THE EFFECT OF COGNITIVE ACCELERATION APPROACH FOR THE DEVELOPMENT OF REASONING AND PEDAGOGICAL SKILLS OF PROSPECTIVE TEACHERS

Researcher

Memoona Bibi

126- FSS/PHDEDU/F16

Supervisor

Dr. Shamsa Aziz

DEPARTMENT OF EDUCATION

FACULTY OF SOCIAL SCIENCES

INTERNATIONAL ISLAMIC UNIVERSITY

ISLAMABAD

2022

THE EFFECT OF COGNITIVE ACCELERATION APPROACH FOR THE DEVELOPMENT OF REASONING AND PEDAGOGICAL SKILLS OF PROSPECTIVE TEACHERS

MEMOONA BIBI

(REG. NO. 126/FSS/PHDEDU/F16)

Submitted in partial fulfillment of the requirements for

the degree of PhD in Education

DEPARTMENT OF EDUCATION

FACULTY OF SOCIAL SCIENCES

INTERNATIONAL ISLAMIC UNIVERSITY

ISLAMABAD

2022

APPROVAL SHEET

THE EFFECT OF COGNITIVE ACCELERATION APPROACH FOR THE DEVELOPMENT OF REASONING AND PEDAGOGICAL SKILLS OF PROSPECTIVE TEACHERS

By

Memoona Bibi

126-FSS/PHDEDU/F16

This thesis has been accepted by the Department of Education, Faculty of Social Sciences, International Islamic University Islamabad in partial fulfillment of the degree of **PhD Education.**

Supervisor: _____
Dr. Shamsa Aziz

Internal Examiner: _____
Prof. Dr. Samina Malik

External Examiner I: _____
Prof. Dr. Fazal-ur-Rahman

External Examiner II: _____
Dr. Shagufta Akhtar

Dated: _____

_____
Incharge
Department of Education
International Islamic University
Islamabad- Pakistan

_____
Dean
Faculty of Social Sciences
International Islamic University
Islamabad- Pakistan

cognition
Cognitive learning

AUTHOR'S DECLARATION

I Memoona Bibi Reg. No. 126/FSS/PHDEDU/F16 as a student of Ph.D. in Education Department at International Islamic University Islamabad do hereby declare that the thesis titled "The Effect of Cognitive Acceleration Approach for the Development of Reasoning and Pedagogical Skills of Prospective Teachers" submitted for the partial fulfillment of PhD Degree in Education is my original work and has not been submitted or published earlier to anywhere and will not be submitted by any researcher for obtaining a degree from this or any other university or institution.

Date: 25-04-2022

Memoona Bibi

Reg. No. 126/FSS/PHDEDU/F16

SUPERVISOR'S CERTIFICATE

This thesis titled "The Effect of Cognitive Acceleration Approach for the Development of Reasoning and Pedagogical Skills of Prospective Teachers" submitted by Memoona Bibi Reg. No. 126/FSS/PHDEDU/F16 in partial fulfillment of PhD Degree in Education, has been completed under my guidance and supervision. I am satisfied with the quality of student's research work and allow her to submit this thesis for further process as per IIUI rules and regulations.

Date: 25-04-2022

Shamsa

Dr. Shamsa Aziz

Supervisor

DEDICATION

I WANT TO DEDICATE MY THIS WORK TO

FIRST OF ALL MY

RESPECTED SUPERVISOR DR. SHAMSA AZIZ

MY FAMILY MEMBERS

PARTICIPANTS OF MY RESEARCH

AND

EVERYONE WHO HELPED ME IN THIS

RESEARCH

ACKNOWLEDMENTS

First of all, the researcher is highly thankful to Allah Almighty for the completion of this work and parents whose continuous encouragement enabled her to do it well.

Researcher would like to especially thank to respected supervisor Dr. SHAMSA AZIZ, for her kind and continuous guidance, support, encouragement, enlightening feedback and insightful suggestions throughout the research work. The researcher is also grateful to all other respected teachers for their guidance and support for the research generally and for this research particularly.

Researcher is greatly thankful to all family members for their encouragement and support at all the stages of this research. Researcher is also highly thankful to all participants who participated in this research and give their precious time for interview and also thankful to all friends for their support, help and encouragement in this research work.

The researcher would like to place on record her sense of gratitude to all of those who facilitated me in the process of completing this research.

