INVESTIGATION INTO STATUS OF SCIENCE MOTIVATION AMONG INTERMEDIATE SCIENCE STUDENTS THROUGH SCIENCE MOTIVATION QUESTIONNAIRE (2006) AND ITS VALIDATION

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Reg. No. 152/FUCLAS/Ph.D (EDU) -2009

FOUNDATION UNIVERSITY
ISLAMABAD - PAKISTAN
2014
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By

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Reg. No. 152/FUCLAS/Ph.D (EDU) -2009

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN EDUCATION AT FOUNDATION UNIVERSITY ISLAMABAD PAKISTAN

2014
DEDICATION

• **My Teacher**
  Thankful to my supervisor, Prof. Dr. Lt Col® M. H. Arif. You were so wonderful to me. You made me believe that I had so much strength and courage to persevere even when I felt lost. You showed me light in a tunnel where everything was dark. You were very tolerant and determined to see me through. You were such a wonderful motivator even when the coping seemed tough for me. I aspire to emulate you.

• **My Parents**
  Thank you for your unconditional support with my studies. I am honored to have you as my parents. Thank you for giving me a chance to prove and improve myself through all my walks of life.

• **My Brother**
  Hoping that with this research I have proven to you that there is no mountain higher as long as God is on our side. Hoping that you will walk again and be able to fulfill your dreams.
FORWARDING SHEET

This thesis entitled “Investigation into Status of Science Motivation among Intermediate Science Students through Science Motivation Questionnaire (2006) and its Validation” submitted by Sarwat Mubeen in partial fulfillment of the requirement, for the degree of Doctor of Philosophy in Education, under my guidance and supervision, is forwarded for further necessary action.

Prof. Dr. Lt Col® M. H. Arif

Advisor
This thesis entitled “Investigation into Status of Science Motivation among Intermediate Science Students through Science Motivation Questionnaire (2006) and its Validation” submitted by Sarwat Mubeen in partial fulfillment of the requirement, for the degree of Doctor of Philosophy in Education, is hereby accepted.

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AUTOR’S DISCLAIMER

Except where otherwise acknowledged in the text, this thesis represents the original research of the author. The material contained herein has not been submitted either as a whole or in part for a degree at this or any other university.

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Sarwat Mubeen
ACKNOWLEDGEMENTS

All the praise and acclamation are for Almighty Allah, the most merciful, the Most Benevolent, All blessings for the Prophet Muhammad (SAW) who is forever a beacon of knowledge for humanity.

The researcher feels honored to express deep sense of gratitude to her supervisor Col. (R). Dr. Manzoor Hussain Arif for his cogent criticism, sincere advice, inspiring guidance, constant encouragement and thought provoking suggestions which have been indispensable for the completion of this dissertation.

The researcher expresses her sincere gratitude to Dr. Aftab Ahmed (Director FURC), Dr. Muhammad Tayyab Alam Boukhari who were an unfailing source of inspiration, encouragement and technical advice.

The researcher expresses deep gratitude to all the principals, science teachers and science students of all colleges, for their personal interest, support and timely help especially regarding data collection of the study.

The researcher is also thankful to all the administrators, teachers of Foundation University for their cooperation during the research work.

The researcher is very grateful to Dr. Maqsood. Alam Bukhari who provided her with a very conductive academic environment. His valuable suggestions kept her on track.

The researcher acknowledges the patronage and loving attitude of her parents whose affection, cooperation and encouragement is always thrilling and striving.

The author thanks her family, Sajid Mehmood, Saqib Mehmood, Yasir Mehmood and Mr and Mrs Naeem-ud-Din, her husband Ch. Shahid Majid who encouraged and
supported her during this research. She is thankful to her friends, Sadaf Tariq, Shafqat Hussain and others for their staunch and unswerving support enabling her accomplish her task.

(Sarwat Mubeen)
ABSTRACT

Motivation is an inner force that activates and provides direction to our thought, feelings and actions. Two main characteristics of motivation are goal directed behavior and persistence. Motivated people persistently work for the goal till it is achieved.

Intrinsic-motivation, self-efficacy and assessment anxiety, independence, career motivation and grade motivation are motivational elements that become visible to affect one’s regulated learning, presented by Glynn and Koballa (2006) Science motivation questionnaire (SMQ) administered its construct validation was investigated on students at the college level. The authors recommended that it may be tried out on students with science major in other cultured settings to examine its construct validity. The study, therefore, sought to explore its construct validity for science students at the college level along with their gender wise comparison on science motivation. The research questions were what evidence is there that motivation can be measured through the SMQ validity and reliability? Are there gender differences in motivation with science students? Are there differences in motivation with science learning experience?

The objectives of the study were thus to investigate the construct validity of the science motivation questionnaire, to examine any motivational differences between male and female intermediate science students, to examine any differences between first and second year science students, and to put forward recommendations in the light of the findings of the study.

The college students of intermediate classes in the province of Punjab constituted the population of the study. A sample of 600 1st and 2nd year science students served as the sample of the study which were selected through two stage cluster sampling.
To measure the science motivation components, the 30-item Likert-type science motivation questionnaire developed by Glynn and Koballa (2006) was used in the study that claims to influence self-regulated learning.

Principal Components Analysis, using varimax rotation, was used to find the fundamental structure of the SMQ. In addition, inter-item correlation was explored using Kendall’s Tau-b. Chi-Square ‘contingency test’ was applied to compare the two distributions of responses. EXCEL spread sheet was used for chi-square analysis because SPSS does not handle it well.

The Scree plot did not indicate any factor structure; also inter-item correlations (Kendall’s Tau-b) suggested no factor structure. However, in gender comparison, the 30 items, there are statistical differences in 9 of them.
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<td>SMQ</td>
<td>Science Motivation Questionnaire</td>
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<tr>
<td>WAEC</td>
<td>West African Examination Council</td>
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<td>SPSS</td>
<td>Statistical Program for Social Sciences</td>
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<td>PCA</td>
<td>Principle Component Analysis</td>
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<td>SOLO</td>
<td>The Structured of the Observed Learning Outcomes</td>
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<td>HOT</td>
<td>Higher Order Thinking</td>
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CHAPTER 1
INTRODUCTION

The 21st century is the age of progress in science knowledge and skill (Okebukola, 1996). There is a tendency for most countries to set scientific and technical goals in order to stimulate national development. This has had an influence on the place of the sciences in education at school and university levels. In some cases, it has led to more stimulating science education while, in others, it has merely increased the amount of material that the learners are expected to memorize. It is important to educate the individuals in the science subjects in ways that relate to their environment, thus leading to the possibilities of improving their livelihood and developing them financially (Ezeliora, 2005).

Salam (1987) stated that, in developing countries, science has been treated as a “trivial activity”. Certainly, it is not fully understood in many developing countries that science and technology have a major contribution to move a culture forward. Indeed, even being conscious of the significance of science and technology is not enough for the development of science and to improve life. Insufficient scientific communication is a serious element that can create strong barriers in the way of progress in developing countries.

The over-emphasis on memorization and over-crowded curricula in developing countries have often led to falling uptakes in the sciences. Skryabina (2000) has reviewed falling uptakes, showing that it does not apply in all countries, and she has pin-pointed the key factors that make science attractive (Reid and Skryabina, 2000). In a third world context, the West African Examination Council (WAEC) reported on poor performance of male and female students and their low
enrollment which play a vital part in national development due to their output in science.

In the context of cell biology, Arwood (2004) argues that it is necessary that both male and female students are scientifically educated so that they are able to cope with scientific problems, especially those problems where answers are not clear cut. He states that many students are not interested in science because do not understand the importance of science for their future career, and find difficulties in the sciences, generating much discouragement and discontentment amongst them.

Those students who are not motivated often show poor performance (Cavallo et al 2003; Glynn et al 2006). An important issue is to find out what is demotivating the learners. The issues can then be addressed although it again has to be recognized that the solutions may be lie beyond teacher control.

Until the mid 20th century, much of the thinking in education was the cognitive that emphasized the acquisition of knowledge. The teacher was seen as a source of that knowledge and the successful learner was the one who was able to memorize and recall most of the facts. This is captured in the 19th century novel by Charles Dickens entitled ‘Hard Times’ and is illustrated in figure 1.1.

![Figure 1 Memorising facts](image-url)
Steadily and gradually, there was a growing awareness that education involved far more than the memorization and recall of information. The key to reform education lay in assessment which had failed to consider measuring much beyond recall. Bloom et al. (1956) published their taxonomy of education goals, especially in the context of assessment, to be followed quickly by their taxonomy of affective goals in 1964. However, the Bloom taxonomy has been modified and developed considerably over the years.

Bloom’s taxonomy became the key classification of educational objectives for better learning with its three domains; cognitive, affective and psychomotor. This classification makes the educational researchers realize that it is not enough to decide the best teaching method or the most effective teaching strategy alone; instead, students’ feelings, interests, attributions, ideas and emotions in terms of goals are also very important for giving meaning to what is being taught to them (Gardner 1999; Goleman 1996; Morgan 2006). This was the time, the “affective domain” found its place in educational area. After realizing the significance of the affective domain, educational research started to look at attitudes and motivation, both of which have a considerable affective dimension.

Cognitive abilities tended to dominate educational research up to the 1970s. Since then, interest in attitudinal research has grown. Related to this are studies on other aspects of education, all with an affective dimension. Palmer (2005) has linked motivation research to the concept of constructivism, which is the idea that every student separately as well as socially constructs meaning from what is offered. However, this may prove unhelpful. While constructivism is a valid picture of learning that leads to meaningful learning (Ausubel et al., 1978), it has proved unhelpful in terms of predicting how to make teaching and learning more effective.
Brown (1994) defines the affective domain as “the emotional side of human behavior” (p.135) that simply includes all of the emotions that a human being shows. According to Bloom, Krathwohl and Masia (1964), the affective domain includes attitudes, emotions, and also five sub-categories in this domain that are the receiving responding, valuing; organizing values and internalizing values.

SOLO (the Structure of the Observed Learning Outcomes) taxonomy was first introduced by Biggs & Collis in their 1982 study. The SOLO taxonomy maps the complexity of a student’s work by linking it to one of five phases: little or no understanding (Pre structural), through a simple and then more developed grasp of the topic (Uni structural and Multi structural), to the ability to link the ideas and elements of a task together (Relational) and finally (Extended Abstract) to understand the topic for themselves, possibly going beyond the initial scope of the task (Biggs & Collis, 1982; Hattie & Brown, 2004). In their later research into multimodal learning, Biggs & Collis noted that there was an ‘increase in the structural complexity of their [the students’] responses’ (1991:64).

It may be useful to view the SOLO taxonomy as an integrated strategy, to be used in lesson design, in task guidance and formative and summative assessment (Smith & Colby, 2007; Black & William, 2009; Hattie, 2009; Smith, 2011). The structure of the taxonomy encourages viewing learning as an on-going process, moving from simple recall of facts towards a deeper understanding; that learning is a series of interconnected webs that can be built upon and extended. Nückles et al., (2009:261) elaborates:

“Cognitive strategies such as organization and elaboration are at the heart of meaningful learning because they enable the learner to organize learning into
a coherent structure and integrate new information with existing knowledge, thereby enabling deep understanding and long-term retention.”

This would help to develop Smith’s (2011:92) ‘self-regulating, self-evaluating learners who were well motivated by learning.’

A range of SOLO based techniques exist to assist teachers and students. Use of constructive alignment (Biggs & Tang, 2009) encourages teachers to be more explicit when creating learning objectives, focusing on what the student should be able to do and at which level. This is essential for a student to make progress and allows for the creation of rubrics, for use in class (Black & Wiliam, 2009; Nückles et al., 2009; Huang, 2012), to make the process explicit to the student. Use of HOT (Higher Order Thinking) maps (Hook & Mills, 2011) can be used in English to scaffold in depth discussion, encouraging students to:

“Develop interpretations, use research and critical thinking effectively to develop their own answers, and write essays that engage with the critical conversation of the field (Linkon, 2005:247, cited in Allen, 2011).”

It may also be helpful in providing a range of techniques for differentiated learning (Anderson, 2007; Hook & Mills, 2012).

Bloom published his taxonomy in the 1950s, and his own team modified it within ten years. It is now considerably out of date and there are much better taxonomies.

The solo taxonomy is just opinion!!

Akbas and Kan (2006) suggest that motivation, attitudes, self efficacy and anxiety are all encompassed in the affective domain. All these constructs have their unique importance in students’ learning. Attitudes relating to the sciences have
dominated but there is much work relating to the motivation of the students, this being looked at from many different angles with many components and constructs. According to Brown (1994), motivation is an inner drive, impulse, emotion, or desire that moves a person.

However, all experienced teachers are well aware that, without motivation, students cannot achieve their goals. Dick and Carey (1996) assert that successful learning cannot be achieved only through successful instruction. Motivation is important because of its fundamental feature of learning: it mediates learning (Wlodkowski, 1985). Those students who are really motivated in their learning will tend to outperform those with poor motivation.

According to Alderman (2008), motivation is an inner force that makes us active and provides direction to our thoughts, feelings and actions. In other words, motivation is responsible for starting and choosing one behavior over another and it helps to maintain the behavior when it becomes difficult, in order to achieve certain goal. Motivated students are actively and pleasurably engaged in academic tasks and are proud about their accomplishments (Stipek, 1996).

Today, secondary science teachers are facing the most important and major challenges: to encourage better performance among science students and to engage other students to undertake mathematics, and science education (Ikeobi, 1997 and Okebukola, 1998). However, it has to be recognized that teachers have very limited control over what they do. The curricula, assessment systems and resource levels are out of the control of the schools and teachers are mandated to teach what others above them decide.
There are many inter-related ideas and aspects related to motivation. This leads to numerous constructs such as intrinsic and extrinsic motivation, assessment anxiety, goal orientation, self efficacy.

Motivation can be divided into two different types: intrinsic motivation and extrinsic motivation. Both types of motivation try to find the situation of individual’s aspiration for achieving a specific job. When individuals get this accomplishment through external rewards, then it is called extrinsic motivation. On the contrary, when one denies the exterior feedback and enjoy the tasks personally, the individual experiences intrinsic motivation (Aronson, et al, 2002).

Conti (2001) notes that people who are intrinsically motivated are less anxious with task difficulties, as compared to those who are extrinsically motivated. Anxiety can have positive or negative effects. Cassady and Johnson (2002) note that a high level of assessment anxiety may prevent students from performing well. Hembree (1990) observes that anxiety is a disagreeable condition, generating apprehension and stress. However, Seymour (1992) concludes that, from time to time, every student experiences anxiety and, if the anxiety experienced is at a moderate level, it helps the students become more motivated to learn.

According to Cavallo (2003), the aims and objectives or goal orientation is related to the two basic motivation types of extrinsic and intrinsic motivation. While the students are inclined to be extrinsically motivated in learning goals, they try to obtain maximum grades to impress their instructors. Intrinsically motivated students sometimes lose their achievement at high levels if their imaginative task-solutions are not properly encouraged. Similarly, those students who are extrinsically motivated most of the time fall short in performance because of not getting adequate rewards.

Bandura (2001), in his social-cognitive theory of human learning and motivation, examines student learning environment, attitudes, and independence
interactively. Learning, according to him, occurs when students observe, control their mental process (reasoning, intuition, and perception) and comprehend. Motivation and behavior is the result of self-regulation (Schunk and Pajares, 2001). Those students who are motivated show good performance in academic areas intentionally, by engagement in class activities, in group discussion during class through class presence, and inquiry method activity (Pajares, 2001).

Bandura (1997) argues that self-efficacy “is the belief about one’s capabilities to organize and execute the courses of action required to produce given attainments” (p. 3) that enables the self-confident individuals, who have the assurance in their capabilities that they can do tasks successfully. They perform those tasks only in those situations when they are completely assured that they can successfully achieve and they tend to avoid tasks where success is uncertain.

Confident individuals with high self-efficacy are more interested in doing challenging work, applying full effort during all procedures. If confident individuals do not make the grade, they do not make others responsible and, when successful, they recognize their performance because of their interests and abilities (Bandura, 1997).

Self-regulated learning plays a significant part in academic education and performance. Self-motivated learners are not only successful in educational settings but also tend to gain good results in examinations. Consequently, educational institutions are so important to bring up the development of special skills in self-motivated students.

In science learning, motivation of science students is defined as students active engagement in science related tasks for obtaining a higher performance and a higher knowledge of science (Lee and Brophy, 1996). Motivation is a vital educational
variable promoting strategy, activating previously performed learning skills, behaviors and learning in new ways (Barlia, 1999). If student perceive the value of learning activities, they will actively enjoy these learning activities with a positive attitude to construct a meaningful understanding of a new science concept based on their existing knowledge. Von Glasersfeld (1998) noted that the students’ learning goal which is based on learning values is also important for construction of their understanding in science (Taun, Chin and Shieh, 2005).

The Science Motivation Questionnaire (SMQ) designed by Glynn and Koballa (2006) was employed to explore the issue of learner motivation. This is based on a postulated set of five factors namely; intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self determination, career motivation and grade motivation. The authors consider that it can be applied across cultures.

This research “Investigation into status of science motivation among intermediate science students through science motivation questionnaire (2006) and its validation” was conducted on the college level students. The study examined students’ conceptualizations of their motivation in science learning. The use of the SMQ allowed a cross-validation across countries as desired by the authors.

1.1 STATEMENT OF THE PROBLEM

This study was entitled, “Investigation into status of science motivation among intermediate science students through science motivation questionnaire (MSQ) and its validation”, based on the SMQ from Glyn and Koballa (2006). The authors of this questionnaire claim that it offers a measure of learner motivation. They have claimed support for the validity and reliability of the questionnaire (Glynn et al, 2009) as evidence for the postulated five dimensions. The study here sought to use the
questionnaire in a different culture to explore what evidence there is that the claims of
the authors are valid.

1.2 OBJECTIVES OF THE STUDY

The objectives of the study were as follows.

(1) To investigate the construct validity of the science motivation questionnaire.

(2) To examine any motivational differences between male and female intermediate science students.

(3) To examine any differences between first and second year science students.

(4) To put forward recommendations in light of findings of the study.

1.3 RESEARCH QUESTIONS

Research questions were:

1. What evidence is there that motivation can be measured through the SMQ with validity and reliability?

2. Are there gender differences in motivation with science students?

3. Are there differences in motivation with science learning experience?

1.4 SIGNIFICANCE OF THE STUDY

One of the most fundamental problems in education is what measurements to make and what they mean. Ideally, we want tests that measure what they claim to measure. Thus, if we want to measure the ability of learners to use English in extended writing, then we set a task for the learners where they are required to write extended English and we mark their work according to agreed criteria. We would
never ask the students in a questionnaire about their opinions about their abilities to write extended English.

Sadly, in educational research, questionnaires are used to measure skills. The argument is that the learners can tell us about their skills. However, all that the questionnaire tells us is what the respondents think. This may not reflect the skill at all. In an interesting study, Hindal (2007) measured various cognitive attributes (like extent of divergence, extent of field dependency) using standard tests of these skills. She then set questionnaires to see how the learners saw themselves. She found very little relationship between the well-validated test outcomes and the questionnaire outcomes.

