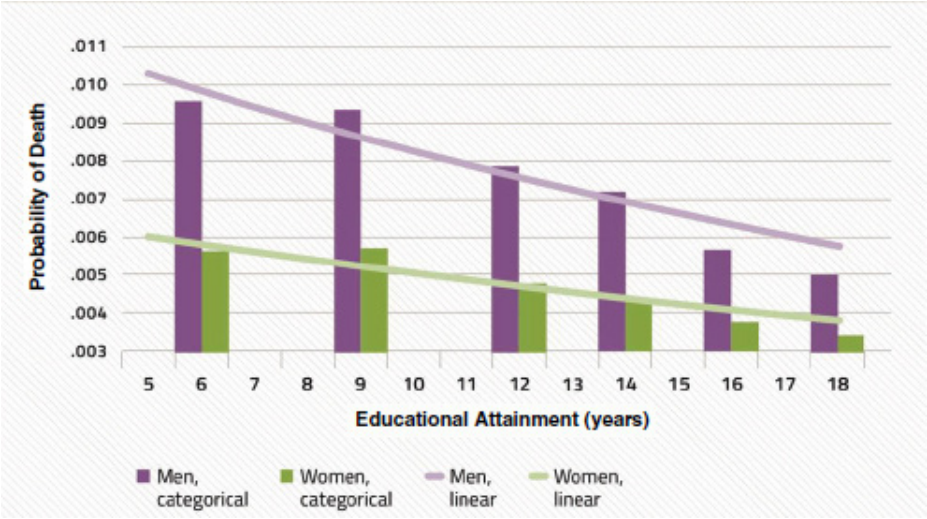

Figure 23. All-cause mortality risk for men and women by years of education.

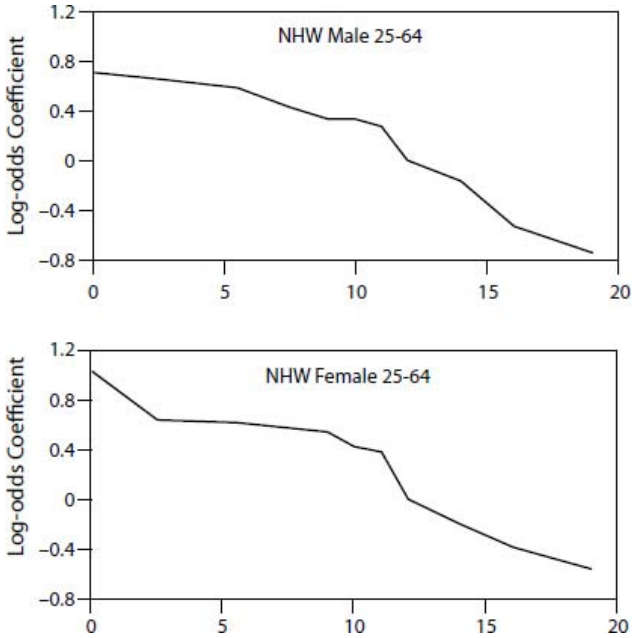

Figure 24. The relationship between education and health shows clear step-like behavior at 12 years of formal education.

What the data are showing, Woolf said, is that people who do not graduate from high school are experiencing an increase in mortality rates while everyone else is experiencing a decline in mortality. This is partly a selection phenomenon, he said. "The people who don't graduate from high school over time are becoming a more select population of sicker people because of the movement of the rest of society into the more educated population," Woolf said.[1] This trend is particularly true for white Americans and especially white women (see Figure 25). In 2008, white men with fewer than 12 years of education had the same life expectancy as U.S. men born in 1972, while white women with this level of education had the same life expectancy as U.S. women born in 1964.

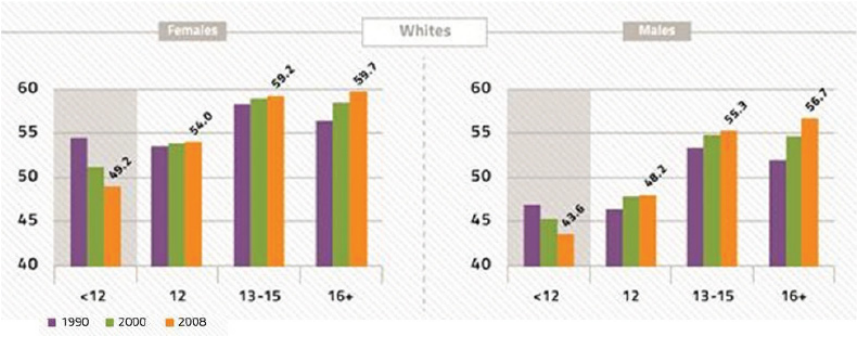

Figure 25. Life expectancy at age 25 years by educational attainment level in years from 1990, 2000, and 2008.

The link between education and health is not confined to death rates, Woolf said; it applies to the prevalence of major diseases as well. "If you look at any number of health metrics, you again see this graded relationship in terms of education," he said. For example, self-reports of fair or poor health are some five-fold higher in high school dropouts than among those with a bachelor's degree or higher (see Figure 26). Similar trends are seen for most other major diseases, he said (see Table 1). The numbers show that there is "nothing we do in clinical medicine at the bedside or in the exam room that achieves differences in the numbers that we're seeing," Wolf said. "Education is that big of a deal."

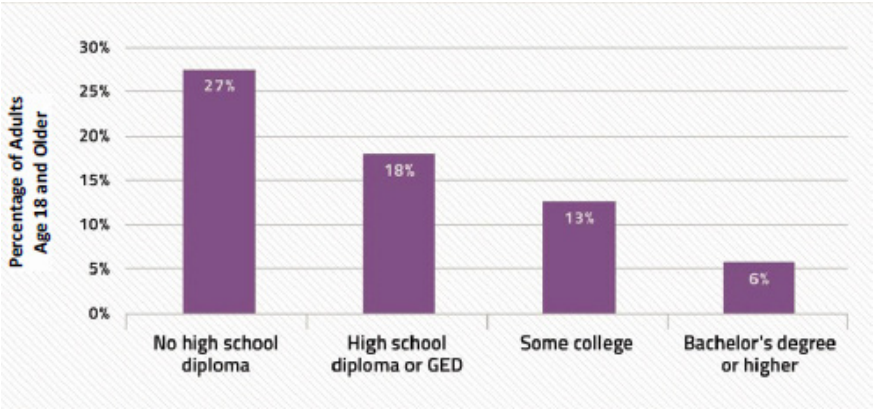

Figure 26. Self-reports of fair or poor health.

Table 1. Prevalence of Diseases among Adults Age 18 or Older, 2011.