MEMOONA BIBI

ABSTRACT

Many evidences have shown the long-term effect of the Cognitive Acceleration teaching approach on the academic achievement of young students. Researchers are being engaged in the exploration of the Cognitive Acceleration teaching approach of enhancing the general intellectual skills of students since the early 1980s. Many published works show the long-term effects of this approach on the cognitive development and academic achievement of young students. Keeping in view the previous findings, the main objectives of this research were to; investigate the effects of the Cognitive Acceleration teaching approach on the reasoning and pedagogical skills of the prospective teachers at the university level and compare the effects of the Cognitive Acceleration teaching approach and traditional approach concerning reasoning and pedagogical skills of prospective teachers' at the university level. The research was experimental and followed a pre-test post-test control group experimental design. The sample of the research included the experimental group and control group from the BS Education program in the Department of Education at International Islamic University Islamabad. A simple random sampling technique was used to select the sample after pre-test and pairing of prospective teachers. CTSR (classroom test for scientific reasoning) developed by A.E. Lawson (2000) and pedagogical knowledge test developed by the researcher were used to collect the data through pre-tests and post-tests. Pedagogical practices of the prospective teachers were observed using a self-developed observational protocol consisting of five major pedagogical practices including planning the instruction, instructional delivery, classroom management, monitoring and professional responsibilities. The experimental group's perception about different activities of the experiment was taken through a self-made perception scale. Collected data were analyzed by calculating mean scores and t-test for hypothesis

testing by using SPSS. The main findings of the study revealed that the Cognitive Acceleration teaching approach has a significant positive effect on the reasoning ability and pedagogical skills and practices development of prospective teachers at the university level. Findings also showed that participants found Cognitive Acceleration teaching approach effective and learned many new concepts and skills with the help of thinking and pedagogical activities. Based on findings it has been concluded that the Cognitive Acceleration teaching approach might be encouraged for training prospective teachers at the university level and training sessions about the use of the Cognitive Acceleration teaching approach can be arranged by teacher education programmes and institutions.

Keywords: Cognitive Acceleration teaching Approach, Traditional Approach, Prospective Teachers, Reasoning Ability, Pedagogical Skills.

TABLE OF CONTENT

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

CA	**Cognitive Acceleration**
CATE	Cognitive Acceleration thorough Technology Education
CASE	Cognitive Acceleration through Science Education
CTSR	Classroom Test Scientific Reasoning
UK	United Kingdom
HOTS	Higher Order Thinking Skills

CHAPTER 1

INTRODUCTION

Empowering the psychological development of children to make sense of the world around them is one of the important roles of education. The fundamentals that are required for life include problem-solving, logical reasoning, and creative thinking. It is shown by the research findings that quality teaching is an important component for the achievement of the students. Literature shows that expert teachers have the characteristics of students' concern, passion, and in-depth knowledge of the subject matter; adaptable instructional strategies, and critical thinking development. It is also suggested that good teachers always challenge the students by teaching them thinking skills through understanding their subject. Schools should also provide a learning environment, social opportunities to the talented students in becoming socialized with their peers and also to work with a group of peers to learn higher-order thinking skills (Güner & Erbay, 2021).

The world is changing nowadays at an accelerated pace, and the pressures are increasing to respond to these rapid changes. Accordingly, the world we live in requires continuous learning and reconsidering the decisions we take (Paul & Edler, 2002). Other than differences about Cognitive Acceleration mechanisms, most of researchers are agree that Cognitive development occurs as a result of internal and external factors. It is also agreed that Cognitive development occurs in a social context and the way information is presented (Bjorklund, 2011). However, the initial studies conducted by a team of Chelsea College showed success that encourages the idea of Cognitive Acceleration which from Adey and Shyer's views focuses on increasing the pace of natural thinking development among students (Adey & Shayer, 1994).

Cognitive Acceleration is known as an approach that is based on the Piaget (1970) and Vygotsky (1978) theory which aims to develop the general abilities of students for information processing. Most commonly, the Cognitive Acceleration teaching approach consists of three main pillars that are called (1) Cognitive conflict, (2) social construction, and (3) Metacognition. Cognitive conflict is introducing the problem by challenging the student to think about it, social construction is the process of making knowledge together as a group and metacognition involves the process of reflection on students' thinking and also group thinking (McCormack, 2009).