It is a fashion to develop all kinds of questionnaires and inventories and argue that these measure various attributes. Motivation is no exception. The importance of this study is to look at one such questionnaire and explore the evidence on its validity. At the same time, by looking at individual questions in the questionnaire, the hope is that new insights will be gained about aspects of motivation that are important in Pakistan. This may offer help in future planning of curricula and how curricula are delivered.

It is evident that there are problems in Pakistan in education in the sciences. Poor performance and lack of popularity are widespread, women sometimes suffering more. Indeed, to achieve the science related objectives offered in the National Education Policy, IQRA (1998-2010), it requires more progress in developing sound evaluation systems, as well as courses that are not only modern but also reflect the way learners actually learn. Thus learners may become more motivated and success will spiral upwards. This study may offer some useful insights in this.
The significance of the SMQ is that it can give important information about student motivation in science learning, about how can we motivate students for science learning and why we need to motivate or demotivate them to learn science. Instructors and science education researchers can use this information. For science teachers and researchers, the study results may play a significant role in promoting motivation. It will be helpful for construct validation of SMQ which investigated student’s ideas of their interest in science learning.

1.6 METHODOLOGY OF THE STUDY

The research procedure of the study was executed as given under the following headings:

1.6.1 Population

The population consisted of the 1st year and 2nd year science students studying in 1st year and 2nd year classes in government colleges in Punjab (Pakistan).

1.6.2 Sample

Six hundred 1st year and 2nd year science students (300 boys and 300 girls) were randomly selected through two stage cluster sampling.

1.6.3 Research Instrument

The 30-item SMQ (Appendix B) developed by Glynn and Koballa (2006), was used as authors desired to cross validate it in other countries.

1.6.4 Data Collection

The intermediate colleges were in person visited for the purpose of data collection. With the acquiescence of concerned establishment, students filled out questionnaire in their classrooms.

1.6.5 Data Analysis

Statistical Program for the Social Sciences (SPSS) version 17.0 was used to evaluate the information, gathered by science students through SMQ.
1. Principal Component Analysis (PCA) was used to find the fundamental structure of the SMQ. The problem with factor analysis is that it requires a value judgment on the part of the researcher to interpret the outcomes.

Following steps was used:

Step 1: In principal components analysis, the first step was entitled 'Communalities'. This gives the amount of variance of each variable that has been 'explained' by the analysis.

Step 2: Step 2 entitled 'Total Variance Explained'. There were three columns which give the 'Cumulative %'.

Step 3: The next step is the Scree Plot. (a) The SCREE plot has a marked discontinuity.

Step 4: In third step of data extraction, set how many components set the cut-off eigenvalue. Default value is 1 in the case of standardized data.

Step 5: 'Rotated Component Matrix'. That gives the factor loadings for each variable. Ideally, every variable should give a high loading somewhere.

2. Kendall's Tau-b is the correct correlation method for ordinal data and used to measure the inter item correlations.

3. Chi-Square 'contingency test' was applied to compare the two distributions of responses.

1.7 DELIMITATIONS OF THE STUDY

Keeping in view the research priorities and restrictions of time and resources, the study was delimited to:

- Intermediate science students
- Specification of subject of Science
- Districts of Gujranwala, Gujarat and Rawalpindi in Pakistan
CHAPTER 2
REVIEW OF LITERATURE

2.1 What is Motivation?

“Why?” is probably the most widely asked question in the English language. Why did he do that? Why didn’t she come? Why would anyone want to be like that? Why didn’t that student complete the assignment? Why does he always pay attention in class? All questions attempt to understand the “motive” that drives people to act or not act in certain ways. They are all questions that attempt to understand and explain human motivation (Richard et al, 2001).

So, what is motivation? Simply stated, the concept of motivation is applied when a person is energized to satisfy some need or desire. The person will engage in, or be attracted towards the behavior which is supposed as having the potential to meet this desire. Since activities that appear to satisfy “unmet” needs will appear attractive and interesting, the teacher who observes an “unmotivated” student may really be observing someone for whom “life in the classroom” is not meeting his needs. When the classroom activities allow for the satisfaction of the student’s needs, even this “unmotivated” student will actively engage in the learning experience. (Richard et al, 2001).

In most theories of learning, motivation is a fundamental notion. The word ‘theory’ is used in its scientific sense, as a rationale that interprets, summarizes or hypothesizes on the basis of gathered evidence. Motivation is strongly interrelated to concentration, criticism, stimulation, and nervousness. For instance, while learning, it is essential for an individual to be motivated; nervousness can reduce his interest to learn. When individual gets any appreciation or recompense for his achievement from others, he becomes more motivated and this enhances the possibility that the task will be completed successfully. Weiner (1990) identifies that behavioral theories cover
extrinsic motivation (for example, rewards) while cognitive theories cover intrinsic motivation (for example, goals). The attribute that “moves” individuals to do something or not to do something is motivation.

### 2.2 Importance of Motivation

In the learning process, motivation is a significant aspect. Attention or interest is a main feature in learning. Motivation maintains and stimulates attention or interest in learning. Learner cannot learn anything without personal interest and learning can never happen without some element of motivation. Motivation facilitates learning (Bhatia, 1997).

### 2.3 How to Define Student Motivation?

Traditionally, learning was seen as memorization. It is hard to be motivated to memorize in that this is not the natural way learning operates. For example, Piaget has shown clearly that the learner is seeking to make sense of the world around and this is much closer to understanding (see Ebbinghaus, 1885; Wadsworth, 1971; Ausubel et al. 1978). However, understanding needs to be described clearly. If a learner really understands something, then the learner can apply the knowledge gained in a novel situation with some prospect of success.

It is very difficult to have any intrinsic motivation to memorize and the only incentive to do this has to be extrinsic: thus, successful memorization is rewarded in examination success. However, motivation to understand is related to the intrinsic satisfaction of being able to make sense of what is learned and the intrinsic satisfaction of being able to use the knowledge gained successfully in other contexts.
There is a real problem relating to examinations. If national examinations only reward recall, then teachers will naturally seek to develop the most efficient memorization and recall for their learners. However, if national examinations reward skills related to understanding, then the learner may well develop intrinsic motivation to learn because making sense of what is learned is internally rewarding.

Thus, students want to participate in the learning process naturally but only when there are perceived rewards: the best rewards are the internal satisfaction gained from understanding, from making sense of what is being learned. It is important to notice what are underlying reasons that individual takes interest or sometime avoid participating in academic activities. The source of motivation might differ but students become equally interested in doing any task. Thus, motivation in relation to learning can be seen as the inner force or state that makes active the desire to learn. The deepest motivation must be intrinsic: the inner desire to make sense of what is presented and then to use that knowledge in meaningful ways.

2.4 Kinds of Motivation

2.4.1 Motivation may be state and trait, internal and external

Motivation is a permanent personal trait of an individual and also a temporary situational state. We may be motivated by inner personality factors such as needs, interests, curiosity and goals. Different persons show different levels of motivation, irrespective of the task they perform. People may be also be motivated, on the other hand, by environmental factors such as incentives, rewards and punishments. People may be highly motivated in one situation but completely de motivated in another situation (Crowl et al, 1997). The teacher’s job is to be creating situation that motivate students to learn leading ultimately to development of personal trait of motivation.
Ladislav Duric (1990) considers the internal motivation as a state ‘forcing’ the individual to do something or to learn something for personal satisfaction, to broaden personal experience. The human being who is internally motivated to learn does so willingly, since the learning provides pleasure and satisfaction.

For Ladislav Duric (1990), external motivation for learning has less value than internal motivation. External motivation (incentives) may create a situation where the subject-matter to be learned is very unpopular, leading to frustrating barriers on the way to fulfilling the set requirements. In this case, overcoming the frustration barriers, the pupil’s experience of pleasure may not follow from the very process of learning, but from the attained goal which had been set from the outside. This is the situation where potential future success in examinations ‘motivates’ the learner to memorize material.

When dealing with this kind of motivation, it often happens that the ‘clever’ pupil soon learns to avoid the learning process and tries to achieve the established outcomes by cheating, copying and other unwelcome forms of behavior. Nonetheless, in spite of the higher value attributed to internal motivation, even external motivation has its place in guiding learning.

Internalization of external motivation requires that certain conditions should be met, as mentioned briefly below:

- **Development stages of student**

  Enthusiasm and interest for learning and learner’s level of development must be in accord. If the task is beyond the learner’s abilities, or if the goal is too distant, external motivation will not function.

  Perhaps the most important contribution to cognitive development is offered by
Jean Piaget, the Swiss-French biologist-psychologist, whose studies totally revolutionized our way of seeing learning. From his very careful observations, Piaget showed that children passed through a series of stages in the way they think (Piaget, 1963, Wadsworth, 1971):

<table>
<thead>
<tr>
<th>Stages of Intellectual Development</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensorimotor (birth to 2 years)</td>
<td>Differentiates self from objects</td>
</tr>
<tr>
<td></td>
<td>Recognises self as agent of action and begins to act intentionally</td>
</tr>
<tr>
<td></td>
<td>Achieves object permanence, realising that things exist even when no longer present to the senses.</td>
</tr>
<tr>
<td>Pre-operational (2 to 7 years)</td>
<td>Learns to represent objects by images and words</td>
</tr>
<tr>
<td></td>
<td>Language facility and grammar expand enormously</td>
</tr>
<tr>
<td></td>
<td>Classifies objects by a single feature e.g. colour or height</td>
</tr>
<tr>
<td>Concrete operational (8-11 years)</td>
<td>Can think logically about objects and events</td>
</tr>
<tr>
<td></td>
<td>Achieves conservation of number (age 6), mass (age 7) and weight (age 9)</td>
</tr>
<tr>
<td></td>
<td>Can classify objects according to several features and can order them in a series along a single dimension</td>
</tr>
<tr>
<td>Formal Operational (12 years onwards)</td>
<td>Starts to think logically about abstract propositions</td>
</tr>
<tr>
<td></td>
<td>Starts to test hypotheses systematically</td>
</tr>
<tr>
<td></td>
<td>Becomes concerned with the hypothetical, the future, and ideological problems</td>
</tr>
</tbody>
</table>

Table 1  Piaget Developmental Stages

The key point that Piaget found in his work is that all learners progress through these developmental stages. In the context of motivation, if the learner is presented with materials which are beyond the developmental stage attained, then learning is more or less impossible and total demotivation will follow, as the learner loses confidence.

The final stage is very important in secondary education, occurring roughly between the ages of 12 to 15. During this stage, the capacity for using key cognitive skills which are important for the sciences are steadily being developed. The young adolescent is moving steadily away from dependence on that which is concrete: that which can be seen and touched directly.

The potential to think in terms of the abstract is slowly emerging and this has very important implications for learning in mathematics and in the sciences where so
much can be conceptual. In addition, the ability to hypothesize is slowly becoming possible so that, by the age of 16, the student is capable of thinking in terms of the hypotheses, a critical skill in scientific thought.

This has enormous implications for teaching in the sciences. At primary school (up to about age 11 or 12), the learner is mainly in the concrete phase. Any science taught then simply has to reflect this and must be such that it is able to be seen, touched or handled. The conceptual ideas are simply largely inaccessible at that stage. This explains why topics like force, energy, and electricity are so difficult to grasp (in the sense of any kind of understanding) and why the study of the human body is much more accessible. It is possible for the young child to explore a model of the human body but it is not easy to represent force, energy, and electricity with any kind of physical model.

All of this has huge implications for motivation. In simple terms, learning must be within the developmental capacity of the learners.

- **Previous experience**

  Learning is a process particularly influenced by previous experience. If no account is taken of previous experience and knowledge acquired in the given subject of instruction, it is impossible to motivate the pupil for further learning. The work of the educational psychologist David Ausubel is seminal here (Ausubel et al, 1978). In his earlier work, he stated that,

  ‘*If I had to reduce all of educational psychology to just one principle, I would say this: the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.*’ (Ausubel, 1968: iv).

  This has enormous implications for motivation. New ideas start to make sense when they can be linked meaningfully to what the learner already knows and
understands. If the learner cannot make the necessary linkages, then understanding is a casualty. Demotivation will follow.

- **Self-expression**

  If no heed is paid to the learner’s individuality, endeavor and the desire to express personality in a given direction, it is not possible to motivate her for learning. In such a case, the opposite effect may be set in motion, either in form of resignation or aggression.

  However, there is a deeper dimension to this. Different learners find it easier to learn in different ways. Thus, some find it easier to learn by means of the symbolic (language and number), while others favor visual learning. Some of the greatest minds of all time have been shown to be natural visual learners (e.g., Mozart in music, Einstein in Physics). If what is to be learned is presented only in one way (usually by means of language and number) then the visual learner is greatly disadvantaged. Indeed, motivation may collapse (see Silverman, 1989, 2002, 2003).

- **Aspiration level**

  Closely connected with self-expression is the learner’s level of aspiration, represented by expectations in the field of success. The appropriate level of aspiration forms the most favorable ground for learning. Very high and very low level of aspiration in relation to the pupil’s potential may unfavorably influence the course of learning.

  This may be strongly influenced by parental or social expectations. This has huge implications for Pakistan in that parents with poor educational backgrounds may not seek opportunities for their children, leaving the latter with a much lower view of the value of education and, thus, much less motivation to learn.
• **Interest**

Familiarity with pupils’ interests provides an important initial basis and means for learning motivation. When the teacher identifies and utilizes these spheres of interest and associates them with further learning elements, learning becomes more effective. The teachers’ own experience will confirm that pupils will tend to be more motivated to learn the subjects they are interested in.

This has interesting implications. While it is important that curriculum planners take the time to ascertain what are the areas of interest for learners, this is only one factor which will determine what is to be taught. Learners are, indeed, motivated by what interests them. However, in life, there are occasions where all humans have to undertake uncongenial tasks.

Arising from this is the concept of the *applications-led* curriculum. Here what is to be taught takes into account what is perceived by the learners to be related to their lifestyles and contexts at that particular stage of life (Reid, 2000). Such curricula certainly motivate as Skryabina found (Reid and Skryabina, 2002a,b).

• **Knowledge of performance in learning**

If pupils have information about the levels they have achieved at different stages of learning, this knowledge becomes strong as a motivating factor for the subsequent stages. This requires a degree of honesty with integrity. Learners, even young children, will not be taken in by reports suggesting they are doing very well when they will know that their performance was not outstanding. Nonetheless, accurate feedback which shows them exactly where they have been successful, where they have been less successful and how they can make improvements, is vital.
• Setting goals

The setting of exact and clear intermediate goals in learning, and trying to achieve or even surpass them, becomes a strong motivation for pupils. Younger pupils should be helped to set nearer goals rather than more distant ones. Not only should clear goals be set but the goals should be attainable.

• Completing the task

When beginning a new task with an established goal, the so-called ‘tension system’ arises within the mind, aimed at the achievement of that goal. As soon as the goal is reached, the tension is released. However, if activity in the achievement of a goal is interrupted, a state of tension remains and the pupil feels forced to return to that activity and attain the goal. Completed tasks are more quickly forgotten than incomplete ones, due to the relaxation of tension.

• Reward and Punishment

Reward is considered to be a positive and punishment a negative motivation. They do not work in the same way in motivating pupils to learn. Psychological research and educational practice both confirm that positive motivation is more effective than negative motivation. Nevertheless, even punishment has its role in motivation.

All this has important implications for the classroom. Learners need to be affirmed in all they do and all they achieve. However, they must not be deluded by spurious ‘success’. Punishment, in its traditional sense, has little place, other than for dealing with unacceptable behavior. However, disapproval, when things go wrong is appropriate, provided that the disapproval also offers a way to improve,
• **Success/failure**

This motive is in force throughout in our lives. Every human undertaking, especially in its initial stages, is noted for its success or its failure. Success in learning motivates pupils to experience the same feeling again and so they try harder. Pupils should be made to understand that they cannot always attain easy success or earn a cheap victory. On the other hand, when the failure is too severe, or becomes repetitious, the learner gets discouraged, loses confidence and, with it, loses the overall motivation to learn. Pupils should be guided in such a way that they experience more often the feeling of success than that of failure, in order that they do not lose motivation to learn.

Conti (2001) identifies that individuals who are interested in their activities are not as much worried with the complexity of a certain task as well as not worried about its time duration as compared to those who is not interested in doing that task.

**2.4.2. Extrinsic motivation**

When an individual is motivated by an external outcome, extrinsic motivation is involved. Motivation then connects to some activity or action (Pintrich and Shunk, 1996). The piece worker on the production line of the widget factory may attempt to increase her production if a special bonus or money incentive is provided. In this situation, it is not the process of making widgets that is motivating but the fact that additional money can be made. In most cases, the individual engaged in some activity because of extrinsic motivation often will be goal oriented and goal directed.

Herter *et al.* (1992) note that extrinsic motivation is often used to maintain not only in our educational institutions but also in our society in the form of grades, awards, and honors. Heavy emphasis on extrinsic motivation and reinforcement has
been criticized because we do something in order to gain something else. We are not really interested in the activity of learning for its own sake.

2.4.2.1. Using Extrinsic Motivators Effectively

However, not all extrinsic motivation is bad (Covington and Mueller, 2001). The problem lies in how teachers use rewards for what purpose? Extrinsic motivators such as praise, money, grades, and stickers can be administered either to control behavior or to reward competence. According to cognitive evaluation theory, using extrinsic motivators effectively requires that extrinsic rewards be non-controlling and informational.

2.4.3. Intrinsic motivation

Intrinsic motivation is the inbuilt tendency to connect the interests of individuals and to develop and use capacities of individuals (Desi and Ryan, 1985). It emerges instinctively out of the needs of the individual for capability, relatedness and self-sufficiency. Intrinsic motivation stimulates or raises student’s emotional or psychological desires. Instructors have to discover different ways to make the tasks interesting, enjoyable and pleasurable. Satisfaction and awareness feelings happen as spontaneous satisfaction (Deci and Ryan, 2000). Intrinsic motivation yield several learning benefits. Intrinsically motivated students express creative performance, healthy, attitudes such as fortitude, high-quality learning, and positive security (Deci and Ryan, 2000).

2.4.4 The classroom: A setting of intrinsic and extrinsic motivation

In any one classroom on any day, numerous children can be seen engaged in learning for its own sake; this reflects some level of intrinsic motivation. However, the same cursory glance at the class may lead one to conclude that emphasis is placed on extrinsic motivational factors (Lepper and Hoddell, 1989). Students of the month
posters, honor cards, smiley faces, grades, special form of recognition are all examples of the payoffs teachers employ to motivate (extrinsically) their students.

Students want to learn and develop something through their classroom environment. However, this motivation may not be adequate. Extrinsic payoffs affect student achievement. Because of these circumstances, the questions are raised for the teacher about “why” and “what to do?” To answer these questions effectively and to make appropriate decisions to facilitate each student’s achievement, the teacher needs a fuller understanding of the research and theory behind both intrinsic and extrinsic motivation (Richard et al, 2001).