Disease	Less Than a High School Diploma (%)	High School Diploma or GED (%)	Some College (%)	Bachelor's Degree or Higher (%)
Coronary heart disease	10.2	7.5	7.4	5.4
Stroke	4.7	3.4	2.7	1.7
Emphysema	3.3	2.5	1.9	0.7
Asthma (current)	8.1	8.3	8.6	7.1
Chronic bronchitis	5.1	5.2	5.0	2.3
Diabetes	15.1	10.5	9.6	6.5
Ulcers	9.8	7.4	8.0	5.0
Kidney disease	3.8	2.2	2.1	0.7
Liver disease	2.4	1.4	1.5	0.8

Chronic joint symp-toms	35.0	33.3	34.6	25.2
Hearing trouble	18.8	19.3	18.1	13.5
Vision trouble	14.0	10.4	9.5	6.3
No teeth	16.2	9.6	7.1	3.6

Given the overwhelming data showing the major impact that educational attainment has on health and mortality, Woolf said, the question becomes: How can the health and education communities use this evidence in a pitch to those who can do something about it? As an example, he said, if a goal is to reduce admissions to emergency rooms, policy makers need to understand that mental health issues are the leading conditions that are contributing to those admissions, and that psychosocial wellness and education are closely associated with mental health outcomes. People with less wellness and less education are at a sharply higher risk for mental health problems. If the goal is to slow down the alarming increase in mortality rates among American women—mortality rates for women have increased in 42 percent of U.S. counties since the 1990s (see Figure 27)—then the link between this phenomenon and educational attainment has to be a critical piece of the argument on what kind of actions the country needs to take, Woolf said.

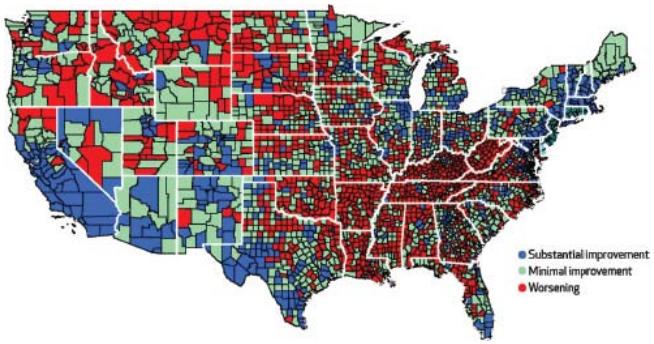

Figure 27. The change in female mortality rates from 1992–1996 to 2002–2006 in U.S. counties.

How is a person's education related to his or her health? Woolf said that there are three broad categories of possible relationships (see Figure 28). First, education has a number of downstream benefits that may lead to improved health, including a higher income, lower odds of being unemployed or having a job that does not provide health insurance, various social and psychological benefits that arise from the social environment at school, and the cognitive and social skills that are acquired in high school and college.

Other downstream benefits include the resources and knowledge to adopt healthier behaviors and the resources to live in healthier neighborhoods.

Second, some suggest that there is a selection phenomenon at work, with people who are less healthy being less likely to succeed and advance in their education so that the people who do end up going farther in school are healthier; in this case better health would lead to more education rather than the reverse. Woolf said that while there is a body of evidence suggesting that education affects health more than the other way around, it is still important to try to improve the health and wellness of students so they can succeed in school.

The third possibility is that various contextual factors—what an epidemiologist would call confounding variables—affect both education and health.

The list of contextual factors would include adverse childhood events that can affect brain development and social, emotional, and cognitive development as well as childhood health and nutrition, parental and maternal health, stress, immigrant status, gender, and socioeconomic status. He noted that data show a clear link between adverse childhood events and increased odds of adult diseases, including obesity, diabetes, heart disease, cancer, stroke, chronic lung disease, and depression.

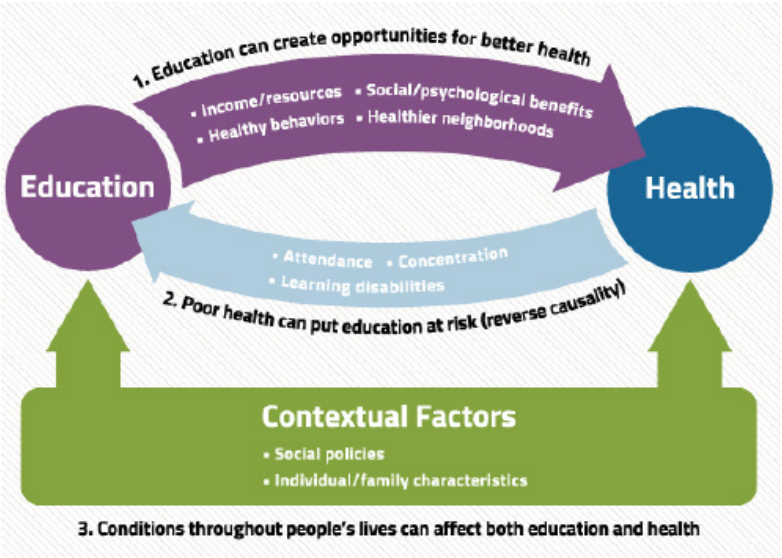

Figure 28. Exploring the link between education and health.

Woolf reported that an animated discussion had been prompted at the previous day's National Institutes of Health (NIH)-sponsored workshop by questions about how to measure the independent effect of education by adjusting for particular variables and contextual factors. This is more than just an academic question, he said; addressing these contextual factors in terms of social and economic policy, jobs, unemployment, and community development should concern policy makers beyond those interested solely in education reform and health care reform. The challenge, he said, is to think of this problem as a whole and not as isolated components. Education is a system; it is a package deal. Education comes with a set of interrelated variables, such as race and ethnicity and income, and this is true at any particular moment in time in the life course and also in the early years that put a child on the path to a successful education. Any strategy for achieving success must also be a package deal, Woolf said. It has to look at the whole system—the whole set of issues together.

In the last part of his presentation, Woolf turned to the subject of "silos" and the need to improve the connection not just between those who are concerned about health and education but also between these people and those who are interested in jobs and social issues. As examples of the education and health silos, he cited two reports: *Rising Above the Gathering Storm* published in 2007 by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine (IOM), which came from the education silo, and the *U.S. Health in International Perspective*, published by the National Research Council and the IOM, from the health silo. Both reports paint a dire picture, one of them of the educational system and the other of the nation's health status, yet neither of the two communities has thought enough about the role of the other in helping with their respective agendas.

In an attempt to break down these silos, Woolf and his colleagues at the Center on Society and Health have conducted the Education and Health Initiative, part of the center's Connecting the Dots portfolio. The education and health aspect of this initiative is aimed specifically at raising awareness among policy makers in education and health about the health implications associated with educational attainment—the subject of this workshop—and at helping researchers in these communities develop the tools to communicate their findings in a way that is responsive to their target audiences. Accomplishing the latter requires that each community understand the issues that policy makers in the other community are facing and to then use that understanding to develop better research questions. "This is a different model of research than the current model of investigator-initiated research, which is driven by the intellectual questions that interest academics," Woolf said.