The first Cognitive Acceleration program was developed by Michael Shayer, Philip Adey, and Carolyn Yates in 1981, and relied in its original version on Piaget's theory of Cognitive development. The outcome of this program was a package of 30 lessons entitled "Cognitive Acceleration through Science Education" (Serret, 2004). The result revealed differences between students' thinking styles and curricula requirements (Adey, 1999). Shayer & Adey (2002) state that there are three basic assumptions on the interventions of Cognitive Accelerations, summarized as; (1) the programmes used in these interventions are appropriate, based on some general mental functions through an independent context or within a specified study content (2) These functions develop during the transition from one stage to another, and (3) The development of these functions is affected by environment and maturation.

The primary principles of Adey and Shayer's model are (Shayer & Adey, 2002):

1- **Concrete Preparation**: Students need an initial introduction of any problem, recognition of problem context, and vocabulary to generate a discussion on it. Therefore, the first stage in Cognitive Acceleration is designed to involve students in the task.

2- **Cognitive Conflict**: This principle uses the idea of Piaget (1970) and Vygotsky (1978) on the equilibrium and the zone of proximate development where equilibrium from Piaget's view represents a process where the Cognitive processing mechanisms adapt to events that cannot be represented directly and create some conflict.

While the zone of proximal development from Vygotsky's view refers to the difference between what can be achieved by the child without assistance and what could be achieved with others' assistance.

3- **Social Construction**: According to Vygotsky (1978) knowledge construction and knowledge understanding is a social process and learners understand from the social environment. Piaget (1970) also proposed that Cognitive conflicts and Cognitive development are created by the social environment which is as much important as the physical environment in a learning situation.

4- **Metacognition**: Vygotsky (1978) proposes that language also works as an important means of learning for Cognitive development and also works as a tool of thinking for students while they interact with each other. The concept of meta-cognition stresses the development of thinking skills and vocabulary among students through the awareness of their thinking abilities.

5- **Bridging**: This principle refers to providing new thinking processes through a wide range of contexts where students are requested to think in other contexts that use these schemas.

It is also found that no pedagogy can be only delivered through print or software resources, but critical thinking is also necessary for the delivery of information. Therefore, many of the Cognitive Acceleration professional development programmes have been designed that are associated with the Cognitive development of the students.

It is to be explored by the theories and researches that while teaching any of the subjects either in science or any other subject, it is necessary to consider the previous knowledge of the students that they have about the content being taught to them.

1.1. The rationale of the Study

Based on previous studies reviewed about Cognitive Acceleration, the necessity of work on Cognitive Acceleration at university is felt. As the basic purpose of any teacher education program is to prepare future teachers with all theoretical and pedagogical knowledge and practices to overcome the challenges of education in the future, the Cognitive Acceleration teaching approach with the combination of pedagogical skills helps to equip prospective teachers with reasoning and pedagogical skills. Teachers trained with reasoning and pedagogical skills are more likely to able to train future teachers at the school and university level. Having command of the subject matter knowledge is not enough for the Cognitive Acceleration teaching approach but it is also necessary to be pedagogically skilled to teach students through the Cognitive Acceleration teaching approach.

So keeping in view the previous studies and main objective of teacher education programmes it was aimed to conduct a study to explore the effect of Cognitive Acceleration teaching approach on both reasoning ability and pedagogical skills of prospective teachers.

1.2 Statement of the Problem

When training prospective teachers, pedagogical skills with reasoning ability must be targeted for improvement, as teachers are not able to communicate material beyond their level of intellectual sophistication. It has been explored that many of the teachers are equipped with subject matter knowledge but they lack in pedagogical skills to deliver that subject matter knowledge effectively. As literature shows that teaching

is not only delivering information but it is the practice of training future generation with latest skills and knowledge. Keeping in view literature gap, primary objective of this research was to compare the Cognitive Acceleration teaching approach and traditional approach to find out the effect of the Cognitive Acceleration teaching approach on the development of reasoning and pedagogical skills and practices of prospective teachers at the university level.

1.3 Objectives of the Study

Objectives of the study were;

1. To investigate the effect of the Cognitive Acceleration teaching approach on the reasoning ability of prospective teachers at the university level.
2. To find out the effect of the Cognitive Acceleration teaching approach on the pedagogical skills and practices of prospective teachers at the university level.
3. To compare the Cognitive Acceleration teaching approach and traditional teaching approach with respect to reasoning and pedagogical skills and practices of prospective teachers.