2.5 Motivation to Learn

Motivation to learn is defined as the meaningfulness, value and benefit of the learning tasks to the learner whether they are attractive or not (Hermine Marshall, 1987). It is characterized by long term, quality involvement in learning and commitment to the process of education. (Carole Ames, 1990).

Learning is an aspect of meeting the needs of individuals. Deci and Ryan (1985) confirmed that inside and outside environment is useful to satisfy the individual’s needs. Learners have inner latent attitudes while all kinds of external factors can affect learning. Thus, the learner may hold very positive attitudes towards learning, the teacher, the materials to be learned, and so on, and this will generate an internal motivation to learn. However, there may be external factors motivating learning: the need to pass examinations, to please parents, to gain access to an ensuing course or career. Cherrington and Wixom (1983) confirmed that individuals only perform those actions from which they are reinforced or pleased for doing.

Teachers are mandated to teach what the curriculum demands and to enable their learners to pass requisite examinations. Teachers often have little freedom in
what they teach and, indeed, in how they teach it, for overcrowded curricula make time precious. However, Woolfolk (2004) emphasizes the need to present the material in thoughtful and exciting ways, to develop and stimulate interest. He admits that this will take considerable mental effort on the part of the teacher. The problem then moves to the motivation of the teacher. If the teacher receives no rewards in doing this, then it is unlikely to happen. Sadly, the way national examinations are set, with the emphasis on recall of largely unrelated facts, hinders the teacher and offers no incentive to change. Indeed, the teacher may well be motivated to focus on the transmission of the facts simply because this gains the learners the best chance of good grades.

With external motivation, the tendency is for the learner to see success in terms of performance and achievement. Indeed, the pressures to perform may generate anxiety and any failure will produce disappointment and a feeling of inadequacy. If the external motivation is directed to encourage the learner to perform at their maximum, without over-emphasis on examination performance, then deeper satisfaction may be possible. However, internal motivation tends to see the value of learning in its own right, not by laying creating on over-emphasis on examination performance and the concomitant anxiety or fear of failure. Learning is perceived as valuable for its own sake.

2.6 Motivation Approaches

The subject of motivation is complicated and vast subject. Woolfolk (2004) has selectively described following four approaches.
These are summarized below:

2.6.1 Behaviorist Approach

Behaviorist approach emphasized extrinsic motivation. An understanding of student motivation begins with analysis of incentives, rewards and punishments present in the classroom.

To promise some reward as an incentive or give some prize is a pleasant action although punishment after an action is usually an unpleasant thing. Reinforcing a desirable behavior is considered to more effective motivator as contrasted with punishing wrong behavior.

2.6.2 Humanistic Approach

Intrinsic motivation is highlighted by a humanistic approach. This arise by meeting the needs for realizing one’s potential. When two or more needs are unmet, individuals gratify them in a specific sequence. Firstly, they satisfy physical needs, then safety needs, then affection and affiliation needs, then respect by others and self-respect needs and finally self-actualization needs. Self-actualization needs, unlike lower needs, lead to personal growth and are never satisfied. Students may not show intrinsic motivation unless they are physically and psychologically comfortable in the classroom.

2.6.3 Cognitive Approach

Cognitive approach believes that thinking plays an important role in motivation because behavior is not simply influenced by rewards and punishment but also by our thinking. Two important theories in this approach are:
2.6.4 Attribution Theory

This theory by Wiener focuses on the causes attributed by people to explain their success and failure. These causes, whether true or false, are the best predictors of future motivation and behavior. The most frequent causal attributions for success or failure are effort or lack of effort, ability or lack of ability, easy or difficult task, good or bad luck. Those students who explain their success and failure by giving internal, unstable and controllable causes like effort and ability are more intrinsically motivated.

2.6.5 Expectancy and Value Approach

Rotter states that the performance potential of any particular behaviors is determined by the expectation that the behavior will be efficacious, leading to a valued reward. In other words, motivation is the product of expectation to succeed and the value of that success. The higher the expectancy to reach a goal and the greater the value of that goal, the higher will be the level of motivation. To express it mathematically,

\[
\text{Motivation} = \text{Expectancy} \times \text{Value}
\]

2.6.6 Societal Approach: This approach emphasizes the needs for affiliation and secure connection with others. Students having caring and supportive connection with others in the classroom will have higher motivation for learning and achievement.

All the above motivation theories vary with each other in their concepts but play a constructive role in their own way to have a complete understanding of an individual’s motivation. Only the behavioral approach support external motivation but other three emphasize intrinsic motivation.
2.7 Contemporary Perspectives on Motivation

To organize the above ideas about motivation in useful ways for teachers, broad areas are conceived as modern perspectives on motivation (Woolfolk, 2004).

2.7.1 Goals and Goal orientation

Although it has to be recognized that achievements do occur without setting any goals, the setting of goals and targets help not only to make achievement but also to know that the achievement has been made. Indeed, it is possible to know when the goals have not been reached and to attempt some other strategy. Goals can direct our concentration to the task. However, the goals must be willingly accepted, specific and of moderate difficulty so as to be attainable. If goals are simply unattainable, then frustration will arise. If the goals are appropriate then they may aid motivation to move forward.

**Goals are specific targets:** Goal orientations, on the other hand, are reasons for continuing the goals and the standards to evaluate progress towards these goals. Four goal orientations are learning goal orientation, performance goal orientation, work avoidance and social goal orientation. Learning goal orientation is orientation to get better and to learn, increase knowledge, and have full command on skills without being worried about one’s performance as compared to other class fellows. Such students are intrinsically motivated learners who get lost in their learning. Performance goal orientation is orientation to perform better as compared to others who are called ego-involved learners. Performance goal oriented learners are extrinsically motivated.

Work avoidance goal oriented students are neither intrinsically motivated nor extrinsically motivated. These students are not interested in learning and usually show over confidence to finish their work fast without much exertion and effort.
Social goal orientation is the orientation in an attempt to satisfy social, nonacademic needs which becomes more visible in adolescence. This orientation may help learning if social goals are in line with academic goals. However, this orientation may hinder learning if group norms conflict with educational norms and success in the peer group becomes more important than school success.

2.7.2 Feelings and Emotions

Feelings and emotions are also strongly connected like goals and goals orientation, with motivation and learning. The learner is unlikely to learn well when the whole process of learning is not emotionally and cognitively charged. The more the learner is interested in learning and feels pleasure, the more she will process the information deeply. The learners need to have positive attitudes towards the key aspects related to learning. Fear and anxiety are harmful for learning unless they are of moderate level. Severe anxiety may be the cause and effect of poor motivation and learning. Anxiety, like motivation, is a personality trait as well as a situational state because some students are anxious in many situations. Some situations also provoke anxiety among students. Anxious students need to learn test preparation and test taking skills to reduce their anxiety.

In the past, school education focused on the cognitive, largely on what was to be memorized and recalled. The emotional dimensions of learning were ignored and, as a result, many learners simply opted out or failed. There is much greater appreciation of the importance of the emotions which suggest ‘hot’ cognition, cognition charged with positive emotions.

2.7.3 Beliefs about Self

Beliefs about self also influence motivation like goal orientations and emotions. Those beliefs consist of belief about ability and beliefs about self-efficacy.
2.7.3.1 Beliefs about ability

This is the belief of learners about their own personal ability. They may think their ability is fixed and uncontrollable or they may see it as flexible and controllable. Those who hold the first view tend to think that their ability cannot be increased with effort. Those who hold the second view consider that ability can be increased by hard work. The first sees ability as an ‘entity’, something fixed and genetic. The others conceptualize ability as ‘incremental’ and consider that it is open to growth and development. This has implications for motivation. The first group will simply do what they can do and any motivation will tend to be external while the second group will tend to be intrinsically motivated who work hard to improve themselves.

Learners with incremental views want to develop their skills. Disappointments and failure are not disasters. They indicate the need to work hard and they set their objectives at reasonable complexity.

2.7.3.2 Values Beliefs about Self-Efficacy

Beliefs about self-efficacy are another type of self beliefs which have strong influence on motivation to attain. It is belief about personal competence, whether true or false, in a precise area. Bandura (1977) describes self-efficacy as the extent to which an individual has confidence in their abilities and actions to achieve specified attainment.

Self-efficacy is future oriented, a private appraisal and satisfaction to execute a definite work; both self-esteem and self-efficacy are quite similar. Self-concept is a broader view about the person. Self-concept occurs as a result of external contrast, the comparison on different aspects of self and with others but self deals with the learners’ confidence on its abilities without any comparison with other.
Self-esteem and self-efficacy differ from each other. Judgment of self-value is self-esteem and judgment of personal capabilities is self-efficacy but there are connections between them. Of course, it might be possible that people have greater self-efficacy with low self-esteem. Similarly, some people have low self-efficacy but not necessary low self-esteem. Nonetheless, the two features tend to go together.

Overall, there are four concepts here. They are distinct but inter-related in many ways. Figure 1 offers one way to look at them.

![Figure 1](image)

The real question is how each relates to motivation. How a person thinks about himself (self-concept) and a person’s self-esteem will, of course, have an underlying
effect on motivation. Thus, the person who evaluates himself realistically and sees value in what he is and does may well be encouraged towards a motivation to learn. However, self-efficacy is likely to be powerfully related to motivation. For example, the learner who simply believes that she can succeed in the task ahead may well be highly motivated to go ahead. This relates to confidence. If persons believes they can do it, then they will have the confidence to try to do it. Overall, there is a drive towards a motivation in the belief that success is likely.

Generally, the literature indicates two broad areas that have been the focus of much educational research. Firstly, some researchers investigated existing relationships between efficacy beliefs and college students’ confidence to enroll to a specific major and career choice in science and mathematics. Secondly, some investigators explored interconnections between efficacy and other psychological constructs such as self-concept, anxiety and perceived usefulness. It is generally reported that when self-efficacy is incorporated in the psychological model, effects of other related constructs like self concept, self esteem, self confidence on students’ academic performance will be reduced and self efficacy influence increased (Young and Choi, 2000).

### 2.7.3.3 Self-Efficacy and Academic Achievement

Bendura (1977) initiated the conception of perceived self-efficacy which influences and modifies human behavior. Self-efficacy, as stated earlier, is identified to be the individual’s personal belief in its personal skills to perform specific tasks effectively. Self-efficacy theory stresses that human action and success depend on how deep the interactions are between one’s personal thoughts and a given task. Individuals who possess a low sense of self worth and think of task’s demands as
threatening, not as challenging and therefore set low learning objectives for themselves (Ali, 2008).

2.8 Self-Determination

Sense of self determination also influences human motivation like three previously described constructs.

Deci (1995) has identified a wide structure of personality and human motivation by the concept of self-determination. Self-determination is the need for autonomy which influences internal sense of self efficacy and intrinsic motivation instead of controlling student behavior too much. Those teachers who permit students choice and freedom to some extent in classroom activities, rules and regulations, due dates of examinations and assignments have more intrinsic learners.

In a sense, self-determination is an aspect of inner motivation. The person feels independent, able to cope, able to move forward, irrespective of the outer circumstances. Thus, even when the classroom climate is unsupportive, or when the work does not seem attractive, the person is still motivated by means of self-determination to learn. In a real sense, this is an aspect of inner security. When an individual feels secure, then (s)he is confident in the ability to cope and is less worried by circumstances. This allows the motivation to learn to blossom.

Of course, the teacher can play a large part in this. There is a need for empathy towards the learner and the use of judicious praise, building up a security in learning and allowing the motivation to learn more to develop. Koestner and Losier (2004) speak of those who are thus internally motivated as those who are self-determined. It is a delicate balance where outer factors of the past enable the learner to develop intrinsic confidence and the will to succeed. Motivation thus has both extrinsic and
intrinsic aspects. By means of extrinsic support and encouragement, the ultimate aims is to enable learners to become self-reliant, self-determined and motivated internally (figure 3).

**Figure 3  Extrinsic and Intrinsic Motivation**

Hyungshim Jang (2008) introduces three different models of motivation:

- Model of self-determination;
- Model of stimulated interest
- Combination of self-determination and stimulated interest.

In fact, these models are little more than the idea of intrinsic motivation, extrinsic and a combination. The important aspect is knowing how to stimulate interest and confidence so that motivation is intrinsic and will continue on without external support. The teacher can assist creating tasks and challenges which develop successful learning experiences and demonstrate the importance of what is being learned. Hyungshim Jang (2008) make the obvious point that the students must be aware of the value of tasks and why they are useful for them.

However, the teacher may face insurmountable problems. Curricula determine what is to be taught. Curricula are usually determined by those outside the classroom and often many curriculum planners have never taught or have not taught recently. There are endless examples where teachers are forced to teach inappropriate material. Developing interest and enhancing motivation thus become almost impossible. In a
recent study, a nice example in mathematics is illustrated with mathematics in Pakistan (Ali, 2008; Ali and Reid, 2012). It is very clear, from this work, that teachers are far more skilled in developing appropriate curricula than those outside the classroom.

Reve and Jang (2006) have looked at what they call teacher autonomy support within self-determination. In essence, this is simply complex language to describe the way teachers can aid learners so that they become internally motivated. The ideal goal is that each learner is internally motivated so she can and will learn effectively without external pressures. How to develop this is not so easy.

One key factor is a level of confidence and honesty that exists in the teacher-learner interface. This is based on trust. The learner needs to trust the teacher and feel supported and valued. This may well lead to self-belief in the learner who feels confident that, no matter how demanding the work is, some level of success is possible. In essence, the teacher has released in the learner some level of internal motivation.

Schwartz (2003) has offered some ways to encourage these outcomes. Some of the ways forward can be summarized in figure 4.
Figure 4 Developing self-motivation

Woolfolk (2004) has identified five important issues when seeking to develop motivation towards learning:

1. Student’s independence in their activities;
2. Reality of educational activities;
3. How to organize learning;
4. How to evaluate them in learning situation;
5. How to acknowledge student’s performance.

This leads to some important practical ways forward in enhancing and developing motivation with the learners:

The learning must be related to what is important in the life of the learners. For example, rather than teaching traditional physics, the students could study the theme of communications and explore how humans communicate by means of sound, light, traditional telephone, optical fibers. At that stage, the topic moves to communicating by means of the transmission of electromagnetic waves and this leads to an understanding of radio and television. Finally, students consider how to communicate by transmission of electromagnetic waves when the curvature of the earth makes it impossible for the waves to come from great distances. This leads to the idea of bouncing the waves off satellites but this requires stationary satellites.
The physics of how satellites can be stationary is then unfolded. The physics is not demanding but it is all built around how humans communicate with each other and this has a direct relevance and significance for young learners. Such an approach exists and has been found to be very effective (Skryabina, 2000).

Parsons et al (2001) identifies one important feature of learning that can be highly motivating. The learners work well in groups and this offers peer support and, often, a less threatening atmosphere. This approach has been used widely in solving real life problems (Reid and Yang, 2000).

One of the greatest threats to motivation lies in assessment. It is fine for those who do well - they are motivated. However, for those who do less well, assessment outcomes can destroy confidence, self-esteem and reduce motivation for future learning quite markedly. It has already been noted that most assessment merely rewards recall skills (Almadani et al, 2012). Indeed, multiple choice questions are highly destructive in this regard and are known to be highly unreliable as indicators of success (Friel and Johnstone, 1978a,b; 1979a,b; 1980; 1988).

There is a need for new forms of assessment. Indeed, the more important issue is how assessment data are used. The traditional way is to use assessment data to assess learning. It is equally possible to use assessment data as an aid to learning.

Most assessment occurs at the end of a course, module or series of lessons and seeks to indicate the learner’s success in the work covered. It is known as summative assessment and can be thought of as assessment of learning. The alternative is that assessment is integrated into the entire learning process and the outcomes of assessment are used to indicate where learning has been successful or less successful and thus it directs future learning. This is known as formative assessment and can be thought of as assessment for learning.
Gronlund and Linn (1990) see formative assessment being used to monitor learning during the course of instruction. Its purpose is to provide continuous feedback to both teacher and student about learning progress, successes and failures. Feedback to the student provides reinforcement to successful learning and identifies specific errors in learning that require correction. Feedback to the teacher informs the teacher for modifying instruction and for prescribing remedial work (p.12).

It is easy to argue that formative assessment is of greater value as it seeks to aid learning. However, research has shown that it depends critically on the quality of the feedback from the teacher to the learner. In other words, it is not so much the assessment itself that is valuable. What is of value is that the teacher gives quality feedback on performance so that the learner is directed into future learning which will be a greatest value. This raises real problems for giving quality feedback to learners on an individual basis which almost impossible in terms of the time required.

In the context of motivation, receiving quality supportive and directive feedback is highly likely to enhance motivation for the next phase of learning. How to do that within the limitations of time is much more problematic.

Wolfolk (2004) suggests four main classroom situations for instructors in order to stimulate classroom learning.

1. Interruption must be avoided in the classroom and it must be controlled.

2. The role of teacher must be encouraging rather than humiliating but supportive as to learning from mistakes.

3. Classroom activities must be normal, and not so effortless or not so complicated because in this situation, students will only concentrate to cover all instead of understanding.
4. Logical tasks should be promoted in the classroom and relate them with their daily life routine.

Much of this is very obvious and every competent teacher will seek to carry it out.

2.9 Approaches for Motivation to Learn

Eccles and Wigfield, as cited in Woolfolk (2004), have summarized influences on motivation to learn in three questions:

1. Can I achieve something?
2. Do I wish to achieve?
3. How can I get achievement?

Learners must have self-confidence in their skills as the result of these queries. As reflected in these questions, students must have self-confidence in their assignment worth, skill, and also have confidence and consider that when they use constructive methods of learning, they will succeed.

2.9.1 Can I Achieve Something?

In order to help the learner’s response to this question, build their confidence:

1. Start work at the learners’ level and divide it into the small steps.
2. Learning goals must be precise, accessible, related to future and be understandable for learners.
3. Encourage self-comparison, not with others. Assist learners observe their improvement and give specific encouraging and negative feedback on their work.
4. Talk to students that academic aptitude is not only improvable but also specific to the present task, that is, complexity in one subject does not represent that other subjects will also be complicated as that one.

5. Display that task is difficult in front of learners who must consider that teacher can also feel difficulty in solving complex tasks.

2.9.2 Do I Wish to Achieve?

In order to facilitate a desire to learn:

1. Interlink activities with each other and connect them with social problems and future of student in the learning task.

2. Stimulate student inquisitiveness by pointing out differences in their level of observation and their level of imagination.

3. Learning activities must be entertaining and help them learn numerous topics with the help of different models, maps, games and videos.

4. Employ diversity and familiarity in teaching approaches. Associate abstract material with something they are familiar and can understand.

2.9.3 How Can I Get Achievement?

In order to help students answer this question,

1. Provide different opportunities to students to respond through short assignments, questions and answers and try to correct their mistakes as soon as possible.

2. Avoid competition and grade’s importance so that students do not experience tension because of competitive evaluation.