Other important components of silo-busting are stakeholder engagement and strategic communication. "We need to package evidence in a way that is compelling and convincing to policy makers," Woolf said, acknowledging that this is a particularly weak skill in today's public health community. Target audiences include not only policy makers at the federal, state, and local levels, but also national organizations, health care systems,

businesses and employers, foundations, the media, and other disciplines in academia. In the education policy area, for example, Connecting the Dots has reached out to a wide range of public and private sector organizations. Each of these organizations, Woolf said, already has its own agendas and sets of talking points, but Connecting the Dots is providing the organizations with an additional line of argument that these organizations have reported is valuable to them. "The resources that we are able to provide are very helpful," he said. "I am here to tell you that this cross-sector dialogue works very well."

As an example, Woolf cited the business community's positive response to the message that educational attainment has a direct impact on the health care costs that are becoming an increasing burden for companies. Subsequently, reforming the nation's education system will have significant effects on the companies' "bottom line" beyond the effects related to the companies' need for an educated and skilled workforce. As evidence that this message is having an effect, Woolf said that the Virginia Chamber of Commerce's recent blueprint for the newly elected governor cited population health and wellness and improved education among the eight domains on which it will focus.

One issue that often gets raised in discussions with policy makers is that given today's focus on the short term, the returns on investment from childhood programs take too long to interest government or business leaders. In answer to that concern, Woolf said that not only are there significant returns on investments in improving adult health, but an increasing amount of evidence shows that investments in health made in early childhood start paying off at an early age. He cited the work of Laurie Miller Brotman (a subsequent speaker in the workshop), which shows that early childhood investments have a positive impact on body mass index that can be seen in children as young as 8 years old. To its credit, Woolf said, the business community understands this connection, and businesses are participating in initiatives around the country that are making significant investments in early childhood. He said he is also encouraged by the financial industry's engagement

in early childhood through novel investment instruments such as social impact bonds.

Woolf and his colleagues have identified a model for strategic communication that divides the target audience into three categories. The first category comprises those who have the lowest level of awareness and who have not yet "connected the dots." For that group, the best message is a simple one: Health and education are linked. The second category includes those who understand that there is a link between education and health but think that it is not a big deal and that reforming health care and health behaviors is more important. Quantification using compelling data is more important with this group. The third category would be the "choir," those who know that there is a critical connection between education and health and who now want an evidence-based action plan. For individuals and organizations in this group, it is important to show what works and how to prioritize effective strategies.

Recognizing this segmentation, Woolf and his collaborators have started developing materials to engage each of these audiences. One example is a YouTube video with the message that education matters more than ever to health. This video received 10,000 views in the first week it was available, which Woolf said is a big number in public health media. Another approach is to create layered issue briefs that enable members of each of the three types of audiences to get the information they need at a level they can understand and use.

Woolf then turned to the subject of stakeholder engagement. Among the stakeholders who must be engaged are members of the community, and in particular, the vulnerable populations in the community who know firsthand about these issues. Stakeholders other than the affected population also need to be engaged. Woolf said that he and his colleagues worked for 1 year to build relationships with health and education organizations to develop partnerships for reaching out to the broad range of stakeholders. "Education and teacher organizations that I never heard of before are distributing our materials, along with the public health

networks that I am more accustomed to," he said. "I think this kind of cross-sector partnership and collaboration is the key if we are really going to connect the dots." As a final comment, Woolf said that although, as his model emphasizes, there is a tremendous need for collaboration in this area, federal agencies and funders are still stuck in their silos. For example, research about education and health has no natural government home because funders like NIH view education as outside their purview.

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CHAPTER 7

EDUCATIONAL ACCREDITATION

INTRODUCTION

Educational accreditation is a quality assurance process under which services and operations of educational institutions or programs are evaluated and verified by an external body to determine whether applicable and recognized standards are met. If standards are met, accredited status is granted by the appropriate agency.

In most countries the function of educational accreditation is conducted by a government organization, such as a Ministry of Education. The United States government instead delegates the quality assurance process to private non-profit organizations. Those organizations are formally called accreditors. In order to receive federal funding and any other type of federal recognition, all accreditors in the US must in turn be recognized by the National Advisory Committee on Institutional Quality and Integrity

(NACIQI), which is an advisory body to the U.S. Secretary of Education. The federal government is therefore still the top-level architect and controlling authority of accreditation. The U.S. accreditation process was developed in the late 19th century and early 20th century after educational institutions perceived a need for improved coordination and articulation between secondary and post-secondary educational institutions, along with standardization of requirements between the two levels.

7.1 OVERVIEW OF ACCREDITATION

Accreditation is a non-governmental process established by colleges and universities to evaluate, assure and improve educational quality in American higher education. It is a peer-review process designed to recognize and validate that an institution or program within an institution (e.g. nursing or business) meets a set of established standards and fosters a commitment to continued excellence.

To become accredited, colleges and universities, as well as specific academic programs, apply to join private membership associations

known as accrediting agencies. These agencies, in coordination with their member institutions or programs, develop standards and criteria around what constitutes "quality" higher learning.

Pathways for institutions or programs seeking or reaffirming accreditation generally begin with institutions or programs completing a self-study report which consists of an internal review and examination of the organization's mission, educational objectives and performance with respect to the standards established by the accrediting body. Peer-reviewers – faculty and administrative colleagues from other colleges and universities – examine and evaluate the college, university or academic program against the agency's standards and make recommendations regarding the award of accredited status.

7.1.1 Purpose and Role of Accreditation

Accreditation of colleges and universities generally serves two purposes:

- ***Institutional Purpose***: Colleges and universities assert that accreditation helps shape and guide the continuous quality improvement of their institutions and academic programs. Accreditation's unique, external peer-review process provides insight, feedback and recommendations on goals, policies and plans to fulfill educational missions and enhance academic quality. Accreditation can also help institutions make judgments about accepting academic credit from other colleges or universities.

- ***Federal Government/Public Purpose***: The federal government and the public rely on accreditation for quality assurance. As the federal government created new federal benefit programs, in the form of grants and loans, for veterans and college students pursuing higher education, it sought a mechanism or system to assure the quality of institutions where students were spending their federal funds. To accomplish this objective, the federal government deferred to an existing system – accreditation – to delegate the role of quality assurance and ensure that students were only using their federal funds at credible, legitimate and quality institutions.

Accreditation is a voluntary, nongovernmental, and collegial process of self-review and external verification by peer reviewers.

In higher education, accreditation has two goals: 1) to ensure that post-secondary educational institutions and their units, schools, or programs meet appropriate standards of quality and integrity, and 2) to improve the quality of education these institutions offer.