For objectives 1 and 2 research questions were made and for objective 3 null hypotheses were formulated.

1.4 Research Questions

1. To what extent the Cognitive Acceleration teaching approach affect the reasoning ability of the prospective teachers at the university level?
2. To what extent the Cognitive Acceleration teaching approach affect the pedagogical skills of the prospective teachers at the university level?

1.5 Hypotheses

Following null hypotheses were tested to achieve the objectives of the study.

H_{01}: There is no significant difference between the mean scores on reasoning ability pre- test between the experimental group and control group.

H_{02}: There is no significant difference between the mean scores on pedagogical skills pre-test between the experimental group and control group.

H_{03}: There is no significant difference between the mean scores on reasoning ability post-test between the experimental group and control group.

H_{04}: There is no significant difference between the mean scores on pedagogical skills post-test between the experimental group and control group.

1.6 Significance of the Study

The study will be significant for the teachers and students. The basic significance of the study will address the application of Adey and Shayer's model (1994) of Cognitive Acceleration in developing reasoning ability and pedagogical skills among a sample of prospective teachers at the university level. Previous studies didn't explore the effect of the Cognitive Acceleration teaching approach on the prospective teachers at the university level and neither has been compared with another teaching approach. The main contribution of the study is in the form of adding value of findings related to the Cognitive Acceleration teaching approach regarding reasoning ability and pedagogical skills and practices. Whereas the practical significance of the study would be for teachers to know about the activities and content that can be used to enhance the reasoning skills of the prospective teachers. Findings of the study can be beneficial for students to get to know effectiveness of being trained with reasoning skills and pedagogical skills and practices for their future teaching practices. Teachers can also get benefit from the findings of the study by planning effective classroom activities to equip prospective teachers with reasoning and pedagogical skills and practices. The results of this study may also guide further research in this educationally important area.

1.7 Assumption

It was assumed by the researcher that if the reasoning is enhanced, the pedagogical skills and practices of prospective teachers will also be simultaneously enhanced.

1.8 Delimitation of the Study

This study was delimited to;

1. Department of Education, International Islamic University, Islamabad
2. Furthermore, dependent variables of reasoning ability and pedagogical skills were also delimited to its subtypes. Reasoning ability variable delimited to inductive and deductive reasoning abilities and pedagogical skills delimited to activity-based, action, and active learning skills.
3. Pedagogical practices assessed through observation protocol were delimited to planning the instruction, instructional delivery, classroom management, monitoring and professional responsibilities.
4. Prospective teachers from BS Education, Batch Spring 17 and Spring 18 studying course of Teaching of G. Science-A with course code ED-041-A

1.9 Operational Definitions of the Terms

1.9.1 Cognitive Acceleration Approach

A teaching approach based on the theory of Piaget (1970) and Vygotsky (1978) aims to enhance the information processing abilities of the students. The researcher has used Cognitive Acceleration as teaching approach focusing on three main pillars including Cognitive conflict, social interaction, and Metacognition to enhance the reasoning and pedagogical skills of the prospective teachers.

1.9.2 Traditional Approach

An approach that is most commonly used in the classroom. The traditional approach used in the study not only included the lecture method but students' assignments, presentations, assessment, and discussion were also included in the traditional approach for this study.

1.9.3 Prospective Teacher

Teacher student who is enrolled in the teacher education program. Prospective teachers for this study were students enrolled in BS Education programme at International Islamic University Islamabad.

1.9.4 Reasoning Ability

Process of thinking about something in a logical way to draw a conclusion or judgment in a logical way such as inductive and deductive reasoning ability. Reasoning abilities for this study were inductive reasoning and deductive reasoning.

1.9.5 Pedagogical Skills

Being able to deliver the information and promote the skills among students in a way that students can understand, remember and apply. Pedagogical skills for this study were activity-based, action, and active learning skills.

1.10 Theoretical Framework of the Study

This study is based on the Cognitive Acceleration teaching Approach that is based on Piaget and Vygotsky theory of developing general abilities among students through information processing. Moreover theoretical framework of the study explains the independent and dependent variables of the research i.e. Cognitive Acceleration teaching approach and traditional approach (independent variables) pedagogical skills and reasoning abilities (dependent variables). Arrows highlights that the effect of Cognitive Acceleration teaching approach and traditional approach had been measured on the pedagogical skills and reasoning abilities of the prospective teachers.