3. Provide flexible time and assistance and possibility to modify or revise work to decrease disappointment on complicated task.
4. Signify the importance of motivation through discussion, students’ learning, curiosity, and assist them to face and tackle intricacy in learning.

5. Educate the students how to study and retain information.
2.10 General Principles of Motivation

Matthew Weller (2005) defines some essential principles of motivation. These are summarized in table 2.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Arrange to meet learner needs and abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The task of a teacher is to organize or make a healthy group environment for, learning through favorable attitudes and develop constant effort use illustrations, such as posters, booklets, encourage by capturing learner’s curiosity and concentration to motivate students.</td>
</tr>
</tbody>
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<table>
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<tr>
<th>Incentives</th>
<th>Encourage the learners wherever possible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incentives include acknowledgement and receiving honor from the teacher and it determine to make it possible to encourage learner at a particular time. Usually in learning condition, with out any praise personal interest will not do well. That will be satisfactory for students if they achieve their goals in learning which are useful to them.</td>
</tr>
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<table>
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<tr>
<th>Intrinsic Motivation</th>
<th>Seek to develop intrinsic motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some adults especially those students who come from a certain age group must repeatedly guide because they have no aptitude for intrinsic motivation. Praise works when learning occur successfully and students satisfied with their learning tasks.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Clear Direction</th>
<th>Seek to offer learning security</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Student are ready to learn something from time to time and the teacher must support its progress. The teacher should direct clearly to make sure that the desired performance occurs in order to preferred changes in performance quickly. In case student is not prepared to learn, it can not be dependable in subsequent or next instruction so teacher should be not only supervise them but also revise information continuously.</td>
</tr>
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<table>
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<tr>
<th>Instructional Material</th>
<th>Aim for high quality motivating materials</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Information becomes more meaningful to the learner through a sound structured material. One way is to connect novel tasks with previous knowledge. Second way is to communicate meaning in order to investigate individual understanding on that knowledge and must educate them to contrast the information.</td>
</tr>
</tbody>
</table>

Table 2 Five Classroom Aids to Motivation

Teachers know that one achievement can often lead on to subsequent achievements. The learner needs clear goals and the demand level must be within the capacity of the learner. Confusion and lack of clear direction quickly undermine learner motivation. Some learners can be unrealistic in seeing their capabilities while others lack confidence. Both need supported to encourage motivation to learn. The art of the great teacher is being able to match the goals to the learner aspirations and capacities.
2.11 Gender Difference and Motivation

In most areas of education, in numerous studies, few gender differences have been observed. However, that does not mean that there are no differences (Ormrod, 1998, p.520).

Herter (1985) reported the high scores of worldwide self-worth in male students as compared to female. Schiefele (1992) suggests that male students perform according to their curiosity level which tends to be higher than female students. In particular, academic performance of female students is not as much related to their interest and well being than academic performance of male students.

Females are more likely to have a higher commitment to work and are more concerned about doing well in school and more likely to graduate from high school. On the other hand, males have higher long-term aspiration for themselves. Ormrod (1998) suggests that efforts to motivate boys and girls lie in different directions, by stressing the relationship of high class achievement to their long term goals. Girls need to be provided more encouragement to consider a variety of career options.

2.12 Science Learning and Motivation

As this study deals with science motivation, the literature related to it is reviewed now. The actual source of word science is a Latin word “scientia” which comes from the verb, ‘scire’: to know. The word has two broad meanings today (figure 5):
Yadav (1992) speaks about the structured and organized nature of scientific knowledge, using the phrase, ‘*a heap of truths*’. However, science is also a systematic way of understanding and an organized source of learning. The definition of science is not limited or classified to the education but it investigates about the world in an organized and systematic way and gain information from suitable sources (Shami, 2001).

Rehman (2004) sees science as a variety of logical behavior concerned with the material world and its phenomena, orderly testing, and observation. He also states that science is a broad range of discipline activities with some similar features. Science is a systematic process, which involves general truths; it is cumulative in nature and covers the natural facts of the world.

Thus, in one sense, each discipline in the sciences represents the organized knowledge and understandings in that area of enquiry. However, in the other sense, science is a methodology, a way of asking questions of the world around. The key characteristics of all the sciences are that understandings are gained by means of evidence gained from the experiment.

In other disciplines, understandings are gained from other sources. Thus, history considers documents and physical evidence left from the past while mathematics gains its insights by means of strict mathematical logic. The creative arts rely on experience, human judgment, aesthetic appeal and emotional reaction.
2.13 Factors Which Reduce Motivation in the Sciences

Historically, in the developed world, the sciences were taught as bodies of facts to be memorized and recalled, up to about 1960. About that time, considerable dissatisfaction was expressed about what was being asked of school pupils. At university level, it was possible in a four year honours degree to cover almost all the known material in any of the main sciences, but again, recall was the main feature of assessment.

In 1962, new curricula were published for school chemistry and physics in Scotland (Curriculum Papers 490 and 512, 1962). Many other countries followed quickly behind. The aim in the Scottish curriculum was to emphasize understanding and the content was brought right up to date to include very recent developments. Two features started to be observed. Firstly, the school pupils liked this approach and, in Scotland, uptake numbers were good. Secondly, pupils found both subjects demanding. One of the earliest studies undertaken identified the specific topics which were causing difficulty in chemistry (Johnstone et al., 1971).

In many other countries, the new approaches did not work so well and pupils started to opt out of studies in the sciences. In fact, the sciences have remained incredibly popular at school level in Scotland from the 1960s to this day, while, in many other developed countries, the physical sciences have proved unpopular. Some of the reasons have been elucidated by Reid and Skryabina (2002a).

The interesting question relates to why the sciences are difficult. It is very clear that much material in the sciences is highly conceptual and some is very abstract. However, this merely pushes the question back a bit: why are abstract or conceptual ideas difficult for learners?
2.13.1 The work of Johnstone

In a brilliant series of studies spanning many decades, Johnstone determined the nature of the difficulties in the sciences, the fundamental reason explaining these difficulties and he offered the key ways to make the sciences much more accessible to the learners.

Working initially in chemistry, he started by establishing where the difficulties lay (Johnstone et al., 1971). He then looked at these areas of difficulties in turn to see if there were ways to reduce the problems. Eventually, one of his students found the key (Johnstone and Kellet, 1980). It lay in what they called ‘information load’. This hypothesis was tested and the outcomes were remarkable (Johnstone and Elbanna, 1986, 1989). Subsequently, the predictions from this were applied to learning in the laboratory (Johnstone et al., 1994, 1998) and then to lecturing (Sirhan et al. 1999; Sirhan and Reid, 2000).

Work on attitudes had developed at the same time (Johnstone and Reid, 1981) but the seminal work on attitudes to physics was completed by Skryabina (Reid and Skryabina, 2002a,b). Later, Jung conducted some brilliant work in South Korea which brought understanding and attitudes together and showed how what we teach and the way we teach it is critical in enabling positive attitudes to develop (Jung and Reid, 2009). This is the critical key for motivation in learning.

The key insights from Johnstone link strongly to the clinical work of Baddeley (1994, 2002) and are supported by the findings of Kirschner et al. (2006).

Looking back at the entire coherent research programme (Johnstone started in 1969 and retired eventually around 2000), there are some key papers which
summarize his findings (Johnstone, 1997, 2000). However, it is now possible to draw together his key findings, under a series of headings:

(a) All thinking, understanding and problem-solving takes place in the part of the brain known as the ‘working memory’. The working memory has a fixed and limited capacity. It varies slightly from person to person but its capacity cannot be expanded (Miller, 1956). If too many ideas have to be held and manipulated at the same time in the working memory, it cannot cope and thinking, understanding and problem-solving become impossible.

(b) The reason why the sciences and mathematics are difficult is because, by their very nature, they involve several levels of thought. Johnstone found this to be a triangle in chemistry and physics. Others have found it to be a tetrahedron for biology and mathematics (figure 6).

![Figure 6 Triangles and Tetrahedra](image)

The point that Johnstone grasped so clearly was that a novice learner (like a school student) could not work in all three or four corners at the same time, as the capacity of working memory is limited. Thus, in chemistry, the learner simply could not handle the sub-microscopic interpretations at the same time as they were handling the representations and the descriptive aspects. The working memory overloaded. Understanding ceased (Johnstone, 1991, 1997).
The effects were quite dramatic (Johnstone and Elbanna, 1986, 1989). Success simply collapses when the load overwhelmed the limited and fixed working memory capacity. In passing, working memory capacity is easy to measure reliably (Miller, 1956; also see Reid, 2009a,b for reviews). Johnstone and Elbanna generated a graph like that shown in figure 7.

![Figure 7](image)

**Figure 7** Performance collapse

The findings from Johnstone and Elbanna have been replicated by others and a summary of the impact can be found in Reid (2009b).

Johnstone was able to predict that, if he could reduce the information load during learning, then understanding would be greatly enhanced. He tested this prediction in laboratory learning and found very marked improvements in understanding (Johnstone *et al.*, 1994, 1998). He then tested it in lecturing where the outcomes were also extremely marked (Sirhan *et al.*, 1999; Sirhan and Reid, 2001).

At this point, normal school teaching was explored to see if the effects could be the same. In three studies, quite dramatic improvements in understanding were shown to take place when the written materials used by the school students were re-
designed to minimize working memory overload (Danili and Reid, 2004; Hussein and Reid, 2009; Chu and Reid, 2012). In each case, the curriculum was not altered, the time allowed for teaching was not altered, and teachers were not trained in any way. All that was changed was the written materials.

Later, Jung was able to show that, when the learners were able to understand, then they tended to develop much more positive attitudes towards their studies (Jung and Reid, 2009). Piaget had shown decades before that ‘seeking to make sense of ....’ was the natural way of learning. When working memory overload prevented this understanding occurring, then the learners had to resort to memorization in order to pass examinations. This runs counter to the natural way of learning. Attitudes deteriorated and motivation collapsed. The outcomes were the rejection of the sciences for further study, a phenomenon seen in many but not all countries.

Although many other authors have made suggestions about difficulties in learning in the sciences, none has offered a cohesive overall picture like that developed by Johnstone. People have talked of motivation and aptitude but offered no way forward (Lee, 2001). Some have looked at language but Johnstone has already shown that language problems are simply a function of limited working memory capacity (Johnstone and Selepeng, 2000).

There has been much talk of conceptual learning (eg. Yee, 1998) but others have often failed to appreciate that concepts, by their very nature, pose overload problems for limited working memory capacity. Indeed, much conceptual literature simply reflects a catalogue of the observed problems in learning without offering any clear better way forward (Yee, 1998; Mohd Zakaria, 1992; Mohammad Najib, 1999; MOE, 2001b; Nabilah, 1998).
Some have looked at the role of parents and found that parental involvement in school achieve better learner results (Desimone, 1999). However, this does not help. The simple fact is that the parents who are willing to take a proactive role tend to be the parents who value education more and have ‘produced’ more able children.

Ballone-Duran et al., (2005) make the most unsurprising observation that the quality of teacher is important. Sadly, this ignores questions about how to develop quality in teachers and it also ignores the facts that the curriculum to be taught, its national assessment and the resources available for teachers are all determined outside the schools. All of these may be making quality teaching almost impossible.

Hofstein and Lunetta (2004) have offered many useful insights, particular in relation to laboratory learning. Osborne and Collins (2001), thinking specifically of England where the physical sciences are so unpopular, note that school students there tended to find chemistry and physics demanding and boring. Perhaps the answer lies in the well-established research findings relating to working memory capacity and attitude development that emanated from the work of Johnstone. Fensham (2006), in Australia, also notes existing curricula, classroom pedagogies, and evaluation approaches do not satisfy students’ interest and curiosity, thus not promoting motivation to learn science.

Palmer (2008) sees the purpose of education in the sciences in terms of technically and scientifically educated people but the needs of all societies requires a population who are scientifically literate, able to appreciate the way the sciences work and their contribution to life. Only a minority will undertake genuinely scientific careers.
Perhaps the keys, in terms of developing positive motivation, can be summarized, from all this work:

(a) Develop curricula which reflect the real needs and aspirations the learners (see Reid, 1999, 2000; Mbajiorgu and Reid, 2006);
(b) Develop teaching materials which take full account of the limitations of working memory capacity;
(c) Develop national assessment systems which reflect the key skills of understanding and thinking and not recall.

2.14 Improving Education in Science

Science education is important in all countries for several reasons in that the findings from the sciences are making a huge impact on life throughout the world. Future populations need to be aware of the place and importance of the sciences. In addition, the methods used in the sciences are critical. Far too much in many countries is decided on the basis of opinion, assertion and wishful thinking. The sciences have shown the power of the experimental to generate insights and to enable learners to make sense of their world.

Of course, there is a further dimension. Every country will need a supply of those well qualified in the sciences to take leadership in carrying forward future developments. The importance of science education can be summarized in figure 8.
Given the importance of science education for any country, the question now is to identify the inadequacies of current provision and to outline ways by which it can be improved. Mbjorgiou and Reid (2006) reviewed the research literature in developing curricula for physics and chemistry, although their monographs only dealt with school education for the chemistry.

Their summary is shown in full:

“The chemistry curriculum at school level should:

(1) Be designed to meet the needs of the majority of pupils who will never become chemists (or even scientists), seeking to educate through chemistry as well as in chemistry;

(2) Be strongly ‘applications-led’ in its construction, the applications being related to the lifestyle of the pupils and being used to define the curriculum: fundamentally, the content is determined not by the logic of chemistry but by the needs of pupils;

(3) Reflect attempts to answer questions like: what are the questions that chemistry asks? How does chemistry obtain its answers? How does this chemistry relate to life?
(4) Not be too ‘content-laden’, so that there is adequate time to pursue misconceptions, to aim at deep understanding of ideas rather than content coverage, and to develop the appreciation of chemistry as a major influence on lifestyle and social progress; avoid using analogies or models (or multiple models) in a way which causes information;

(5) Not introduce sub-micro and symbolic ideas too soon or too rapidly; avoid developing topics with high information demand before the underpinning ideas are adequately established to overload and confusion;

(6) Be set in language which is accessible to the pupils, avoiding the use of unnecessary jargon and offering careful clarification of words where the normal contextual meaning can cause confusion;

(7) Be couched in terms of aims which seek to develop conceptual understanding rather than recall of information, being aware of likely alternative conceptions and misconceptions;

(8) Offer experiences of graded problem solving situations starting from the more algorithmic and moving on to the more open-ended;

(9) Involve laboratory work with very clear aims: these should emphasise the role of lab work in making chemistry real as well as developing (or challenging) ideas rather than a focus on practical hands-on skills; lab work should offer opportunities for genuine problem solving;

(10) Require assessment which is integrated into the curriculum and reflects curriculum purpose, is formative as well as summative and aims to give credit for understanding rather than recall, for thinking rather than memorization.

As an extra, the curriculum should be taught by teachers who are qualified as chemists and are committed to the place of the discipline in its social context.”

This summary only deals with the way the curriculum is constructed and the general policy issues that arise from it. The argument is that this is where the problems lie. Teachers are not the source of the problems in that they do not decide curricula, assessment or resource levels. Nonetheless, there are implications for teachers in using such a curriculum. Some of these are listed:

- The textbooks to be used must reflect this curriculum construction consistently;
- Teaching must take into account the limitations of working memory capacity. This includes textbooks, worksheets, ways of presentation, labwork, and assessments;
- Assessments must reflect the aims of the curriculum;
• Resources (preferably visual) need to be made available to enrich lessons;
• Problem-solving resources need also to be made available (sets of these do exist in some areas and one set is described in Reid and Yang (2002b).

There are further issues to be addressed. All monitoring and supervision of the teaching process within and beyond schools must also be consistent with the curricula being employed. Those who set national examinations need to re-think the testing procedures completely. There are ways to reward skills beyond recall. Examination setters need to be completely re-trained.

Education is full of those who advocate teaching strategies which they claim will reduce the problems: cooperative learning (Jawed, 1995), exploratory strategy (Trindade, 1998), activity-based instruction (Augustine, 1999) with the help of verbal communication of science encouraging science education, (Jan, 2003), and investigative approaches (Siraj, 2002). The review by Kirschner et al., (2006) destroys all these claims. They show that these strategies do not hold the answers at all although the strategies are not, in themselves, bad. They show that the key lies in limited working memory capacity, the very point that Johnstone has stressed.

2.15 Student Success in Science

In science and mathematics, student’s achievement levels are low. The SPDC survey 2003 conducted achievement tests from twenty colleges in another country in physics, mathematics, biology and chemistry. It has ensured that all sample students had accomplished the secondary school certificate. Pass percent fixed at 40% and 19.1% students passed (40% or above) in mathematics, 4.3% in physics, 7.7% in chemistry, and 37% in biology. Looked at gender wise, it shows that male performed well in mathematics, chemistry, and physics with high percentage as compared to female, although in biology females presented good result.
In the above paragraph, there may be a fatal flaw. Poor marks do not necessarily mean poor performance: the exams set might simply be unrealistically demanding. Examinations measure nothing absolutely for they are like measuring tapes with no scale marked on them. What exams do is to place the candidates in a rough order of performance. In an interesting finding, Yang (2000) found that perceived high demand was no hindrance to positive attitudes. Thus, difficulty, on its own, is not the cause of bad attitudes and, therefore, poor motivation. Poor performance in examinations may simply be caused by inappropriate curricula, assessed in appropriate ways.

At the first education conference in Pakistan held in 1947, both the fundamentals of Islamic tradition and the modern science and technology were included in the education philosophy. In 1959, on national education commission, stress upon the development of the individuals’ skills through encouragement of scientific and occupational abilities.

In the national education policies of 1972 and 1979, focus was on re-orientation of the learning plans according to the financial requirements in the society at that time. In particular, this involved promoting mechanical, systematic and methodical, technical and professional education. In the national education policy 1992 and 1998, similar aims and objectives were presented for the technological and systematic learning’s endorsement. But unluckily, with all efforts on papers, due to deprived implementation plans no actual outcomes have been attained due to financial constraints and un-scientific planning of Education and Training Programs (Akhter, 2000).

About the scientific systematic education in Pakistan, Ilyas and Ibrahim (1989) pointed out:
“Different science instructors at high school level, Math, Biology, Physics and Chemistry taught in difficult way and usually all these four subjects are taught by two teachers but good schools have at least three teachers to teach these subjects. Curricula are prescribed by the Ministry of Education through its curriculum wing. As for as the related instructional material such as teacher guides, student’s work book, learning modules for students, charts, transparencies, film slides, filmstrips, demonstration models and low cost and cost effective equipment for conducting inquiry – oriented practical are concerned, there is no single agency to cater this comprehensive process of science education. The quality in the middle and high school of science learning is poor leading to high failure rate and fewer pupils gaining places in higher institutions of learning. This is the result of overall poor teaching-learning process by untrained and poorly motivated science teachers, inadequate laboratories and science equipment; outdated curricula; inadequate practical work; poor examination techniques and inadequate educational research.”