The two types of postsecondary education accreditation are institutional and specialized.

Institutional accreditors evaluate and accredit an institution as a whole. There are a number of institutional accrediting agencies throughout the US.

Each accrediting agency is responsible for accrediting institutions within its region. For this reason, institutional accreditation is sometimes referred to as regional accreditation.

Specialized accreditors evaluate and accredit professional and occupational education at the unit or program level. Each accrediting agency is responsible for the units or programs in its specialty. As a specialized accreditor, the American Library Association's (ALA) Committee on Accreditation (COA) accredits programs leading to the first professional degree in library and information studies, which is the master's degree.

Accreditation has several benefits. It assures the public that individuals who have graduated from accredited schools or programs have received a quality education. It assures students that accredited programs meet the standards of the profession that they seek to enter. Institutions of higher education benefit through self and peer evaluation and through the opportunity for continuous improvement. Accreditation does not, however, result in ranking of programs. Rather, it respects the uniqueness of each program while ensuring that all accredited programs meet the same standards.

The accreditation process involves the continuous assessment and evaluation of a program and the enhancement of the program's operations using standards. This process, through self-evaluation and peer review, is designed to foster collegial relations among educators and members of the profession. Accreditation indicates that a program demonstrates a commitment to quality and that the program seeks to continue that commitment.

7.1.2 Functions of Accreditation

1. Certifying that an institution or program has met established standards
2. Assisting prospective students in identifying acceptable institutions
3. Assisting institutions in determining the acceptability of transfer credits

4. Helping to identify institutions and programs for the investment of public and private funds
5. Protecting an institution against harmful internal and external pressure
6. Creating goals for self-improvement of weaker programs and stimulating a general raising of standards among educational institutions
7. Involving the faculty and staff comprehensively in situational evaluation and planning
8. Establishing criteria for professional certification and licensure and for upgrading federal assistance

7.1.3 The Accrediting Procedure

1. *Standards*: The accrediting agency, in collaboration with its communities of interest, establishes and periodically revises standards and policies.
2. *Self-study*: The institution or program seeking accreditation prepares an in-depth self-study that measures its performance against the standards established by the accrediting agency.
3. *On-site Evaluation*: The association selects a team of external academic and administrative experts from other similar institutions or programs. The team reviews the self-study and visits the institution or program to determine first-hand if the applicant meets the established standards. The evaluation team issues its report of findings enumerating any conditions that need to be met before full positive approval may be given.
4. *Publication*: The association's members of the Board of Commissioners vote on the status of the candidate or member, and publish the names and information about successful candidates and re-accredited members in the next annual edition of its official approved list.
5. *Reevaluation*: The accrediting agency periodically reevaluates each institution or program that it lists to

ascertain whether continuation of its accredited or pre-accredited status is warranted.

7.2 VALUE OF ACCREDITATION

Accreditation in the United States is a means to assure and improve higher education quality, assisting institutions and programs using a set of standards developed by peers. An institution or program that has successfully completed an accreditation review has in place the needed instructional, student support and other services to assist students to achieve their educational goals. Accreditation has helped to provide the conditions necessary for the United States to develop diverse, flexible, robust and often admired higher education.

7.2.1 Accreditation: A Process and a Status

Accreditation is both a process and a status. It is the process of reviewing colleges, universities, institutions and programs to judge their educational quality – how well they serve students and society. The result of the process, if successful, is the award of "accredited status." Accreditation is carried out through nongovernmental organizations created in whole or in part by the higher education community. Some accrediting organizations review colleges and universities. Others review specific programs, e.g., law, medicine, engineering. In a number of fields, especially the health professions, graduation from an accredited program is a requirement for receiving a license to practice. At present, 80 recognized organizations accredit more than 7,000 institutions and 19,000 programs serving more than 24 million students.

All accrediting organizations create and use specific standards both to assure that institutions and programs meet threshold expectations of quality and to assure that they improve over time. These standards address key areas such as faculty, student support services, finance and facilities, curricula and student learning outcomes.

All accrediting organizations use common practices, including a self review by the institution or program against the standards, an on-site visit by an evaluation team of peer experts and a subsequent review and decision by the accrediting body about accredited status. This review is repeated every three to ten years if the institution or program is to sustain its accreditation.

Established accrediting organizations themselves are usually subject to external review, a process called "recognition." This involves periodic examination of the organizations based on a set of standards, The external examination is carried out by the U.S. Department of Education or, in the private sector, the Council for Higher Education Accreditation.

7.2.2 Accreditation Benefits Students and the Public

Accredited status" means that students and the public can expect that a school or program lives up to its promises. It means that a student can have confidence that a degree or credential has value. Accreditation signals that the public can have confidence in the worth of an institution or program.

For students, accreditation provides value related to not only judging quality, but also obtaining employment, receiving student aid and transferring credits. Accreditation:

- Encourages confidence that the educational activities of an accredited institution or program have been found to be satisfactory.
- Assists with student mobility: Accredited status indicates to institutions judging requests for transfer or applications for graduate school that the sending

institution or program has met threshold expectations of quality.

- Signals to prospective employers that a student's educational program has met widely accepted standards, with graduation from an accredited program, in some cases, a prerequisite for entering a profession.
- Provides access to federal and sometimes state financial aid, available to qualified students who attend institutions accredited by recognized accrediting organizations.

To the public, the accreditation process provides value not only through judging quality, but also assuring reliable information about institutions and programs, promoting accountability and identifying successful improvement efforts. Accreditation:

- Confirms that the public presentation of an educational program, student services and graduate accomplishments is fair and accurate.
- Promotes accountability through ongoing external evaluation of the institution or program, with a finding that there is compliance with general expectations in higher education or a professional field as reflected in the accreditation standards.
- Identifies institutions and programs that have voluntarily undertaken explicit activities directed at improving the quality of the institution and its professional programs and are carrying them out successfully

7.3 QUALITY ASSURANCE IN HIGHER EDUCATION

Quality assurance in higher education was until relatively recently an implicit activity. Measured but could be recognized by academics when and where it existed were prevalent. However, over the last two decades, a number of factors have combined to challenge traditional views about quality in higher education and how it is assured. These factors have been elaborated by many commentators - individuals and organizations such as UNESCO and the World Bank – and have led to the making of quality assurance in higher education "a central objective of governmental policies and an important steering mechanism in higher education systems worldwide".