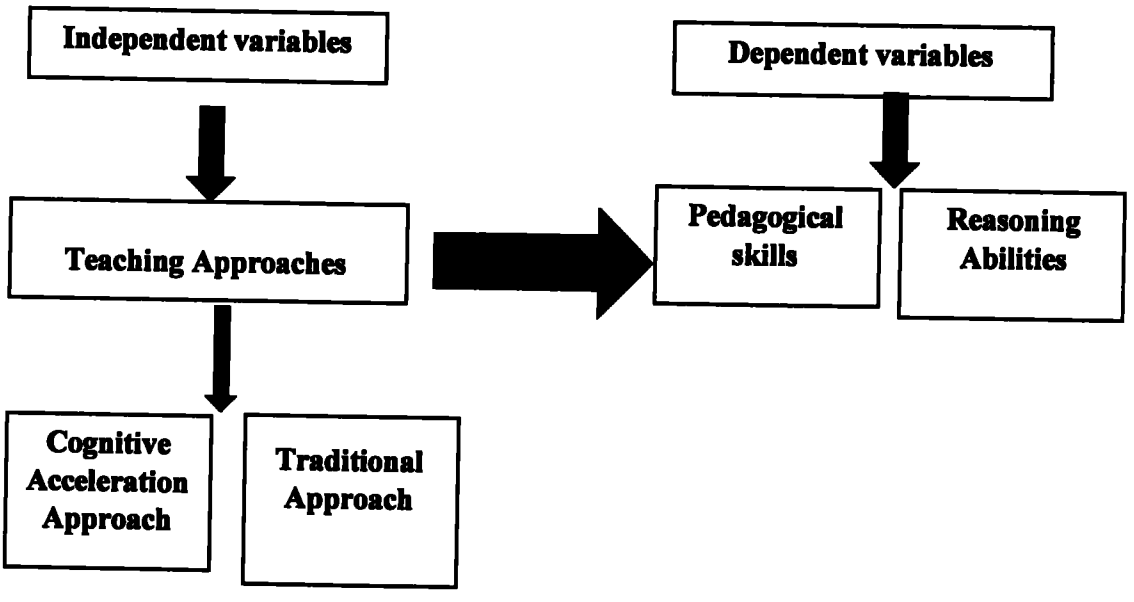


Figure 1: Theoretical Framework of the Study

1.11 Research Methodology

1.11.1 Research Design

The research design of the study was a true-experimental pre-test post-test control group design. The study was experimental and quantitative in nature. Two groups control group and the experimental group were formed for the experiment. Two pre-tests and two post-tests were used to check the effect of the Cognitive Acceleration

teaching approach on the reasoning and pedagogical skills of prospective teachers. Symbolic representation of the research design is as;

$$RO_1 \quad X_1 \quad O_2$$

$$RO_1 \quad X_2 \quad O_2$$

Where R= Randomization, O_1 = pre-test and O_2 =post-test

X_1= Experimental Group

X_2 = Control Group

1.11.2 Population

The population of the study included all prospective teachers enrolled in the BS Education program in the Department of Education at International Islamic University Islamabad. The population consisted of only female enrolled prospective teachers. The total population of the study was 250.

1.11.3 Sample and Sampling Technique

The sample of the study consisted of prospective teachers from the BS Education program studying the "Teaching of General Science" subject during Fall 2019. Total number of 64 prospective teachers were treated as a sample of the study and simple random sampling technique was used to select the sample for the control group and experimental group after the pre-test. The sample of the study was selected keeping in view the nature and research design of the study i.e. true experimental pre-test post-test design.

1.11.4 Instrumentation

To collect the data from the experimental and control group through pre and post-test, two instruments were used in the study.

1.11.4.1 CTSR (Classroom Test of Scientific Reasoning)

CTSR (classroom test of scientific reasoning) was used to measure the reasoning skills of prospective teachers. The Classroom Test of Scientific Reasoning (CTSR) 2000, developed by A. E. Lawson, is designed to assess students' scientific literacy and thinking skills. The test measures students' ability to apply aspects of scientific and mathematical reasoning, including analyzing situations, making predictions, and solving problems. The CTSR consists of 24 items that are suitable to measure the reasoning abilities of prospective teachers at the university level. As this instrument has open access on the internet, no permission was required to use it for the study.