In 1991, a report on secondary and technical education sketched the scenario of learning science education in Pakistan like; “Sixty percent of higher institutions (both urban and rural) do not have sufficient conveniences of laboratory, equipment, gas etc. Motivated and skilled science teacher are fewer in number. Science is being taught by those who do not even possess any background of science and no attention is given to the spirit of investigation, inquiry and problem solving approach. Examination system is only encouraging rote learning and no emphasis is laid on testing understanding, comprehension and application of knowledge.” (Govt. of Pakistan, 1991).

This pinpoints the key issues needing to be addressed: lack of resources, lack of science teachers, poor curricula, poor national examinations systems. Sadly, little has changed in any of these areas.
2.16 Review of Plan and Policies in Term of Science Education in Pakistan

Special attention was given to enhance the proportion of science students in the New Education Policy (1970). This aimed to shift the emphasis in secondary education to science, technical and vocational education, so as to attain a relative amount of 40:60 between universal streams science, professional and scientific stream. It was also noted that science should form an integral part of courses in technical and vocational education and also serve as a basis for higher technological education. The general education stream also should follow a curriculum with an adequate content in science and mathematics.

The need to modernize the curriculum was also emphasized in the same policy in these words:

“To promote a technical attitude by supporting, motivating, and gratifying the strength of inquiry, problem solving and evaluation authority, it is important to promote science and technical education from the earliest stage. It is essential to update curriculum on a constant basis for science teaching and learning.”

(Govt of Pakistan, 1970).

General learning was to be shifted towards science and technology was the projected goal in The Education Policy 1972-80: “Science and technical education will be improved for progressive combination of technical and general learning in colleges and secondary schools.” (Govt. of Pakistan, 1972).

The National Education Policy and implementation programme (1979) aimed to introduce mathematics as a compulsory subject and to provide physical facilities to all rural and urban schools. The aim was to establish Mathematics as a compulsory subject for all science learners studying in class IX – XII. New science laboratories and libraries were to be added to the secondary schools where these do not exist for increasing the enrollment of the students in science subjects. Additional classrooms,
drawing rooms, library rooms and hostels were to be provided wherever necessary. Science equipment, library books and other teaching aids will be provided particularly to the secondary schools in rural areas (Govt. of Pakistan, 1979).

Emphasis on revision in science curricula, provision of science teachers and laboratories were the main objective of The National Education Policy, 1992-2002, described as follows:

“Science curricula will be revised and made compatible with the demands of new knowledge. The weightage of mathematics and science shall be increased; Mathematics shall be progressively included as a compulsory subject for all science students at the F.Sc level. Crashed programs will be launched with the assistance of the universities for the training of science and mathematics teachers. Textbooks shall be revised and updated to incorporate new knowledge.”

(Govt. of Pakistan, 1992).

The National Education Policy 1998-2010 envisaged the need for science and technology.

A series of five year plans was developed and these are summarized:

**First Five Year Plan, 1955-60** (Govt. of Pakistan, 1955)

For secondary education, the main points of the plan were:

- To develop individual character and dignity, improved courses in Maths, Science, Commerce Industry and Agriculture should be introduced.
- Well-rounded multipurpose secondary schools with an agricultural, technical or commercial bias in the country should be introduced.
- The number of secondary schools should be increased.
- Curriculum diversification should be implemented.

**Second Five Year Plan, 1960-1965** (Government of Pakistan, 1960)

- To develop leaders and to provide special opportunities for the able students, in each district, some standardized schools should be started.
• Enrollment of secondary level should be increased.

• Modern physical facilities should be provided.

• Scholarship should be given to able and needy students

The Third Five Year Plan, 1965-1970 (Government of Pakistan, 1965)

• Strong emphasis should be given to the teaching of science and mathematics.

• People should be trained with different skills to support the economy of the country.

• Diversification of curriculum should be introduced. General subjects should be replaced by agricultural, commerce, and technical subject.

• Such an educational system should be introduced which could take the country into modern science and technological world.

• Guidance system at secondary level, for selection of subject should be introduced.

The Fourth Five Year Plan, 1970-1975 (Government of Pakistan, 1970a)

• With increasing science based technology in most of sectors, student should study elective science and mathematics.

• Teaching of science and diversified courses including part-time and full-time vocational and professional training should be provided.

• Curricula of madrasses should be developed as a means to advanced knowledge and as to permit education in mathematics, science and professional subjects.

• For increased enrollment at secondary level, better educational facilities should be provided.

• Young men and women should be trained in such a way that they can be easily absorbed in the national economy.

The Fifth Five Year Plan, 1978-1983 (Govt. of Pakistan, 1978)

• At secondary level, major stress should be on reorientation of education by introducing agro-technical and qualitative improvement.

• Efforts should be made to improve existing physical facilities.

• New 340 science laboratories should be constructed, at the level of secondary education.
The Sixth Five Year Plan, 1983-1988 (Govt. of Pakistan, 1983)

- Numerous secondary schools should be equipped to provide professional teaching in one selected area of education corresponding to restricted requirements.
- Secondary learning should be broad based, flexible and of high quality.
- Science teachers should be trained according to modern needs.
- Secondary education should provide sound academic base in humanities, science, agriculture or commerce.
- Islamiat, Pakistan studies, Science and mathematics should be the core subject at secondary level.
- Latest information about science and technology should be provided at the stage of secondary education.

The Seventh Five Year Plan, 1983-1988 (Government of Pakistan, 1988)

- The education conveniences at secondary level should be expanded to soak up the increased output from primary schools.
- The participation rate at secondary level should be from 17.2 percent to 24.1 percent.
- Large number of primary and middle school should be upgraded.
- Incentives should be provided to attract good science and mathematics teachers.
- The on-going project of improvement of science education should be expanded.
- XI and XII classes should be added to select secondary schools and XI and X classes should be added to college gradually.
- Comprehensive schools should be opened.

The Eight Five Year Plan, 1993-98 (Govt. of Pakistan, 1993)

- The existing curricula of science and mathematics should be reviewed.
- Physical facilities for science teaching should be increased.
- Better trained science teachers should be appointed.
- Skills such as accountancy, typing, industrial arts and agricultural should be introduced in secondary schools.
• The participation rate at secondary level should be raised from 38.1 percent to 42.7 percent.

There should be clear effort to allocate increasing proportion of national resources towards science and technology, raising it to 1 percent of GNP in the closing year of the plan.
2.17 Motivation in a Wider Context

Motivation is an inner state or force that energizes, directs and sustains behavior towards achievement of a goal. It is a nebulous psychological construct which cannot be directly observed but inferred from overt behavior of the learner. Motivation is a latent force that depends upon a number of latent factors that are being investigated through motivation research. It is still very difficult to measure it because motivation to learn has not so far been thoroughly understood. The key to measuring motivation must be to look for behaviors indicating high motivation and low motivation. However, most approaches have relied on self-report and this can only measure what respondents think about themselves and may or may not reflect reality.

2.17.1 Motivation and attitudes

Motivation to learn influences learning. In turn, there are a variety of factors that influence motivation. The motives of learning drive students to act in certain ways to reach their learning goals. In fact, goals, needs, interests, incentives, fear, anxiety, social pressures, attributions, self confidence, curiosity, values, expectations, reinforcement all serve as motives that energize, direct and maintain behavior. Wlodkowski, as cited by Elliot et al (2000), noted that key pair of motivational factors that influence learning are the attitudes and needs, attributions and emotions, and competence and reinforcement respectively (p.363).

This way of thinking can be summarized in figure 9.
Figure 9  Factors Influencing Motivation

Of the six factors which might influence motivation, attitudes are extremely important. Without a positive attitude towards the learning task, it is difficult to generate the motivation necessary to perform the task and certainly almost impossible to perform the task well. In science education, four target areas are the science subject itself, the learning of science subject, topics and themes covered in the course and methods of science or scientific attitudes (Reid, 2001).

We cannot have an attitude in a vacuum. It has to be an attitude toward someone or something. There has to be a target. In science education, four areas of targets can be identified:

Attitude towards:

a. The science subject itself as a discipline;
b. The learning of the science subject (and perhaps learning more generally);
c. Topics and themes covered in a particular course (e.g. themes of social awareness);
d. The methods of science (the so-called scientific attitude).
2.17.2 The Concept of Attitude

It is not easy to define the word ‘attitude’ precisely and, nearly 30 years ago, specifically in the field of science education, Johnstone and Reid (1981) observed that there were simply too many descriptions in the literature, resulting in a lack of clarity and also a lack of a common approach.

The description which dominated was that of Gordon Allport, yet another American Psychologist (1897-1967). In 1935, he talked about ‘a mental and neural readiness to respond, organized through experience, exerting a directive and/or dynamic influence on behavior’. His definition has stood the test of time and has influenced many future thinkers and researchers. The strength of his definition was that he presented an attitude as a factor which influenced behavior. However, an attitude was not the same as behavior.

Later, in 1958, Rhine referred to an attitude as a ‘concept with an evaluation dimension’. This is remarkably terse. By using the word ‘concept’, he was stressing the hidden nature of an attitude. It was stored in the brain. However, it was his use of the word, ‘evaluative’ that proved to be particularly helpful. In developing attitude, a person is evaluating someone or something. This idea of evaluation is, perhaps, a critical feature.

A more modern definition which is now widely shared is that given by Eagly and Chaiken when they brought together the literature of their day in their monumental work entitled, ‘The Psychology of Attitudes’ (1993). They described an attitude as ‘a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor.’ (page 7). That description captures the true essence of the meaning of the word well.
The key feature of their description is the word ‘evaluating’. In developing an attitude towards, say, learning in physics, we are evaluating our knowledge and experience of learning in physics. This generates favour or disfavour. This, in turn, may influence behaviour, including our willingness to study physics. Motivation to study physics is, therefore, a link between the evaluation and attitude formation and the behaviour we demonstrate when learning physics.

However, how do we consider opinions, beliefs, and values? Are these the same as attitudes? Oraif (2007) offers an interesting analysis (figure 10).

![Figure 10 Attitude Hierarchy (after Oraif, 2007)]

Alongside beliefs, we might add words like perceptions and opinions. The key things is to recognize that attitudes are not the same as knowledge although they involve knowledge. Attitude involves groups of beliefs (or opinions) and these mean that
knowledge is being evaluated. Arising from this evaluation, behavior may be determined.

2.17.3 Attitudes are everywhere

It is taken for granted that we all develop attitudes towards more or less everything. They serve a vital purpose in the way we move through life. In simple terms, attitudes do three things for us:

Attitudes enable us:

- To make sense of life;
- To make sense of ourselves;
- To make sense of relationships.

An enormous amount of research has explored the way we form attitudes which are consistent with each other and how, sometimes, we can hold attitudes which are totally inconsistent with each other. While consistency is a goal we almost instinctively seek, life is complex and there are times when inconsistency is inevitable. The research is summarized in Eagly and Chaiken (1993).

However, when we hold attitudes which are inconsistent, then it is vital to keep them separate in our thought. When attitude which are inconsistent with each other or which are inconsistent with our behavior are somehow brought into direct contact with each other, we feel very uncomfortable. It was the research on this which led to the key ways by which attitudes can be developed in educational settings but more of that later.
2.17.4 Towards a Working Description

Here are some important statements, derived from the literature findings (as summarized in Eagly and Chaiken, 1993):

✓ Attitudes, on their own, do not control behavior but they are powerful indicators of behavior.
✓ Attitudes involve knowledge but they are not simply knowledge.
✓ Attitudes may well involve the emotion but they are not simply emotional responses.
✓ Attitude involves evaluation.

These are all true statements but these can leave us somewhat bewildered: just what are attitudes: and how do they relate to what we know, feel, or do?

Let us explore this further. Like all knowledge, and skills, attitudes are stored in long term memory and involve three components:

- What we know
- How we feel
- How we behave

This can be put in more formal language. Attitudes have three components:

1. A knowledge about the object, the beliefs, ideas, components (Cognitive).
2. A feeling like the object, like or dislike component (Affective).
3. A-tendency-towards-action the object components (Behavioral)
It is important that we recognize that an attitude must be directed towards someone or something. We can hold a positive (or negative) attitude towards chemistry or the chemistry teacher, for example. We can represent this in diagrammatic form:

![Figure 11 Nature of Attitudes](diagram)

One key feature of figure 10 is the reminder that attitudes are hidden away in long-term memory and that they can only be measured indirectly. This is done by looking at behaviour. However, this assumes that behavior is an accurate measure of the hidden attitude. In other words, it assumes that attitudes control behavior.

Overall, it has been established that attitude tend to be consistent and stable with time. Nonetheless, despite this stability, they are open to some change and development although deeply held attitudes are highly internalized and are resistant to modification (Johnstone and Reid, 1981).
2.18 Attitude Targets

One of the important features of attitudes is the realization that there has to be an attitude ‘target’, in science education, four areas of targets can be identified:

a. The science subject itself as a discipline:

b. The learning of the science subject (and perhaps learning more generally):

c. Topics and themes covered in a particular course (e.g. theme of social awareness):

d. The methods of science (the so-called scientific attitude).

![Diagram of attitude measurement]

Figure 12 Basis of attitude measurement

Though the surveys provide accurate picture of a large number of people’s attitudes, there is always an element of doubt about the reality of these responses. Interviews give more insights and details than surveys but they are more time consuming and more difficult to summarize and draw clear conclusions, especially when interviews are less structured. Observing student behavior can offer interesting insight but this is also time consuming and may contain uncertainty of observed behavior in reflecting the underlying attitudes.
2.19 Attitude and Behavior

Early work in social psychology reveals the considerable confusion over attitudes and behavior as well as attitudes and emotions. While attitudes can be strongly influenced by past behavior and can lead to future behavior, attitudes are *not* the same as behavior. The confusions are compounded by the fact that the only way we can make any measurement of attitudes held by groups of people is to observe aspects of their behavior. Because much of the work on attitudes has focused on attitudes *towards* the science (often physics or chemistry), the behavioral aspects have received much attention. The behavior here is reflected in whether the students want to continue with students in chemistry or physics. Various models have tried, on the basis of empirical evidence, to show the extent to which attitude influence subsequent behavior.

Ajzen and Fishbein (1980) developed a generally accepted model (his theory of reasoned action). Their studies showed that behavior is rather well predicted from what they described as behavioral intentions (*are you intending to do........?*). In turn, the behavioral intentions were predictable by attitudes towards the possible behavior and social norms (opinions of others). Later, the model was adapted and was called the *Theory of Planned Behavior* (Ajzen, 1988). It has to be stressed that Ajzen (1989) was only looking at planned behavior, behavior under the deliberate control of the person.

The model developed by Ajzen can be illustrated in figure 12.
We can illustrate this specifically by looking at student deciding to study more physics (figure 12).

Ajzen found that this model did account for much behavior and that the first factor (attitudes towards the behavior) was often the most important factor. The results from the work of Skryabina (2000) on attitudes to physics were found to fit this model.
However, the Theory of Planned Behaviour has importance when considering measurement. Attitudes are measured by looking at behaviour. This might be response patterns from a survey or questionnaire or it might be responses from an interview. Indeed, in figure 11, attitudes towards physics might be deduced from whether the person chooses to study physics. If the observed behavior is to reflect the attitude, then the effects of the subjective norm and perceived behavior control must be minimized.

2.19.1 What Allows Attitudes to Develop?

There are two important key factors that need to be considered when looking at how attitudes change. Something new must come to the person. This is usually in the form of new information which is heard, read, seen, or experienced in some way. The second fact is that the person must change his/her evaluation of something as a result of the new information.

![Diagram of Attitude Development](image)

**Figure 15   Developing Attitudes**

However, we all know that new information only occasionally changes our evaluations. Thus, for example, we might learn something new about another person and this might change our attitude towards the person. On the other hand, it might
not. We might still regard the other person with skepticism and distrust even though the new information suggested that the other person was genuine and could be trusted.

The first problem rests with how we understand the new information. It is so easy to misunderstand in the sense that we re-interpret the new information in such a way that its real meaning and impact are lost. Thus, teachers always would like to think they are giving students beneficial information for their life. However, students sometimes do not connect this information with their life (Suzuki, 2008).

Many issues arise here and research offers some clear guidance. Not only should new information be related to the existing feelings and beliefs of students, the new information must be perceived as relevant. The learner must also be sufficiently motivated to pay attention. Finally, the learner needs to be actively involved with the incoming information. This can be summarized:

<table>
<thead>
<tr>
<th>New Information</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must come from a credible source</td>
<td>The teacher-student relationship needs to be such that you are seen as</td>
</tr>
<tr>
<td></td>
<td>a credible source</td>
</tr>
<tr>
<td>Must be accessible (understandable)</td>
<td>Know your school student and watch their faces</td>
</tr>
<tr>
<td>Must relate to where students are in terms of their</td>
<td>Requires considerable knowledge and empathy for your students and a relaxed,</td>
</tr>
<tr>
<td>current beliefs, opinions and feelings</td>
<td>trusting atmosphere</td>
</tr>
<tr>
<td>Must be perceived as relevant</td>
<td>What is relevant for us may not be relevant for the student. Watch their</td>
</tr>
<tr>
<td>Needs to be received by motivated learner</td>
<td>faces</td>
</tr>
<tr>
<td>Must interact, inside the brain with previously</td>
<td>If motivation is lacking, leave it until later</td>
</tr>
<tr>
<td>held knowledge and attitudes</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3  Conditions for Attitude Development**
2.20 Criticism of use of Questionnaires

In order to measure psychological variables, the most common approaches are questionnaires, interviews, tests, and observation. Ellington et al (2003), while discussing student questionnaire and interviews as a means of obtaining student opinion about a wide range of issues gave a detailed account of advantages and disadvantages of questionnaire and stressed a few limitations of the use of questionnaires. The students respond in a casual way and make instant responses by ticking the boxes quickly at the surface level of thinking rather than at the deeper level of thinking. The obtained data may contain \( \pm 20\% \) errors on any item (Reid, 2012). They want to please the people giving them the questionnaires especially if they like them. Questionnaires are often used after an activity rather during it that tend to reduce any learning as a result of process of completing of it. These produce feedback on a particular issue covered but not on other issues. There is a tendency to design questionnaires that gives positive feedback. Therefore, you see what you want to see. Another limitation is the responses are colored by how student feel at the moment. Therefore, response of the same students on the same questionnaire may be different on different occasions.

It is very difficult to say that the responses reflect the underlying psychological variables. Several possible ways to check this are by asking the teachers who know the student population, by asking the experts, by pretesting the questionnaire on a small body of equivalent groups in advance or by interviewing a few of them afterwards to see the consistency of their responses with the responses on the questionnaire.

The questionnaire measures what people say. There is always a doubt about whether responses of students are real or ideal, reflect a reality or an aspiration. This
problem has been identified as reality-aspiration problem by Danili (2004). Irrespective of the format of the questionnaires but particularly in Likert type rating scale, much research adopts a method of handling responses that is difficult to defend (Reid, 2006, 2011). Reid is highly critical of scoring and adding the response scores and then using measures of central tendency and variability on these scores because the categories are not equally spaced. Therefore, scoring is not justified for an ordinal scale. Combining the scores hides the rich details by summing up in response pattern. Moreover, similar scores may be obtained on the different response patterns. Moreover, Reid does not recommend the use of product moment correlation techniques also because normality is frequently absent in such responses. His point of view appears to be logically sound.