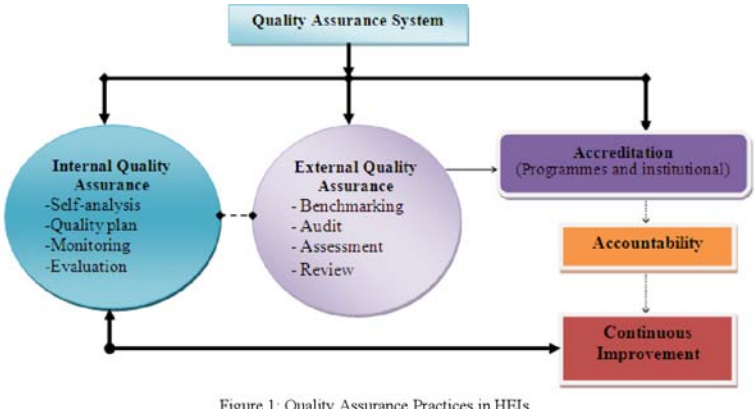

Figure 1: Quality Assurance Practices in HEIs

In the rapidly changing environment of higher education, the maintenance of high quality and standards in education has become a major concern for higher education institutions and governments; thus, the demand for explicit quality evaluation and assurance processes has increased.

The challenges facing higher education worldwide include the following:

- The need to assure quality and standards against a background of substantially increased participation – a process often referred to as the massification of higher education. This process accelerated throughout the latter

part of the Twentieth Century as many countries began to consider that their economic and social future was dependent, in part, on the availability of quality higher education for the majority of the population rather than for a small élite. However, expansion has not always been well planned or controlled;

- The expansion in student numbers with either constant or declining (public) funding resulting in a lower unit of resource per student. This position has been compounded by the inefficient use of available resources. Examples of inefficiencies include overly high staff-student ratios, programme duplication in many small institutions/units with high unit costs, and under-utilized facilities. Such inefficiencies divert resources from such objectives as quality and access.
- Increased demand for accountability in higher education institutions as a result of deregulation and the granting of increased autonomy in regard to such matters as curriculum design, the selection of students, and the appointment of staff. However, increased autonomy has not always been accompanied either by financial authority or by improved institutional management and strategic planning capabilities;
- The meeting of new expectations in terms of the "employability" of graduates in the knowledge society.
- The addressing of demands from a variety of stakeholders for increased and improved information about programmes and institutions and about the skills, competencies, and aptitudes which graduates possess;
- The contribution to the achievement of social and political agendas such as access, inclusion, and equity.

In addition to these factors, recent developments include the appearance of new providers of tertiary ducation, sometimes in competition with traditional public higher education, and new modes of provision, such as on-line learning, resulting from the information and communication technology revolution.

Quality in higher education is not only a national concern but has become an international issue through academic, political, and commercial developments associated with globalization, such as the rise of market forces in tertiary education and the emergence of a global market for skilled professionals and graduates.

The traditional providers of higher education are facing competition from transnational education providers as well as from the emergence of local commercial providers. Through the internationalization of higher education national systems, qualifications and individual higher education institutions have become exposed to the wider world. This exposure has stimulated a demand for better information and transparency about quality and standards in order to attract and retain students and staff, both national and international students, and to secure the recognition of qualifications.

They include the following:

Quality as excellence: This definition is considered to be the traditional academic view that holds as its goal to be the best.

Quality as "zero errors": The idea of "zero errors" is defined most easily in mass industry in which product specifications can be established in detail, and standardized measurements of uniform products can show conformity to them. As the "products" of higher education, the graduates, are not expected to be identical, this view is not always considered to be applicable to higher education.

Quality as "fitness for purpose": This view requires that the product or service meet a customer's needs, requirements, or desires. Learners (students) and prospective learners, those who fund higher education, the academic community, government, and society at large are to a greater or lesser extent all clients or users of higher education but may have very different views of both "purpose" and "fitness".

A major weakness of the fitness for purpose concept is that it may seem to imply that "anything goes" in higher education so long as

a purpose can be formulated for it. This weakness is more likely to be exacerbated in large and diverse higher education systems in which a wide range of "purposes" at institutional level may be identified by individual institutions, generally through their mission statements, and at more precise academic levels through the learning outcomes of particular programmes. This diversity is often further complicated in transnational and distance education (situations in which educational provision crosses borders) as there is frequently a divergence of national views between "sending" and "receiving" countries as to both "fitness" and "purpose". By complementing "fitness for purpose" with a notion of "fitness of purpose", an evaluation can consider and challenge the comprehensiveness and relevance of purposes in order to ensure improvements.

Quality as transformation: This concept focuses firmly on the learners: the better the higher education institution, the more it achieves the goal of empowering students with specific skills, knowledge, and attitudes which enable them to live and work in the knowledge society. This notion of quality may be particularly appropriate when there have been significant changes in the profile of learners, for example, when changes in society or politics have enhanced access to higher education for large numbers of disadvantaged learners. It is argued that the delivery of a transformational quality approach involves five key elements:

- envisioning quality as a transformational process designed to enhance the experience of students;
- a bottom-up approach to continuous improvement;
- responsiveness and openness as the means of gaining greater trust;
- an emphasis on effective action;
- external monitoring which is sensitive to internal procedures (and values).

While this notion is popular, it may be difficult to measure quality as transformation in terms of intellectual capital.

Quality as threshold: Defining a threshold for quality means setting certain norms and criteria. Any programme, department, or institution, which reaches these norms and criteria, is deemed to be of quality. The advantage of setting a threshold is that it is objective and certifiable. However, there are arguments that setting a threshold creates uniformity across the higher education system. This argument might well apply if institutions adopt a "compliance" mentality and only do what is sufficient to satisfy the minimum. There are significant disadvantages to this concept, especially when the criteria and standards are based on quantitative "input" factors enshrined in law. It cannot readily be adapted to changing circumstances or to stimulate change and innovation. In this respect, the "threshold" can mitigate against improvement. Neither does it take account of "output" standards, the actual level of achievement by graduates, the criteria used to assess these achievements, nor how that assessment is verified. Nevertheless, in many European higher education systems, a "minimum standards" variant has been used if only as a starting point in the quest for quality.

Quality as value for money: The notion of accountability is central to this definition of quality with accountability being based on the need for restraint in public Expenditure.

Quality as enhancement or improvement: This concept emphasizes the pursuit of continuous improvement and is predicated on the notion that achieving quality is central to the academic ethos and that it is academics themselves who know best what quality is at any point in time.

7.3.1 Purposes of Quality Assurance in Higher Education

When planning and designing a national quality assurance framework, it is crucial to identify the function and purpose quality assurance should serve, as this will determine the ultimate nature of the overall system and detailed processes.

Quality Assurance for Accountability

The purpose of QA is usually linked with the needs to provide the public with information and certify that the expectations, required minimum quality thresholds/standards or goals in higher education have been met. In publicly funded higher education systems, the state may use QA mechanisms to evaluate the quality and as an instrument to demonstrate efficiency in public spending. A QA process may also serve to help reassure the external stakeholders of maintaining sufficient or high standards of quality. The accountability purpose of quality assurance is typically associated with external stakeholders such as the state, the public or regional accrediting bodies, and sometimes international stakeholders.