Another problem is that of measuring validity and reliability of questionnaires. Validity is the extent to which the questionnaire measures what is intended to be measured. The validity evidence can be gained by asking a panel of experts, by conducting interview of a sample, by formulating discussion, questions for the population or by external observations. However, attitudes cannot be measured exactly with the present state of knowledge about attitudes. Nevertheless, attitudes can be compared before and after an experience or between female and male groups (Reid, 2006).

The reliability of the questionnaire indicates accuracy in measuring the construct it seeks to measure. In many studies, split-half and the use of Cronbach’s Alpha are thought to indicate reliability. They do not. They indicate internal consistency. Attitudes are highly multi-dimensional and any idea of internal consistency is meaningless. What we want to know is the extent to which the responses patterns gained from a survey are similar when the survey is used more than
once. There is an extensive literature which has looked at critically at many of the techniques used in the literature and shown them to be inappropriate. Some of this is reviewed by Reid (2006, 2011).

Summarizing some of the main findings gives some key principles:

- Surveys cannot be used to measure any variable in any *absolute* sense;
- Surveys cannot be used to measure the responses of *individuals* with any useful degree of accuracy;
- Surveys can be used to *compare* response patterns between groups of respondents;
- Data from surveys are *ordinal* or *categorical* and numbers cannot be added, means cannot be computed, and statistical methods that assume integer data cannot be applied;
- Data from surveys are often *far from normal* and parametric statistics cannot be applied;
- *Non-parametric* statistics that are useful include Kendall’s Tau-b correlation and chi-square;
- Surveys give an indication of what a population *thinks*: this can be very useful but may not reflect reality;
- *Validity* is elusive but using expert opinion and some interviewing can often confirm the validity or otherwise of a survey;
- *Reliability* is a measure of accuracy in terms of the survey giving similar patterns of responses on different but equivalent occasions;
- As with every measurement, the quality of the measurement is only as good as the *quality of the questions* asked;
- A critical feature of question quality can be seen in the way *all the options* offered are used by the respondents.
2.21 Related Studies

There are several studies which have looked at motivation and attempted to measure it using questionnaires. It has to be recognized that questionnaires only indicate what respondents think. They do not necessarily reflect reality. In addition, the data handling is often flawed in most studies although any conclusions they gain are unlikely to be totally wrong. The wrong methods will more often fail to reveal potentially interesting findings.

Pintrich et al (1993) used a questionnaire (motivation strategies for learning questionnaire (MSLQ), an 81-item range) in a research study to show analytical validity of school achievement. In this study, they established that inherent objectives and goal orientation was positively related to achievement next to with other variables. Dissimilarity between male and female was observed as a significant aspect in motivation. Males showed a better amount of extrinsic motivation (Anderman and Anderman, 1999), although females showed a superior inherent or intrinsic motivation (Mecca and Holt, 1993).

Nadia (2010) found a significant association between motivation and academic progress ($r = 0.56; n = 200$). Broussard and Garrison (2004), Skaalvik and Skaalvik (2006), and Sandra (2002) found a positive affiliation between motivation and educational achievement. In the same way, Johnson (1996) identified the relationship between individual’s interest and academic performance which is greatly related with each other. On the other hand, Bank and Finlapson (1980) established that those learners who do well were found to have considerably great interest in academics for attaining successful results as compared to those learners who are not interested in academics. Husman and Lens (1999) suggests that self-motivated learners can at the same time be extrinsic in order to upcoming target orientation. Young energetic
individuals perform more successfully in school because of their intrinsic motivation (Gottfried, 1990).

Self motivated learners are more successful in learning modern ideas which affect their performance and student show good understanding of the educational material (Stipek, 1998). In a research study on science learning, Renni (1990) identified that good performance in science is the evidence of student’s personal interest in education and constructive interest in learning science, that overall involves the inherent inspiration of students.

Nadia (2010) found no significant similarity between male and female on the intrinsic and extrinsic motivation towards college results (t: 4.32; p < 0.05). Results showed in the research that females were more interested than males. On the other hand, males were not personally motivated but they are extrinsically interested as compared to females. These findings agreed with Chee, Pino and Smith (2005) who specify that female learners studying in college were better in learning beliefs than male learners, which are differentiated by higher educational achievement.

Nooraini Othman (2011) examined the relationship of self-motivation, self-concept, and self-determination with educational performance among the learners studying in different disciplines. A study was conducted on 200 sample students studying in class 5 and class 6, using a self-developed instrument for the purpose of data collection. For testing internal consistency on the questionnaire, Cronbach’s Alpha was applied which was 0.94. Pearson Correlation was used to measure the relationship among variables. The result showed no relationship between all variables and with academic performance. This is not surprising as the methodology is flawed and will be insensitive to detect patterns and relationships (Reid, 2011).
According to Bozena, (2009) Chemistry anxiety encompasses apprehension regarding learning chemistry, evaluation in chemistry courses, and fears about handling chemicals. The study goal was to ascertain the prevalence of these three types of anxiety in college students enrolled in a two-year college. In their study, chemistry-evaluation provoked the most chemistry anxiety followed by handling-chemicals anxiety and then learning-chemistry. Females reported more anxiety about evaluation than males. Allied health majors reported significantly more fear regarding learning-chemistry than science majors. Participants who never had chemistry reported higher levels of both learning-chemistry and chemistry-evaluation anxiety. Recognizing the existence of chemistry anxiety is the first step in reducing negative attitudes toward chemistry and perhaps increase student enrollment, success, and retention in chemistry courses.

Zeyer (2010) conducted a research study on the relationship between thinking, motivation to learn science and style. Systemizing and empathizing are two main psychological dimensions and thinking style suggests the interaction of these two abilities. To calculate the empathizing and the systemizing dimension respectively, EQ and the SQ score (systemizing quotient) was applied. To determine the interest in science learning, SMQ was applied with its five components. Sample was constituted of 44 high schools students. There was found a strong relationship with high significance among systemizing quotient and motivation to learn science but no relationship was found between empathy quotient and learning in science motivation. Both gender and science-orientation was found dissimilar between the empathy quotient and motivation to learn science. Wintler (1992) investigates that male student performance is much better related to their motivation as compared with to female students which is less associated with their interest (Schiefele et al, 1992).
Teresa and Nelson (2000) investigated male and female difference towards motivation and skill level of 242 students studying in high school and science subjects (biological vs physical). Students of physical sciences achieved high grades and biological learners on academic goals achieved lower scores. Males performed better than females on ability and creative thinking on science.

Lack of self-efficacy in a person generates negative thoughts and tasks are seen as threatening, not as challenging. Therefore, such a person sets low objectives for themselves (Aid Suraya and Wan Ali, 2009; Bandura, 1994). Students that were able to initiate their study activities with self-efficacy and developed applicable self-learning strategies are more likely to progress and achieve better because non self-regulated students are not actually concerned in education process and consequently might be subjected to any kind of shallow knowledge and low academic achievement (Pintrich and Schraben, 1992).

Rahil (2006) conducted a correlation study on 1,146 learners. Research findings explain that 51 percent students who had high self-efficacy and the students who showed low self-efficacy were 48 percent. There were positive relationship between different components of self-efficacy with education performance efficacy ($r = 0.48, p = 0.005$) and education progress in the English. When learners have great self-efficacy in linguistic achievement in English, they performed better.

Lent (1984) conducted a study with science and engineering college students and reported that to maintain great learning achievement, self-efficacy affects academic persistence. Pintrich and Groot (1990) investigated that educational self-efficacy is related with quizzes and educational examination performance and Shunk (1984) identified that self-determination in mathematics directly affects achievements in mathematics.
Research indicates that performance results relates with self-efficacy (Bandura, 1997; Pajares, 1996; Schunk, 1995). Learner performs well with high self-determination as compared to those who show less. There is association between self-efficacy and personal skills. Therefore, parents and instructors should provide opportunities to encourage academic confidence among learners.

In developed countries, mathematics, the sciences and engineering are often supposed to hold important places in education. However, in many such countries, the popularity of the physical sciences and mathematics is poor. Students are not motivated to continue their studies in these areas. Thus, in England, there are problems with uptakes at university level physics, chemistry, and mathematics (as illustrated by HESA, 2005) although later evidence shows some improvement. All kinds of suggestions are asserted about why this should be so: for example, Roberts (2002) suggests the lack of optimistic role models and successful professional advice to stimulate learners in Physical sciences and Mathematics.

It is interesting to note that, in the neighbouring country of Scotland, the sciences and mathematics are incredibly popular at all levels. There is considerable evidence about why this is so: Skryabina (2000) found that three factors were critical in motivating students to opt to study physics: the teacher quality, the curriculum quality, the perceptions of career opportunities arising from studies in physics. The first two are very different in Scotland.

A survey conducted on 50 schools in England illustrated that at schools, students take pleasure in studying science but some wanted to learn science after school (Bevins et al, 2005). It has observed that student felt difficulty and complication in Physics. A study by Deci (1995) identifies positive correlation of 0.89 between academic achievement and intrinsic motivation.
In several studies [Sarver (2002), Thoma and Getzel (2005), Wehmeyer and Plmer (2003), Wehmeyer and Schwartz (1997)] a constructive association was found between the measured variables of autonomy, competency and relatedness. These results supported the belief of self-determination theory that basic mental and emotional requirements for independence of an individual, relatedness and skills must get together on an continuing basis for the individual to perform at their best (Ryan and Deci, 2000).

Gregson (2000) investigated about the pessimistic attitude of students towards science and emphasis on tertiary education. A study by Hazari (2010) examined the output of the later success in achieving a degree in physics and chemistry. This study deals with two main groups of goal orientation, performance orientation, and learning orientation or learning through desire. Results indicated that the motivation of physicist and chemists entering in high school were extra creative.

Shambhu (2009) conducted a study on a topic “Achievement Motivation across Different Academic Majors” to assess the student’s achievement motivation in academic majors. Students learning different subjects had different variety in their performance motivation. It was also predicted that the students in science fields were more motivated than studying in other areas. The sample was chosen through random sampling from the five disciplines as Social Science, Science, Commerce, Humanities, and other vocational subjects. Maya Singh (1988) developed an Academic Motivation Inventory for the purpose of data collection. Students studying in science department showed greater performance motivation than social science students (p < 0.01), Humanities (p < 0.05) and Commerce (p < 0.01) faculty but there is no significant difference from the vocational courses. p values refer to the level of significance attained which was much higher for students of science.
The above related studies show that males tended to be extrinsically motivated, but females were intrinsically motivated and performed well in science. Males usually feel the basic economic source as motivating but for females, education progress is totally related to their motivation and self-exploration, perhaps explaining why females are self-motivated in their learning and males are extrinsically motivated.

Those students, who are intrinsically motivated, have high self-efficacy and self-determination. These variables affect their performance and these students have high academic achievement. These variables are also helpful for career orientation accordingly and those science students who learn science with the understanding and set future targets, perform well and are motivated for achieving high grades.

Motivation is an important variable in many research studies and educational psychology research has also been conducted on this variable but every research has its own findings, some deal with a single variable and some studies deal with more than one variable and with different demographic variables.

Looking at the research studies overall, most have simply explored relationships. In doing this, much of the methodology is open to considerable criticism (Schebeci, 1984; Gardner, 1995, 1996; Osborne, et al. 2003; Reid, 2006, 2011). In simple terms, the methodology may well be hiding important details.

The findings have largely been unsurprising. Those with higher motivation tend to perform better. Those with higher self-belief and confidence tend to perform better. Indeed, there are relationships between a range of constructs like self-belief, self-efficacy, confidence, motivation. Any teacher would be able to tell us that. Teachers know fully well that highly motivated learners are a joy to teach and they perform much better.
What is interesting would be to look much further and ask questions starting with ‘why?’ Much of the research has avoided the real questions, like: why does motivation vary (is it essentially genetic, life experiences or choice?), how can we enhance motivation (what can be done in practical terms?), is there anything specific about the sciences that is critical in developing positive motivation?

A major problem relates to methodology and this study seeks to look at this by asking more searching questions relating to the validity of the survey approach. This is done by looking at the supposed six motivational dimensions and construct validity of SMQ (2006). Exploratory factor analysis was used in this research to analyze the data. And this is the theme of the following chapters.
CHAPTER 3

RESEARCH METHODOLOGY

The research study was conducted in order to examine the science motivation of male and female intermediate science students through a science motivation questionnaire (2006) and its construct validation.

In this chapter, the methodology employed in this piece of research study is explained in detail. The population of the study, selected sample, instrument used for data collection, and the procedures used in the process of data collection and data analysis are laid out.

3.1 POPULATION

The target population comprised male and female intermediate science learners from government degree colleges in the province of Punjab (Pakistan). Punjab consisted of 36 districts and there were total 323 degree colleges, 171 were female and 152 were male colleges (Punjab University, 2011).

3.2 SAMPLE

A sample of 600 intermediate science students served as the sample of the study which was selected through two phase cluster sampling by using the following sampling procedure:

1. Three districts of Gujrat, Gujranwala and Rawalpindi were randomly selected from 36 districts of the Punjab province.

2. 200 students, 100 males and 100 females, were selected through random sampling from six colleges (three female and three male) located in each district headquarter.
The following tables show the sampling frame, overall and for both females and males.

**Table 4. Distribution of Sample of Intermediate Science Students in Punjab**

<table>
<thead>
<tr>
<th>Districts</th>
<th>Number of Colleges</th>
<th>Class wise Distribution of Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Gujarat</td>
<td>3</td>
<td>3</td>
<td>100</td>
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<tr>
<td>Gujranwala</td>
<td>3</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Rawalpindi</td>
<td>3</td>
<td>3</td>
<td>100</td>
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<tr>
<td>Total</td>
<td>18</td>
<td>300</td>
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**Table 5. Selected female colleges and number of sample students**

<table>
<thead>
<tr>
<th>Districts</th>
<th>Female Colleges</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>Gujarat</td>
<td>Government Marghazar College for Girls, Gujarat</td>
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<td>15</td>
<td>30</td>
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<tr>
<td></td>
<td>Government Degree College for Women, Kharian District, Gujarat</td>
<td>20</td>
<td>20</td>
<td>40</td>
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<tr>
<td></td>
<td>Government I.D Janjua College for Women, Lalamusa District, Gujarar</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
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<td>20</td>
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<td>40</td>
</tr>
<tr>
<td></td>
<td>Post Graduate College for Women, Gujranwala</td>
<td>15</td>
<td>15</td>
<td>30</td>
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<tr>
<td></td>
<td>Govt. College for Women, Model Town, Gujranwala</td>
<td>15</td>
<td>15</td>
<td>30</td>
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<tr>
<td>Rawalpindi</td>
<td>F.G. Post Graduate Degree College for Women, Wah Cantt.</td>
<td>15</td>
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<tr>
<td></td>
<td>F.G. Degree College for Women, Abid Majid Road, Rawalpindi</td>
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<td>15</td>
<td>30</td>
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<tr>
<td></td>
<td>F.G. Degree College for Women, Kashmir Road, Rawalpindi</td>
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<td>30</td>
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<tr>
<td>Total</td>
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<td>150</td>
<td>300</td>
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</table>
Table 6.  Selected male colleges and number of sample students

<table>
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<th>1st Year</th>
<th>2nd Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>1 Government Zamindara College for Boys, Bhimber Road Gujarat</td>
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<td>2 Government Science College for Boys, G.T Road, Gujarat</td>
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<td><strong>Gujranwala</strong></td>
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<td><strong>Rawalpindi</strong></td>
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<td>1 F.G. Degree College Men, Wah Cantt, Rawalpindi</td>
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<td>40</td>
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<td>2 F.G. Science Degree College for Men, Wah Cantt, Rawalpindi</td>
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<tr>
<td>3 Govt. College of Asghar Mall, Rawalpindi</td>
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<tr>
<td><strong>Total</strong></td>
<td>150</td>
<td>150</td>
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3.3 RESEARCH INSTRUMENT

The 30-item Science Motivation Questionnaire (SMQ) developed by Glynn and Koballa (2006), constituting the five factors of motivation was used as authors desired to cross validate it in other countries.

The authors claim that the instrument covers following five factors, with relevant item number shown against each:

- Intrinsic Motivation and Personal Relevance (item 1,2,3,4,5,6,7,8,9,10)
- Self-Efficacy and Assessment Anxiety (item 11,12,13,14,15,16,17,18,19)
- Self-Determination (item 20,21,22,23,24)
- Career Motivation (item 25,26)
- Grade Motivation (item 27,28,29,30)

The items were worded in clear, comprehensive sentences. All the questions were simple to read and understandable. A five-point Likert type scale was used for the students’ responses which were coded: ranging from 5 as the strongly agree to 1 as strongly disagree.
3.3.1 Pre-Trial of SMQ

The instruments are generally tested through pretrial for checking their validity and reliability. Validity indicates how well an instrument measures something it claims to measure so that research conclusions correspond to reality (Nunnally and Bernstein, 1994). Construct validity is a kind of validity that explores the extent to which the findings can be seen as a measure of the construct under consideration. As the instrument’s construct validity was sought to be checked in this survey in order to see whether the authors claims are upheld, its pretrial in the sense of checking its validity did not matter. Because the real purpose of this study was to establish whether the structure claimed by the authors was supported by factor analysis, pretrial of SMQ’s validity was of no consequence.

In order to collect evidence about the SMQ’s reliability, it was administered and responses were obtained from 150 science students. These students came from four colleges (two male and two female) and 40 to 44 students from each college of Wah Cantt were selected. The students’ responses were analyzed through test-retest reliability which was nearly perfect, when the instrument was administered on two separate occasions. The reason was that the questionnaire was tried on a large sample under good test conditions which always guarantees reliability, assuming the questionnaire is valid (Reid, 2003).

Cronbach’s Alpha is often used as a supposed estimate of reliability. However, this statistic is merely a kind of combined correlation coefficient which brings together into one number all the inter-item coefficients. While it has its place in some areas of psychology, it has more or less no place in education where measurements nearly always fit a multi-variate pattern. In the light of this, Cronbach’s Alpha was not used (Reid, 2006; 2012)
3.4 DATA COLLECTION

The following procedure was adopted to collect data:

To begin with, the official letter for the heads of selected colleges was obtained from the head of the Foundation University College of Liberal Arts and Sciences, Rawalpindi with a request for allowing the researcher to collect data from students of their college. Then, the colleges’ heads were approached for obtaining permission for data collection, this being followed up by personal telephone calls. Some colleges granted permission to conduct the study. Some college heads refused to respond to the researcher and telephone calls. Some declared their colleges could not cooperate in the study.

Data collection started on 5th January, 2011 from Rawalpindi district. The purpose of the study was explained to the science teachers, the questionnaire were administered in colleges of Rawalpindi district personally. The respondents were approached in or out of the classrooms formally or informally under the guidance of their science teachers, in their free time. The researcher briefed them personally about her research, its purpose and also about the questionnaire. Average completion time to fill out the questionnaire was from 15 to 20 minutes. The response rate was 100 %.