Quality Assurance for Improvement

The improvement or enhancement purpose of quality assurance focuses more on the internal audience and higher education institutions. Instead of relying on the one-off certificate confirming that the quality standards have been met, the QA process serves as a more forward thinking cycle for continuous improvement. In this model, the QA process acknowledges both strengths and weaknesses and recommends paths leading to quality improvement. Evaluations in this QA approach are often in the form of recommendations rather than a pass or fail result. The recommendations are typically targeted at an academic audience,

whose involvement in the process is crucial to successful quality improvement.The UNESCO-IIEP expert team warns that the improvement/enhancement centered approaches to quality assurance are more likely to succeed in more mature systems, "where threshold standards have already been met and institutions have developed a basic understanding of self-regulation".

The function and purpose of information provision:

1. To maintain quality in higher education, thus meeting the public interest;
2. To allow for informed decision-making by students and parents through sharing information on the status of universities, and
3. To enhance assessment and assurance of standards

Another typology of purposes of quality assurance comes from Randall (2008) and appears. In this model, QA is to provide:

1) *Accountability* – to those who pay for higher education. This includes the state, individuals and their families, and employers.

2) *Information* - for those who need to know about the standards that are achieved by students. This includes employers, governments and potential students themselves.

3) *Enhancement* – of the quality of educational provision, through learning from identified strengths and weaknesses, and the sharing and dissemination of good practice, both within and between institutions.

7.3.2 Difference between External Quality Assurance and Internal Quality Assurance

Quality assurance can be used to describe all activities and mechanisms related to quality, both at the system level (external quality assurance) and at the level of teaching and learning in higher education institutions (internal quality assurance).

External Quality Assurance (EQA)

The external quality assurance (EQA) system concerns regulations, policies and practices that take place at the national higher education system level to assure quality of higher education programs and institutions. In some EQA systems, the focus is on both programs and higher education institutions, while in others it can be on one or the other. At the EQA level, there is typically a dedicated entities or units responsible for assuring quality of higher education institutions or programs. These entities, depending on the QA framework design, can be accrediting agencies, evaluation agencies, quality assurance units and similar organizations; as well as those bodies responsible for the superordinate, external quality assurance of these agencies themselves. Depending on the national context, these agencies can be fully autonomous and independent from the state, autonomous but publicly funded, fully private and independent (such as university membership associations), or in contrast operate as designated agencies within the state structures.

Internal Quality Assurance (IQA)

In national higher education systems based on the principles of university autonomy, it is typically the universities themselves that are seen as the key agents and experts responsible for assuring quality of higher education. This is the case of the European Higher Education Area, at least at the policy level. Internal

Quality Assurance-centered approaches are considered by some studies to have a greater impact on the actual quality of teaching and learning, in comparison to more accountability-driven EQA mechanisms, which may not guarantee quality improvement. There are cases among the countries of the EHEA that confirm this claim. For example, in some countries proper and well-designed EQA structures and procedures had been set up and implemented but it later turned out that these formal EQA mechanisms were not sufficient for stimulating significant quality improvement and transformation at the level of higher education institutions and teaching and learning. This may have been caused by an imbalanced approach to EQA and IQA, in which EQA was the main focus while internal processes requiring participation of academics and students received less attention.

7.3.3 Dimensions of Quality in Higher Education

Quality, as we know so far, was originally developed in the manufacturing industry. In the area of higher education, the adoption of quality control has been superficial and diluted by the exercise of academic freedom. Further, the prevailing culture of universities is often based on individual autonomy, which is zealously guarded. Thus, it is usually difficult to apply the features of quality to higher education considering the fact that quality requires teamwork. However, the quality of higher education is very important for its stakeholders. Notably, providers (funding bodies and the community at large), students, staff and employers of graduates are important. The most commonly grouped dimensions of quality are product, software and service.

Product Quality Dimensions

Garvin proposed the following eight dimensions for quality that, as he stated, can define both product and service quality:

Performance: It is concerned with the primary operating characteristics of a product. For example, for a TV, the performance comprises of sound and picture quality. In higher education performance is the abilities expected of a graduate.

Features: Those characteristics that supplement the basic performance functions are called features. In higher education, flexibility of course offering could be a feature.

Reliability: It is the probability of a product working fault-free within a specified time period. In higher education, it can be considered as to what extent the knowledge gained is correct, and up-to-date.

Conformance: The extent to which a product meets the established specification/standard. For higher education, it can be defined as the extent of meeting the established educational standards and its own promises to the client.

Durability: The product's assumed life to perform satisfactorily is durability. In higher education, it can be defined as the depth of learning.

Serviceability: It is concerned with the repair and field service of the product. In higher education it is concerned with handling of complaints from students, staff and industry. Some also emphasize the continuous updating of their alumni as evidenced by professionals like the Chartered Accountants through their magazines, newsletters and continuing education to provide after training service.

Aesthetics: In the context of product, it is concerned with the design, looks, color and presentation, and how the customer views it.

Perceived quality: This is yet again subjective like aesthetics and 'customers' opinion is more appropriate in service quality dimension. For a product too, through branding, the customer perceives a certain degree of confidence on quality.

Software Quality Dimensions

The characteristics of software as an intangible product are more consistent with higher education. The software quality dimensions widely used in software engineering are:

Correctness: The extent to which a programme/course complies with the specified requirements.

Reliability: The degree to which knowledge/skills learned is correct, accurate and up to date

Efficiency: The extent to which knowledge/skills learned is applicable to the future career of graduates

Integrity: The extent to which personal information is secure from unauthorized access

Usability: The ease of learning and the degree of communicativeness in the classroom

Maintainability: How well an institution handles customers' complaints?

Testability: How fair examinations represent a subject of study?

Portability, reusability and interoperability: The degree to which knowledge/skills learned is applicable to other fields

Service Quality Dimensions in Higher Education

The service dimension of quality is probably more akin to the educational processes. We know that unlike physical goods, services are ephemeral to the extent that they can be consumed only as long as the activity or the process continues. Thus, there is inseparability of production and consumption. Thus, services can't be stored and are perishable. The consumer is also an integral part of the service process. Thus, in higher education, this framework is more applicable as the teaching learning situations are more like a service.

Reliability: The service is carried out in the way it is promised.

Responsiveness: The service is carried out promptly according to the needs of the customers.

Competence: The staff of the service provider has the knowledge and skills required for delivering the service in a proper way.

Access: It concerns the location, opening hours, etc.

Courtesy: How polite, friendly and respectful the employees are.

Communication: It is the process of keeping the customers informed in a language that they could understand and also listening to them.

Credibility: How trustworthy, believable and honest the service provider is.

Security: Freedom from danger, risks or doubt.

Understanding the customer: The effort of the service provider to understand the needs and wants of the individual customers.