It was not convenient for the researcher to visit most of the colleges especially the male colleges to collect data personally; the data from these colleges were collected with the help of some other suitable persons. The whole process of data collection was completed in about three months.

3.5 DATA ANALYSIS

For the purpose of data analysis, the Statistical Program for the Social Sciences (SPSS) was used. The following procedure was followed to analyze the data:
1. Principal Component Analysis (PCA) was used to find the fundamental structure of the SMQ. The problem with factor analysis is that it requires a value judgment on the part of the researcher to interpret the outcomes.

Following steps was used:

**Step 1:** In principal components analysis, the first step was entitled 'Communalities'. This gives the amount of variance of each variable that has been 'explained' by the analysis.

**Step 2:** Step 2 entitled 'Total Variance Explained'. There were three columns which give the 'Cumulative %'.

**Step 3:** The next step is the Scree Plot. (a) The SCREE plot has a marked discontinuity.

**Step 4:** In third step of data extraction, set how many components set the cut-off eigenvalue. Default value is 1 in the case of standardized data.

**Step 5:** 'Rotated Component Matrix'. That gives the factor loadings for each variable. Ideally, every variable should give a high loading somewhere.

2. Kendall's Tau-b is the correct correlation method for ordinal data and used to measure the inter item correlations.

3. To compare the two distributions of responses, Chi-Square 'contingency test' was used. Although it is a very simple test, yet there are some very important and subtle aspects to it that SPSS does not handle well, so an EXCEL spreadsheet was used for chi-square analysis.
CHAPTER 4

ANALYSIS AND INTERPRETATION OF DATA

4.1 Factor Analysis

This chapter deals with the analysis and interpretation of data related to the research problem “Investigation into status of science motivation among intermediate science students through Science Motivation Questionnaire (2006) and its Validation”. Data were collected through 30-item Science Motivation Questionnaire developed by Glynn and Koballa (2006) where items were presented on a five point rating scale. The author claimed that this instrument measures five factors of Intrinsic Motivation and Personal Relevance, Self-Efficacy and Assessment Anxiety, Self-Determination, Career Motivation and Grade Motivation that needs to be cross-validated in other cultures in term of its construct validity through factor analysis.

Using the total sample of 600, Principal Components Analysis using Varimax Rotation was applied to the response data for all 30 items. The Scree plot did not suggest that there was any factor structure. Indeed, the inter-item correlations (Kendall’s Tau-b) suggest that there would be no factor structure. Most of the correlations lie between 0.1 and -0.1. Very few exceed 0.2.

However, 14 factors had an eigen value above 1.0 which accounted for 63.4% of the variance. This is not entirely acceptable because 70% is regarded as a safer minimum value. Table 1 (overleaf) shows the loadings obtained after rotation. Only loadings above 0.5 are shown, for clarity. This is very low threshold.
Table 7: Factor loadings on the Science Motivation Questionnaire

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</tbody>
</table>

It is clear that the loadings do not relate in any way to the claimed factors. Indeed, 4 items do not load above 0.5 on any of the 14 factors while the threshold of 0.5 is set far too low (although often used in the literature). The loading value is the correlation between what the items measure and what the factor is. A correlation is, in
fact, the cosine of the angle between the directions of the two measurements. A cosine value 0.5 corresponds to an angle of 60°. This can be illustrated in figure 16.

![Figure 16 Measurements and correlation](image)

Accepting a minimum loading of 0.5 is like suggesting that two lines at an angle of 60° are measuring in the same direction. This is clearly not true. If 0.7 is taken as the minimum, then the directions of measurement are still about 45° apart while a minimum of 0.87 corresponds to an angle of 30° which is much more satisfactory.

At this stage, each of the supposed dimensions suggested by Glynn and Koballa (2006) were examined in turn.
Table 8:  Factor 1: Intrinsic motivation and personal relevance

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM22</td>
<td></td>
<td></td>
<td>-0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM1</td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM25</td>
<td></td>
<td></td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM23</td>
<td></td>
<td></td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM16</td>
<td></td>
<td></td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM2</td>
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<td></td>
<td>0.88</td>
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<td></td>
</tr>
<tr>
<td>IM27</td>
<td></td>
<td>0.80</td>
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</tr>
<tr>
<td>IM30</td>
<td></td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM11</td>
<td></td>
<td>0.58</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table shows a factor structure within that group alone! However, this structure does account for all the questions except one although some of the loadings are too low. Again, this is consistent with there being no structure. The highest inter-item Kendall’s Tau-b correlation is 0.25. If there is a structure giving one factor as claimed, very much higher inter-item correlations would be expected.

Table 9:  Factor 2: Self-efficacy and assessment anxiety

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>SeAa4</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa13</td>
<td></td>
<td>-0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa6</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa28</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa14</td>
<td></td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa29</td>
<td>0.50</td>
<td>0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa18</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SeAa24</td>
<td></td>
<td></td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>SeAa21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table shows a factor structure within that group alone! However, this structure does account for all the questions except one although some of the loadings are too low. Again, this is consistent with there being no structure.
Table 10:  Factor 3: self-determination

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD8</td>
<td></td>
<td>0.76</td>
</tr>
<tr>
<td>SD26</td>
<td></td>
<td>0.73</td>
</tr>
<tr>
<td>SD9</td>
<td></td>
<td>0.80</td>
</tr>
<tr>
<td>SD5</td>
<td></td>
<td>0.70</td>
</tr>
</tbody>
</table>

The above table shows a factor structure. This structure does account for all the questions. Thus self-determination is showing two factors.

Table 11:  Factor 4: career motivation

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM17</td>
<td>0.74</td>
</tr>
<tr>
<td>CM10</td>
<td>0.74</td>
</tr>
</tbody>
</table>

With only two questions, it is difficult to draw conclusions but they seem to load on to one factor.

Table 12:  Factor 5: Grade motivation

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM7</td>
<td></td>
<td>0.70</td>
</tr>
<tr>
<td>GM12</td>
<td></td>
<td>0.69</td>
</tr>
<tr>
<td>GM15</td>
<td></td>
<td>0.80</td>
</tr>
<tr>
<td>GM20</td>
<td></td>
<td>0.62</td>
</tr>
</tbody>
</table>

Here again, there is more than one factor within the claimed factor.

In four of the five supposed factors, there is a factor structure within the supposed factor. This confirms that the factor structure claimed by the authors is not sustained. Indeed, with a sample as large as 600, any supposed factor structure should have been very evident.
i. Discussion

The results obtained here raise major questions about the way many questionnaires are constructed. The method developed by Likert (1932) was designed to look at various attitude constructs in the world of psychology. These include attitudes related to politics, to race and to communism.

Questionnaire designers in the world of psychology were looking at attitudes which were much less multidimensional in nature when compared to education. They also took very detailed steps to ensure that the various items they used were very strongly related to the attitude being considered.

The methodology has been taken over into education carelessly. Rarely is the rigour practiced by the early psychology researchers employed. More fundamental, most attitudes related to education are highly multidimensional as Gardner (1995, 1996) observed long ago. The approach is simply inappropriate. In addition, in most questionnaires in education, ordinal numbers are being added. This is mathematically invalid.

Motivation is what might be called a second order variable. It depends on the attitudes of the person. Such attitudes are highly multidimensional and it is, therefore, very unlikely that a theme like motivation will reduce to a small number of variables. Thus, it is unsurprising that the questionnaire considered here generated the outcomes that have been observed. The way motivation is to be seen can be illustrated in figure 17.
Figure 17  Multi-dimensional nature of attitude and motivation

The way forward has been discussed in detail by Reid (2006, 2011). The key is to consider each item on its own and compare the pattern of one group of respondents to that of another. This is now done in relation to gender.
4.2 Chi-square comparisons

Chi-square is used to compare response patterns.

Table 13: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 1)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I find science interesting in studying</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>52</td>
<td>19</td>
<td>5</td>
<td>0.6</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>55</td>
<td>18</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>54</td>
<td>19</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I take pleasure in science learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17</td>
<td>56</td>
<td>18</td>
<td>9</td>
<td>2.8</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>57</td>
<td>19</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>57</td>
<td>18</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The science has realistic worth for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>53</td>
<td>21</td>
<td>6</td>
<td>4.8</td>
<td>4</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>50</td>
<td>17</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>52</td>
<td>19</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>All the science learning is associated or pertinent to my existence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>56</td>
<td>17</td>
<td>6</td>
<td>19.7</td>
<td>2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>48</td>
<td>12</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>52</td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Receiving high grades in science is not as significant to me than the science I learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>26</td>
<td>52</td>
<td>16</td>
<td>5</td>
<td>8.4</td>
<td>3</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Female</td>
<td>17</td>
<td>58</td>
<td>17</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>55</td>
<td>16</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In two items, men and women differ in their response patterns. Thus, women say that they see the relevance of science to their existence more while the men claim slightly more than the women that grades are not as important as learning. In the first case, it may simply reflect a more socially aware perspective with women, a point noted by Skryabina in relation to Physics (Reid and Skryabina, 2002). In the latter, the women may simply be more willing to accept reality than the men.
Table 14: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 2)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>χ²</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>My personal goals and objectives associate with my science learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>25</td>
<td>51</td>
<td>21</td>
<td>4</td>
<td>3.8</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>43</td>
<td>26</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>47</td>
<td>23</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>When I learn science I like that it challenges me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>53</td>
<td>21</td>
<td>6</td>
<td>2.9</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>52</td>
<td>24</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>53</td>
<td>23</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I feel success in understanding the science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>57</td>
<td>16</td>
<td>5</td>
<td>2.8</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>53</td>
<td>14</td>
<td>8</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>55</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>How I will employ the science which I study in daily lives and in future is significant to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>54</td>
<td>19</td>
<td>5</td>
<td>0.4</td>
<td>2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>52</td>
<td>25</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>53</td>
<td>22</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>How science will be obliging or useful to me is considerable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>52</td>
<td>21</td>
<td>5</td>
<td>2.6</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>57</td>
<td>16</td>
<td>4</td>
<td></td>
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<tr>
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<td>23</td>
<td>55</td>
<td>18</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table indicates that there is no significant difference between male and female students towards science learning on all items.
Table 15: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 3)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>It makes me anxious about how I will perform on science exam.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>54</td>
<td>19</td>
<td>7</td>
<td>6.9</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>50</td>
<td>20</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
<td>52</td>
<td>20</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>It makes me worried to think about weakening the science exam.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17</td>
<td>54</td>
<td>21</td>
<td>8</td>
<td>3.9</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>60</td>
<td>20</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>57</td>
<td>21</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>When the time comes to take science test I will become anxious.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>53</td>
<td>19</td>
<td>5</td>
<td>0.2</td>
<td>2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>54</td>
<td>23</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>54</td>
<td>21</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I am confident in my abilities to perform well on science exam.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>52</td>
<td>23</td>
<td>6</td>
<td>1.9</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>53</td>
<td>22</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>52</td>
<td>23</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>It’s always concerned to me that other students perform better in science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>60</td>
<td>15</td>
<td>7</td>
<td>1.2</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>15</td>
<td>63</td>
<td>17</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>62</td>
<td>16</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above table shows that there is no significant difference between male and female students towards science learning on all items.
Table 16: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 4)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
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<tr>
<td></td>
<td>16</td>
<td>I am positive that I can achieve 'A' grade in science subject.</td>
<td></td>
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<tr>
<td>Male</td>
<td>21</td>
<td>45</td>
<td>27</td>
<td>6</td>
<td>12.8</td>
<td>3</td>
<td>&lt; 0.01</td>
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<tr>
<td>Female</td>
<td>13</td>
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<tr>
<td>Total</td>
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<td>51</td>
<td>25</td>
<td>8</td>
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<tr>
<td></td>
<td>17</td>
<td>I do not like to even think about science evaluation.</td>
<td></td>
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<tr>
<td>Male</td>
<td>25</td>
<td>51</td>
<td>20</td>
<td>5</td>
<td>7.4</td>
<td>3</td>
<td>n.s.</td>
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<tr>
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<td>60</td>
<td>13</td>
<td>6</td>
<td></td>
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<td>Total</td>
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<td>56</td>
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<tr>
<td></td>
<td>18</td>
<td>I am sure on my capabilities and competencies in the science subject.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Male</td>
<td>21</td>
<td>51</td>
<td>21</td>
<td>7</td>
<td>8.6</td>
<td>3</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Female</td>
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<td>56</td>
<td>21</td>
<td>6</td>
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<tr>
<td></td>
<td>19</td>
<td>I am sure to perform better in science projects or developments and labs.</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>57</td>
<td>17</td>
<td>7</td>
<td>11.9</td>
<td>3</td>
<td>&lt; 0.01</td>
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<tr>
<td>Female</td>
<td>20</td>
<td>66</td>
<td>8</td>
<td>6</td>
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<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>19</td>
<td>62</td>
<td>13</td>
<td>7</td>
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<tr>
<td>20</td>
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</tr>
<tr>
<td></td>
<td>20</td>
<td>I learn science with great interest and put adequate effort.</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>60</td>
<td>16</td>
<td>5</td>
<td>1.8</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>62</td>
<td>13</td>
<td>4</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>61</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In three items, men and women differ in their response patterns. Thus, men say that they are more confident in their abilities in subject of science and can earn good grade while the women claim slightly more than the men that grades are not as important as learning and they can perform better in projects and labs. Cassady and Johnson (2002) note that a high level of assessment anxiety may prevent students from performing well. Student’s responses also show a consistent behavior. Roediger et al (1984) referred to the stability or relative permanence of attitudes.
Table 17: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 5)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>I get ready well in doing science tests and laboratory work.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>56</td>
<td>19</td>
<td>6</td>
<td>1.8</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>59</td>
<td>15</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>58</td>
<td>17</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>I employ different approaches that make sure and give guarantee I learn the science well.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>27</td>
<td>51</td>
<td>17</td>
<td>6</td>
<td>26.5</td>
<td>3</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>44</td>
<td>33</td>
<td>7</td>
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</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>48</td>
<td>25</td>
<td>7</td>
<td></td>
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</tr>
<tr>
<td>23</td>
<td>I seek to understand if I do not get or feel difficult in learning the science</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>58</td>
<td>18</td>
<td>5</td>
<td>3.5</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>54</td>
<td>15</td>
<td>7</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>56</td>
<td>17</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>I think about the science learning that how it will help me in my profession.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>56</td>
<td>19</td>
<td>6</td>
<td>9.2</td>
<td>2</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>68</td>
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<tr>
<td>Total</td>
<td>15</td>
<td>62</td>
<td>19</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>After learning the science how can it assist me to find an excellent career.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>46</td>
<td>28</td>
<td>6</td>
<td>11.8</td>
<td>2</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>52</td>
<td>18</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total</td>
<td>23</td>
<td>49</td>
<td>23</td>
<td>5</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

A significant difference was found between male and female in their response patterns. Both have strong relation on efficacy beliefs and confidence on career choice in science. Thus, men are more confident on their abilities in subject of science while the women were found anxious about their future career so the ideal goal of a teacher is to internally motivate the student. Reve and Jang (2006) have looked at what they call teacher autonomy support within self-determination. In essence, this is simply complex language to describe the way teachers can aid learners so that they become internally motivated.
Table 18: Item wise Gender Comparison between the degree of agreement of Intermediate students on SMQ (Comparison 6)

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>I try to perform well on science evaluation as compared to the other students.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Male</td>
<td>24</td>
<td>53</td>
<td>19</td>
<td>5</td>
<td>0.3</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>23</td>
<td>52</td>
<td>19</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>52</td>
<td>19</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>It is essential and valuable for me to get high scores on science.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>59</td>
<td>18</td>
<td>5</td>
<td>11.7</td>
<td>3</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
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<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>53</td>
<td>23</td>
<td>5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>28</td>
<td>I suppose to achieve better in the science subject than other students.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>52</td>
<td>19</td>
<td>7</td>
<td>2.5</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>47</td>
<td>18</td>
<td>8</td>
<td></td>
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<td></td>
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<td>Total</td>
<td>24</td>
<td>50</td>
<td>18</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>I take it seriously about my science performance that how it will influence on my over result.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22</td>
<td>50</td>
<td>20</td>
<td>7</td>
<td>5.9</td>
<td>3</td>
<td>n.s.</td>
</tr>
<tr>
<td>Female</td>
<td>16</td>
<td>59</td>
<td>18</td>
<td>7</td>
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<td>Total</td>
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<td>54</td>
<td>19</td>
<td>7</td>
<td></td>
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</tr>
<tr>
<td>30</td>
<td>If I do not get the science well and weak in understanding so I am personally responsible for that.</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>55</td>
<td>19</td>
<td>7</td>
<td>4.1</td>
<td>3</td>
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<td>18</td>
<td>11</td>
<td></td>
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<td>19</td>
<td>53</td>
<td>18</td>
<td>9</td>
<td></td>
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</tr>
</tbody>
</table>

The above table shows that male and female differ in their response pattern in only one question. Females are more possessive and give value to their learning and results. Oakes (1986) maintain that performance indicators provide broad indication of existing education and schooling environment; they help to supervise and assess quality of education.

ii. Discussion

In science learning, motivation of science students is defined as “students’ active engagement in science related tasks for performing a higher knowledge of
Barlia (1999) asserts that motivation is a vital educational variable promoting use of strategy, previously performed learning skills, behaviors and learning in new ways. In some ways, this view is self-evident. In other ways, it is misleading. First of all, it assumes that motivation is one variable. It is highly multi-faceted-variable. Secondly, it assumes that it is a fundamental variable that ‘controls’ behavior and learning. Almost certainly, it is dependent on attitudes (themselves multi-variable) and on personal traits. Thirdly, there is almost an implication that motivation can be ‘controlled’ by the teacher and teaching environment. While teachers can influence motivation, other factors are totally out with the control of the teacher, the school or, indeed, the student, may be far more powerful.

Of course, if students perceive the value of learning activities, they will actively enjoy these learning activities with positive attitude to construct a meaningful understanding of a new science concept based on their existing knowledge. How to achieve such a perception is far more elusive.

According to Reeve, Hmm and Nix (2003), student motivation increases when they have confidence about their learning. However, every teacher knows this! The real issue is how to generate such confidence. In an interesting study on the place of confidence in education in Saudi Arabia, Oraif (Al-Ahmadi and Oraif, 2009) found only one factor that generated such confidence: the previous examination success. She pointed out the challenge of developing assessment approaches which allowed EVERY student to be successful.

Harter (1985) reported the high scores of worldwide self worth in male students as compared to the female. Schiefele (1992) suggests that male students perform according to their curiosity level which is much better than female students.
Particularly, academic performance of female students is not as much related to their interest and well being than academic performance of male students.

Stark and Gray (1999) reported interesting insights into gender preferences in learning science. Other similar studies developed this further; for example, Dewson (2000) looked at upper primary pupils attitudes while Skryabina (Reid and Skryabina, 2000b) surveyed pupils from the age of 10 to 20 in relation specifically to Physics and offered a clear picture of the main factors which generate positive attitude towards the learning of physics in Scotland (Reid and Skryabina, 2000a). Spall et al (2003) focused on biology and Physics undergraduates, although they did not emphasize the gender issues so much.