Tangibles: Physical objects that are needed for carrying out the services such as facilities, equipment, etc.

7.4 HOW CAN QUALITY BE ASSESSED?

Quality assurance is the responsibility of everyone in an educational institution, though the top management sets the policies and priorities. Thus, assuring quality should be a continuous and ongoing process. It should not be considered as a onetime activity for accreditation alone. However, accreditation as external quality monitoring (EQM) can be found in all types of higher education systems.

In spite of the importance of EQM and the credibility attached with the impartial and objective system, developing an internal quality assurance mechanism in every educational institution is highly important. It is in fact, this unit within the higher education

institution that will prepare the base for EQM. Thus, understanding the criteria of quality assurance and adhering to the best practices become highly significant. Across the world quality assurance is done in the following ways:

- Self evaluation;
- Peer review by a panel of experts, usually including at least some external panel members and one or more site visits;
- Analysis of statistical information and/or use of performance indicators or the best practices benchmarking;
- Surveys of students, graduates, employers, professional bodies;
- Testing the knowledge, skills and competencies of students

Self-evaluation/Self-study

Real quality that is sustainable is one that is assessed by self. This is how we know what our strengths and limitations are. Self-evaluation is like looking at ourselves in a 'mirror'. The self-study report required for submission at the time of assessment for accreditation should be self-critical and reflective, as inspection and quality control imposed from outside would not work. Self-evaluation would be an indicator for continuous improvement and a first step for ensuring quality.

Benchmarking

Benchmarking is a common topic in business and industry. What it entails is a process of recognizing 'best practices' in the industry and implement them. It is defined as "a continuous systematic process for evaluating the products, services and work processes of organizations that are recognized as representing the best practices for the purpose of organizational improvements". Benchmarking as a process has four main activities:

- Comparing one thing with the other
- Creating and using criteria to evaluate differences between two things and recognizing which is better
- Use the experience to identify the direction for change
- Implement the required change to improve

Benchmarking in education is a relatively new concept and can bring huge benefits in terms of continuous improvement of quality. As it is based on identification of the best practices, it inculcates competition and constant comparison. At the same time, it is also criticized for being a system of imitation. Moreover, something that has produced satisfactory results in one organization, if replicated, may not produce the same results. Nevertheless, as we compare with the best, and follow the best university or college, it becomes a tool for motivation to change. By following the best model, other institutions can improve their own quality.

In higher education, we are concerned with functional benchmarking, where comparisons are made between higher education institutions as they use similar processes and practices.

External Quality Monitoring

EQM has become mandatory in many countries, though it could be a voluntary process. The process of external quality monitoring/ assurance reassures external stakeholders such as employers, professional bodies and the general public about the legitimate quality of a higher education institution. It also offers an impartial and objective mechanism for assessing the educational institution by a peer team not directly related to the institution. Visit by a peer team is a common activity in EQM, which critically analyses the self-study report and the quality provisions based on established criteria. The peer team checks institutional reports, records and policies. It also meets and discusses with the top management, principals, HoDs, teachers, students and support staff to make its opinion on quality. In the Indian context, the external quality assurance mechanism is a much-debated concept; especially because universities are autonomous bodies established by an

Act of Parliament or State Legislature and are empowered to award degrees. External monitoring is very often considered as an invasion on the 'autonomy' and 'academic freedom' of the educational institutions. To some, the University Grants Commission (UGC) already performs the task of monitoring the universities regularly for funding purpose, and thus no further intervention is needed. The universities, being degree awarding agencies, are responsible for assuring their own quality, and therefore, various internal bodies like the Academic Council, Planning Board, Executive Council, Board of Studies, etc., within the system monitor and undertake corrective measures to assure the graduates are worthy of the degree awarded to them. In the case of colleges, the affiliating universities perform the role of assessing the quality. Thus, EQM to some Indian academics is a borrowed western concept to further widen the gap between the elite and the non-elite institutions. In practice, EQM is a process of continuous improvement, mark of excellence, and recognition of all the efforts of the academics by their peers.

Unit of Assessment

Quality assurance and accreditation can be performed at different levels, though the institutional quality assessment model is quite popular in India. Many academics believe that in institutional accreditation, the strengths of good departments and weaknesses of poorly performing units cannot be categorized. Thus, these set of intellectuals favor department-level and programme-wise accreditation. Though such assessment results would be highly useful to the stakeholders, they are practically difficult. However, NAAC recognizes that institutional and department/ programme level assessments are not alternatives, but are mutually complementary to each other.

7.4.1 Tools for Quality Assessment

Quality assurance is a conscious and planned process, and therefore, we should have some tools and mechanisms to ensure

quality. Though quality as such is a 'qualitative' abstraction, there are many 'quantitative' tools available to us for assuring quality. Some are analytical tools and the others are facilitation tools. Using these tools and techniques, we can ensure quality in higher educational institutions.

Process Flow Chart

A flow chart is a pictorial/symbolic representation of the stages in a process. It records the series of activities and events in a process in such a way that communication becomes instant and clear. Flowchart is extremely useful when a problem needs systematic approach. Flowchart can help us to identify critical steps and also ensure that all the steps are carried out without fail making it error free, ensuring quality. Use of a flowchart in a laboratory situation can reduce hazards. The author of this monograph has used flowchart to ensure quality in the publication process of a newsletter. An example of flow chart application in educational institution is depicted in Fig. 1. By following the flowchart of the admission process, it is less likely that any of the departments will make mistakes that may affect the admission cycle. In fact, the development of a flowchart for any activity should be a participatory process by those involved in the task/problem.

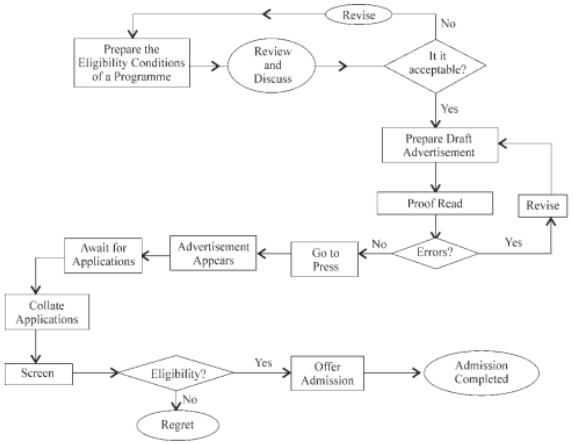

Figure 1: Admission Process in a Programme.

Graphs

These are tools to present information in a concise and graphical manner. There are different types of graphs that can be used to represent data for decision-making. Some of these are histograms, pie charts, line graphs, etc. For example, in order to show the popularity of a programme over the years (to showcase the reputation and quality), we can present the number of applications received over the last 5 years for 30 seats in a line diagram, Fig. 2.

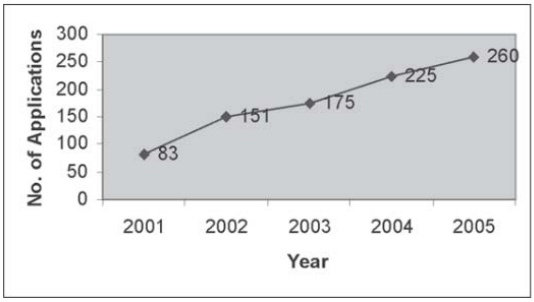

Figure 2: Line Diagram.

We can use the histogram to show the quality of faculty in terms of their qualifications, as shown in Fig. 3

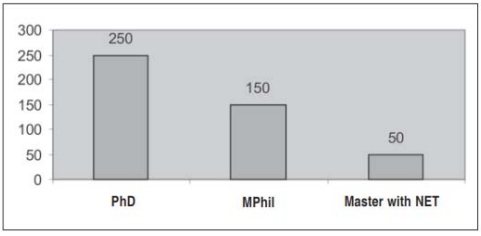

Figure 3: Histogram

Pareto Analysis

Pareto analysis is a tool used to prioritize problems for solutions. It says that 80% of problems stem from 20% of the causes. It is also known as 80-20 rule. Thus, by focusing on the 20%, we can

improve 80% of results. This is a very important principle in quality assurance, and thus identifying the critical 20% in performance that will result in 80% solution/satisfaction is very important.

Fish-bone Diagram

The fish-bone diagram is also known as cause-and-effect diagram. It is a tool for analysis and open thinking in problem solving. It is also useful in organizing ideas during and after a brainstorming session. In a diagrammatic representation, the effect is placed at the right end of a broad arrow. Major causes are recorded on either side of the effect line. Minor causes are aligned to the respective major causes as clusters, as depicted in Fig. 4.

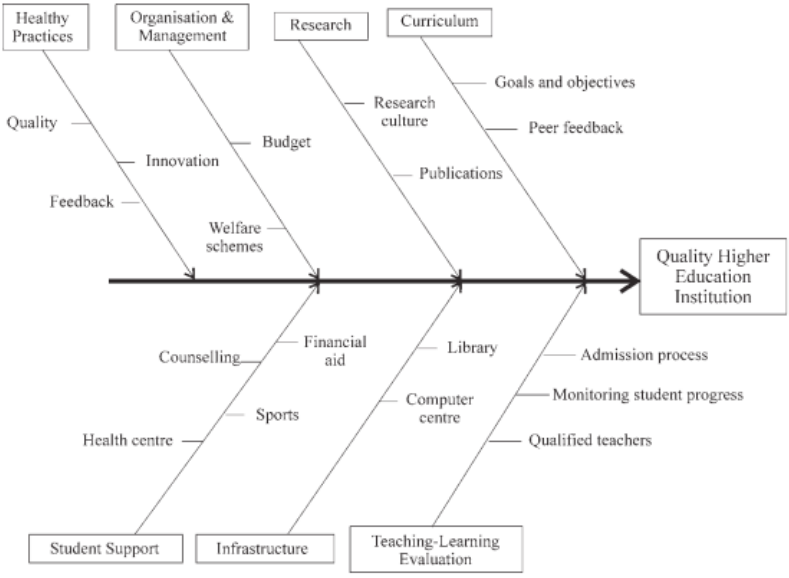

Figure 4: Example of Fish-bone Diagram.

Scatter Diagram

The fish-bone diagram provides a simple way to identify causes and effects, whereas the scatter diagram is a method to determine

the relationship between the cause and effect in a pictorial manner. Scatter diagrams show pattern of association or otherwise of two variables/parameters. For example, if we see a pattern of poor student attendance in a particular month, using a scatter diagram of attendance record and months, we may decide to cover not so complex topics in that month so that majority of the students can understand and learn important topics that may have bearing on other components of study.

Control Charts

Control charts are primarily used in statistical process control operations in manufacturing and product development to ensure that all the outputs are within an acceptable limit of variations. Thus, control charts show deviations in two possible ways:

- the unavoidable or permissible deviations; and
- the unacceptable deviations. The control charts depict the upper and lower limits of variations to find out whether a particular product is acceptable or not.

The control charts serve as a priori method and can be used as a tool for measurement in measuring speed tests of achievement of knowledge/ skills.

Brainstorming

It is one of the most fundamental processes of generating ideas and solutions for problem solving. It involves participation of the stakeholders and thus teamwork is the hallmark of the process. Thus, brainstorming is a key activity in quality assurance. Brainstorming can be used for all the tools discussed above to generate ideas for assuring quality. The process involves knowledgeable and experienced participants who share their ideas on a problem in a free flowing manner without restrictions. One of the major criticisms of brainstorming is that it does not provide objective assessment. But, at the time of brainstorming, a

large pool of possible alternatives can be generated which can be later subjected to objective assessment. During the brainstorming session, the following rules may be followed:

- Be clear about the topic of brainstorming
- List all ideas as they are expressed
- Wild ideas are welcome
- Do not criticize people's ideas
- Build on ideas
- Allow everyone to express their ideas
- Record all ideas in a visible manner

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The Essence of Academic Performance

Academic performance refers to outcome, result or achievement of education as a result of learning within a period of time. The learning outcome also shows the scope of knowledge a student has acquired or that a learner has accomplished specific goals that were the focus of activities in instructional environments. There are many determinants responsible for a student's success in academic pursuit. The nature of motivation and learning strategy use is vital to improving student learning outcomes. Motivation is a fundamental recipe for academic success. It involves internal and external factors that stimulate desire and energy in people to be continually interested and committed to job, role, or subject, or to make an effort to attain a goal.

The present book comprises chapters that look into the extent to which various cognitive, non-cognitive or psychological, and contextual factors contribute to the academic achievement of learners with various sociodemographics and sociocultural backgrounds. Excellent performance at any stage in life is paramount to great achievement and good success at all levels of human endeavors including scholastic attainment. High academic performance requires thorough progressive guidance, adequate preparations through constant supervisions and mentoring from significant others which include but not limited to the learners, the teachers, school administrators, counselling psychologists and concerned parents. However, some learners are fraught with low academic performance and therefore would perform abysmally low. The low academic performance could be due to many factors. Internal factors within learners and external factors which could be positively managed to increase or activate high academic performance in the learners.

This book presents a comprehensive view of recent developments in the field of academic performance. This book therefore seeks to establish the synergy between the internal and external factors through effective mentoring to activate high academic performance in learners.

Dr. Ricardo Alfred is Assistant Professor in the Faculty of Psychology and Educational Sciences. He has keen interest in adult learning and development, equity and social justice in education and the workplace, immigration and learning, welfare reform and women's economic development, women of the diaspora. He has worked in several universities and has published and spoken at conferences extensively.

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