In general, attitudes are very important in that they can influence subsequent behavior. Thus, attitudes related to the science developed at school may well be retained into adulthood and play a major role in all kinds of patterns of behavior. Negative attitudes may well have potentially very harmful effects at personal, social or national levels.

Sometimes, learners have impractical ideas on their abilities about what they can achieve. Probably learners do not recognize about the depth of knowledge to master some material. Teacher should be capable in evaluating the willingness or development of learner attitudes towards goals.
CHAPTER 5
CONCLUSIONS

5.1 Review of Work Done

It is evident that there are problems in science education in Pakistan. Poor performance in science and lack of popularity of science subjects are widespread, women sometimes suffering more. In developed countries, mathematics, the sciences and engineering are often supposed to hold important places in education. However, in many Western countries, there are reports of declining popularity (e.g. Ramsden, 1998: Osborne et al., 2003) although, in some countries, the subjects are attracting large numbers (Stokking, 2000; Reid and Skryabina, 2002a,b).

The aim in this study was to investigate the construct validity of the science motivation questionnaire (SMQ) developed by Glyn and Koballa (2006) and to examine any motivational differences between male and female intermediate science students.

Motivation in learning sciences is clearly important, and the authors of this questionnaire claim that it offers a measure of learner motivation. They have claimed support for the validity and reliability of the questionnaire (Glynn et al, 2009) and evidence for the postulated five dimensions. The study here sought to use that questionnaire in a very different culture and to explore what evidence there was that the claims of the authors are valid.

The college students of intermediate classes in the province of Punjab constituted the population of the study. 600 male and female students, 300 1st year and 300 2nd year science students served as the sample of the study. The overall conclusions were drawn from these questions:
1. What evidence is there that this questionnaire measures motivation with validity?

4. Are there gender differences in motivation with science students?

5. Are there differences in motivation with science learning experience?

5.2 Findings

The questionnaire (30 items) was applied and the response data entered on to a spreadsheet before analysis, using SPSS. Principal Components Analysis, with varimax rotation, was used. In addition, inter-item correlation was explored using Kendall’s Tau-b. The Scree plot did not indicate any factor structure; also inter-item correlations (Kendall’s Tau-b) suggested no factor structure. It took 14 factors to account for 63% of the variance and four of the items did not load on to any of these factors above 0.5. It is accepted that 63% is on the low side as a cut off point while the minimum loading of 0.5 is arguably far too low (Reid, 2006).

Thus, the claims of the authors are not supported from the data. Going further, the items that were claimed to relate to the various factors were factor analysed on their own and, in most cases, there was a factor structure within the supposed factors. This undermines the claims of the authors even further.

The response patterns for the two year groups for each item were compared using chi-square as a contingency test. Surprisingly, no statistical differences were found at all. This indicates that, whatever the survey items were measuring, there were no changes as the students progressed through their course. However, in gender comparison, the 30 items, there are statistical differences in 9 of them.

1. Women saw relevance of science to their life and existence more than male students. (item 4)
2. Men claimed that learning in science is more important for them than learning good grades (item 5)

3. Men claimed to be more confident about the abilities and performance in science subjects (item 16)

4. Males were more positive about their competencies in using different methods of learning science. (item 18)

5. Women claimed slightly more than male student that they can perform better on science practical. (item 19)

6. Women were more confident on their abilities and performance in science as compared to men. (item 22)

7. Men thought more about the importance of studying science to choose their future profession. (item 24)

8. Females were more concerned about relevance of science to find excellent career. (item 25)

9. Women valued good grades more than learning science in itself. (item 28)

5.3 **Strengths and Weaknesses**

It would have been nice to have some other measure of motivation but I know of none that exist that have any reasonable validity. I do not think questionnaires will ever get at this for they only say what respondents think not what the actual reality is. Their thoughts may be accurate but they may not see things as they really are. They also cannot respond beyond their experience and that may be limited.

It is an interesting thought as to how motivation might be genuinely measured. I think it has to be approached by means of what respondents actually do.
We need a study to look at what behavior patterns are indicators of high motivation and low motivation.

Another area which is interesting is to look at how motivation relates to attitudes. I think this could be got at by means of questionnaires, supported by interviews.

A final area is to see how motivation relates to performance. That is more difficult but would be an exciting prospect.

5.4 Summary

In recent years, many studies claimed that motivation has a vital role in science learning (Dalgety et al. 2003). Most have used self-report surveys as a measure of motivation. The present study was one such survey that investigated the data obtained to see if the structure claimed for the instrument was upheld.

The objectives of the study were to investigate the construct validity of the science motivation questionnaire, to examine any motivational differences between male and female intermediate science students, to examine any differences between first and second year science students, and to put forward recommendations in light of findings of the study. The 30-item SMQ developed by Glynn and Koballa, (2006) was analyzed in its construct validity as author permitted it to cross validate in other countries. Principal Components Analysis using Varimax Rotation was applied to investigate construct validity of SMQ. Contingency test was applied to examine the gender comparison.

The population of the study was comprised of learners studying in 323 intermediate science male and female colleges of Punjab, 171 female and 152 male (Punjab University, 2011). Three districts of Gujarat, Gujranwala and Rawalpindi
were randomly selected through cluster sampling from 36 districts of the Punjab province (Pakistan).

The sample of the study consisted of 600 1st year and 2nd year science students (300 males and 300 females), studying in these colleges who were selected through two stage cluster sampling. The sample responded on a five-point Likert-type scale of sequential frequency ranging from 5 (strongly agree) to 1 (strongly disagree) to each of the 30 items.

Before undertaking the research exercise, formal approval in the form of official letter for the heads of selected colleges was obtained from the head of the Foundation University College of Liberal Arts and Sciences, Rawalpindi. Data collection started on 5th January, 2011. The respondents were approached in the classrooms formally under the guidance of their science teachers and where it was not possible, they were assessed informally after their classes. The data were tabulated, analyzed and interpreted in the light of the objectives of the study after obtaining the scores.
5.5 Conclusion

- This questionnaire is not valid for measuring students’ motivation towards science while the actual questions were seen as naive and reveal a total lack of empathy with learners, certainly for the students in the Colleges in Pakistan;

- The unstructured question quality is confirmed by the observation that responses to most of the questions used only four points on the scale and, often, one of them is poorly selected. Good questions should use the maximum rage of points on the scale fairly consistently.

- The 30 questions ask 30 different things. This can be seen by simply looking at any two questions in any of the supposed categories. They are asking different things.

- The claim of the authors is not supported from the data.

- The significance of this work was that it exposed the weakness in considering a concept like motivation as a variable or even a group of a small number of variables. Motivation is almost certainly highly multivariate and cannot be reduced to a small number of factors.

5.6 RECOMMENDATIONS

From the above conclusions and discussion, the following recommendations are derived.

1. Surveys are widely used in Pakistan but, very often, the methodology assumes that surveys actually measure a variable. They do not; they measure what the respondents think. It is recommended that the use of questionnaires
be greatly reduced and the methods used to analyse them be brought line with the evidence from this study (and many other studies).

2. A review paper on survey methodology and interpretation be developed and made widely available across Pakistan universities.

3. Holding positive attitudes towards all aspects of studies in the sciences is very important. Fresh studies need to be undertaken to identify which features of current science education provision are causing attitude deterioration in Pakistan.

4. It is often claimed that certain teaching and learning approaches encourage positive attitudes. These include inquiry-based learning, discovery methods, and the use of group-work. These approaches should be implemented with a sample of students and the student reactions measured.

5. One key factor is a level of confidence and honesty that exists in the teacher-learner interface. This is based on trust. The learner needs to trust the teacher and feel supported and valued. This may well lead to self-belief in the learner who feels confident that, no matter how demanding the work is, some level of success is possible. In essence, the teacher has released in the learner some level of internal motivation.

6. The learning must be related to what is important in the life of the learners. For example, rather than teaching traditional physics, the students could study the theme of communications and explore how humans communicate by means of sound, light, traditional telephone, optical fibers. At that stage, the topic moves to communicating by means of the transmission of electromagnetic waves and this leads to an understanding of radio and television. Finally, students consider how to communicate by transmission of electromagnetic waves when the curvature of the earth makes it impossible
for the waves to come from great distances. This leads to the idea of bouncing the waves off satellites but this requires stationary satellites.

7. Interruption must be avoided in the classroom and it must be controlled.

8. The role of teacher must be encouraging rather than humiliating but supportive as to learning from mistakes.

9. Classroom activities must be normal, and not so effortless or not so complicated because in this situation, students will only concentrate to cover all instead of understanding.

10. Logical tasks should be promoted in the classroom and relate them with their daily life routine

**Recommendations for Future Research**

11. As the present research was limited to examine the construct validity of the science motivation questionnaire and to examine the gender differences in science motivation, science motivation may be related with science achievement in future research studies. This would be carried out by correlating the response patterns from each item in a survey with test marks.

12. The construct validity of SMQ was analyzed at the intermediate level in Punjab. Future studies may, therefore, be conducted with the instrument at degree and university level in Pakistan in order to validate the instrument with respect to construct validity at high levels of education in Pakistan.

13. Studies need to be undertaken to identify which features of current science education provision are causing attitude deterioration in Pakistan.

14. In fact, using questionnaire and surveys for the purpose of measuring science motivation is questionable. Interviews and tests may be used as better
alternative to measure science motivation. A future study could develop this approach.

15. The relationship between attitudes and motivation needs to be explored in order to address the question Is motivation simply an outcome from attitudes or is it more complex?

16. There needs to be major study in which different strategies in teaching are explored and the reactions of the learners (in terms of their attitudes towards their studies) measure.
LITERATURE CITED


Arwood, L. (2004). Teaching Cell Biology to non science Majors through Forensics, or How to Design a Killer Course, Cell Biology Education 3, 131-138.


Hermine Marshall (1987). Another notes that motivation to learn is ... "Motivational Strategies of Three Fifth-Grade Teachers...


The 30-item SMQ assess six component of students’ motivation to learn science in college or high school courses.

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Appendix - B

INVESTIGATION INTO STATUS OF SCIENCE MOTIVATION AMONG INTERMEDIATE SCIENCE STUDENTS THROUGH SCIENCE MOTIVATION QUESTIONNAIRE (2006) AND ITS VALIDATION

Name of the Student: ___________________________________________________
(If you want to write)
Class: _____________________________________________________________

Name of School: ______________________________________________________
Achievement Scores in Previous Examination: ____________________________

Dear Students,

Read the following statements about Science Motivation Questionnaire. In order to better understand what you think and how you feel about your college science courses, please respond to each of the following statements from the perspective of: “When I am in a college science course. . .”

<table>
<thead>
<tr>
<th>S.No</th>
<th>Statements</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Indifferent</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I get science interesting in studying.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>I take pleasure in science learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3.</td>
<td>The science has realistic worth for me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>All the science learning is associated or pertinent to my existence</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5.</td>
<td>Receiving high grades in science is not significant to me than the science I learn.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6.</td>
<td>My personal goals and objectives associate with my science learning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7.</td>
<td>When I learn science I like that it challenges me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>8.</td>
<td>I feel success in understanding the science.</td>
<td></td>
<td></td>
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<tr>
<td>9.</td>
<td>How I will employ the science which I study in daily lives and in future is significant to me.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10.</td>
<td>How science will be obliging or useful to me is considerable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>It makes me anxious about how I will perform on science exam. (r)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12.</td>
<td>It makes me worried to think about weakening the science exam. (r)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>When the time comes to take science test I will become anxious. (r)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>I am confident in my abilities to perform well on science exam.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>It’s always concerned to me that other students perform better in science. (r)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>16.</td>
<td>I am positive that I can achieve ‘A’ grade in science subject.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>17.</td>
<td>I do not like to even think about science evaluation. (r)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>I am sure on my capabilities and competencies in the science subject.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>I am sure to perform better in science</td>
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<td></td>
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<tr>
<td>20.</td>
<td>I learn science with great interest and put adequate effort.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>I get ready well in doing science tests and laboratory work.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>I employ different approaches that make sure and give guarantee I learn the science well.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>I seek to understand if I do not get or feel difficult in learning the science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>I think about the science learning that how it will help me in my profession.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>After learning the science how can it assist me to find a excellent career.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>I try to perform well on science evaluation as compared to the other students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>It is essential and valuable for me to get high scores on science.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>I suppose to achieve better in the science subject than other students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>I take it seriously about my science performance that how it will influence on my over result.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>If I do not get the science well and weak in understanding so I am personally responsible for that.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Chi-square Test ($\chi^2$)

The chi-square test is said to be one of the most widely used tests for statistical data generated by non-parametric analysis. There are two different applications of chi-square test.

1. **Goodness of Fit Test**

This tests how well the experimental (sampling) distribution fits the control (hypothesised) distribution. An example of this could be a comparison between a group of experimentally observed responses to a group of control responses. For example,

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>55</td>
<td>95</td>
<td>23</td>
</tr>
<tr>
<td>Control</td>
<td>34</td>
<td>100</td>
<td>43</td>
</tr>
</tbody>
</table>

N(experimental) = 173
N(control) = 177

(Using raw numbers)

A calculation of observed and expected frequencies lead to

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>fo = observed frequency</td>
<td>55</td>
<td>95</td>
<td>23</td>
</tr>
<tr>
<td>fe = expected frequency</td>
<td>33</td>
<td>98</td>
<td>42</td>
</tr>
</tbody>
</table>

Where $fe = \frac{N(\text{experimental})}{N(\text{control})} \times \text{(control data)}$ or $(173/177) \times \text{(control data)}$

This gives a computed value for $\chi^2 = 23.0$ (df2)

The calculation is:

$$\frac{(55-33)^2}{33} + \frac{(95-98)^2}{98} + \frac{(23-42)^2}{42}$$

This indicates that the responses of the experimental group differ from those of the control group:

$p < 0.001$

This means that we are over 99% confident that the responses of the experimental group differ from those of the control group. ($\chi^2$ critical at 0.1% level = 13.8)

**Notes**

Chi-square MUST be calculated using frequencies and never using percentages.

In this thesis, all data are shown as percentages for clarity but all statistical calculations have been carried out using frequency data.

There are small rounding errors which will arise if chi-square is computed using a calculator compared to the more accurate results from a computer.
(2) Contingency Test

This chi-square test is commonly used in analysing data where two groups or variables are compared. Each of the variables may have two or more categories which are independent from each other. The data for this comparison is generated from the frequencies in the categories. In studies, the chi-square as a contingency test is used, for example, to compare two or more independent samples like year groups, gender, or ages. The data is generated from one population group. For example,

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (experimental)</td>
<td>55</td>
<td>95</td>
<td>23</td>
</tr>
<tr>
<td>Female (experimental)</td>
<td>34</td>
<td>100</td>
<td>43</td>
</tr>
</tbody>
</table>

(Actual data above)

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (experimental)</td>
<td>55 (44)</td>
<td>95 (96)</td>
<td>23 (33)</td>
<td>173</td>
</tr>
<tr>
<td>Female (experimental)</td>
<td>34 (45)</td>
<td>100 (99)</td>
<td>43 (33)</td>
<td>177</td>
</tr>
<tr>
<td>Totals</td>
<td>89</td>
<td>195</td>
<td>66</td>
<td>350</td>
</tr>
</tbody>
</table>

(Expected frequencies above in red)

The expected frequencies are shown in red in brackets ( ), and are calculated as follows:

c. g. 44 = \( \frac{173}{350} \) x 89

\[ \chi^2 = 11.1 \]

At two degrees of freedom, this is significant at 1%. (\( \chi^2 \) critical at 1% level = 9.21)

Degrees of Freedom

The degree of freedom (df) must be stated for any calculated chi-square value. The value of the degree of freedom for any analysis is obtained from the following calculations:

\[ df = (r-1) \times (c-1) \]

where \( r \) is the number of rows and \( c \) is the number of columns in the contingency table.

Sample Sizes

There is no restriction on sample sizes except that values in each category must not drop too low. If they are too low, there is a chance that the calculation of \( \chi^2 \) may occasionally produce inflated results which may lead to wrong interpretations. It is safe to impose a 10 or 5% limit on all categories. When the category falls below either of these, then categories are grouped and the df falls accordingly.

In practical terms, the ideal size of the total sample is determined by the number of categories. Thus, for example, if there are five categories (eg strongly agree ... strongly disagree), then the sample is better to be at least 100 and, ideally, nearer 200. However, other than minimum value restriction, \( \chi^2 \) can handle samples of any size and even samples where two groups are very different in size.

This method was used in this study to compare groups by age and by gender.
Correlation

It frequently happens that two measurements relate to each other: a high value in one is associated with a high value in the other. The extent to which any two measurements are related in this way is shown by calculating the correlation coefficient. There are three ways of calculating a correlation coefficient, depending on the type of measurement:

(a) With integer data (like examination marks), Pearson correlation is used. This assumes an approximately normal distribution.

(b) With ordered data (like examination grades), Spearman correlation is used. This does not assume a normal distribution.

(c) With ordered data where there are only a small number of categories, Kendall’s Tau-b correlation used. This does not assume a normal distribution.

Sometimes, the two variables to be related use different types of measurement. In this case, none of the methods is perfect and it is better to use more than one and compare outcomes. It is possible to use a Pearson correlation when one variable is integer and other is dichotomous. The coefficient is now called a point biserial coefficient.

With ordinal data, this study used the Kendall’s Tau-b correlation.

Factor Analysis

This technique is used to reduce a large number of variables which intercorrelate to see if there are any underlying reasons to interpret the inter-correlations. The technique identifies the number of reasons (known as factors or components) but does not indicate their nature.

In this study, Principal Components Analysis was used, with varimax rotation, using SPSS. This is the mostly commonly used technique.

The data are entered in spreadsheet format. In this study, a default eigenvalue of 1 was employed and the number of factors which exceed this value were shown. The Scree plot was also considered to ensure that the default was a reasonable decision. Different assumptions are made by different authors but, in this study, a high standard was set. For a factor structure, the variance to be explained had to exceed 70%.

The rotation procedure seeks to obtain the best fit for orthogonal axes in multi-dimensional space. This generates loadings. These are correlation coefficients of each variable with the factor. Again, there is disagreement on acceptable loadings but a minimum loading of 0.7 was set here (justification in Reid, 2006).

In this study, the following standard approaches were employed to explore if there was any factor structure:

(1) The Scree plot was studied. If a factor structure is present, there is usually a discontinuity at the point of the number of factors involved. In this study no such discontinuity was found. Indeed, the graph was 'smooth', typical of data which has not generated any factor structure.

(2) The number of factors to explain a minimum of 70% of the variance was considered. This should be low if genuine data reduction has taken place. In the study it was very high.

(3) The rotated table of loadings was considered. Each of the 30 variables should load onto one factor (at 0.7 or more) and not load onto any other factor (< 0.3). In this study, several variables did not load uniquely at all and few loadings exceed 0.7.