1.11.4.2 Pedagogical knowledge test

A pedagogical knowledge test was used to measure the pedagogical skills knowledge of prospective teachers. The pedagogical knowledge test was developed according to the course content of "Teaching of General Science" focusing on the research objectives of the study.

1.11.4.3 Observation Protocol

To measure the pedagogical practices of prospective teachers in practicum form, an observation protocol was developed based on 5 major pedagogical practices that need to be observed during model lesson plan presentation and these major pedagogical practices were planning instruction and designing learning experiences, instructional delivery, classroom management, monitoring assessment, and evaluation and professional responsibilities.

1.11.4.4 Perception of prospective teachers about their learning experiences with Cognitive Acceleration teaching method

A researcher-made perception scale to explore the experimental group's perception about the experiment was used as an instrument of the study. The perception scale was consisting of statements related to activities and materials used during the experiment.

1.11.5 Data Collection

The effect of the Cognitive Acceleration teaching approach was checked by;

1. Applying the CTSR before and after the completion of the experiment.
2. Applying the pedagogical knowledge test before and after the completion of the experiment.
3. Using observation protocol to assess the pedagogical practices of prospective teachers through a model lesson plan.
4. Self-reported sheets filled by the students about their experiences, impressions, and attitudes towards the different aspects of the experiment.

1.11.6 Data Analysis

Data collected through pre-test, post-test, observation protocol, and perception scale, were analyzed using SPSS software. To compare the effect of the Cognitive Acceleration teaching approach between the control group and experimental group *t*-test was applied. The effect size was also calculated to measure the effect of the Cognitive Acceleration teaching approach on the experimental group. Prospective teachers' perception about different aspects of the experiment was calculated through the mean. All analyzed data were presented in tabulated form with a detailed description.

1.12 Overview of the Chapter

This chapter has a detailed background and introduction of the Cognitive Acceleration teaching approach that it is based on the Adey and Shayer model (1994) and research on Cognitive Acceleration was started in 1992 at Chelsea College London University and main focus of research was to develop thinking abilities among secondary school students. Background and introduction of the topic lead with the rationale of the study that why a need was felt to conduct this study, rationale with logical reasoning and justification is explained in this chapter. Research objectives, research questions, hypotheses, and a short description of the research methodology used for this study are also part of this chapter. A self-explained theoretical framework of the study is also explained in the chapter. Overall this chapter is a brief introduction of the research process adopted for this study.

CHAPTER 2

LITERATURE REVIEW

A literature review is known as the search and evaluation of available literature on the particular topic a researcher is going to research on. Literature reviews show a reader that a researcher has an in-depth grasp of a particular topic and knows here his/her research best fits in the literature. The literature review for the study was divided into three main sections according to the topic of the study. Section 1 highlights the introduction, background, and history of the Cognitive Acceleration teaching approach. Section 2 presents the detailed literature about reasoning and thinking skills, how they can be developed among students, and why thinking skills are necessary for prospective teachers. Section 3 leads a discussion about pedagogical content knowledge and pedagogical skills. Let's have a look at each section in detail.

Section 01: Cognitive Acceleration Approach

Cognitive Acceleration is known as a teaching method that has a foundation in the theory given by Piaget and Vygotsky, and the main of the theory is to enhance the general ability of thinking and information processing among students. With the significance of this theory, there is also some critique on the reliability and validity of this theory in terms of processing ability among students.

Many studies have explored that different types of pedagogical practices are used to deliver the information with reasoning, critical thinking, and effective pedagogical skills (Adey, Hewitt, Hewitt, & Landau, 2004).

2.1 Cognitive Development among Students

Cognitive development has always been a debatable topic by many researchers. During 1930-1970 Jean Piaget and his companions perform an experiment and proved

that the intellectual development of human beings is created in different stages with different styles (Johnson and Newport, 1993).

It is also known by teachers that the understanding level of young students is developed in different phases of learning and over time it becomes more established. Application of different teaching techniques including quizzes, group activities, discussion, role-play, and different types of evaluation guide teachers and students about their learning progress. If assessment techniques mainly focus on the content, at that point memory and review become significant elements in accomplishment (Kozulin, 2003).

Cognitive development is known as the understanding of the concepts and thinking and reasoning ability. The Cognitive development of young students is also affected by language influences and the ability to communicate with others. It has been observed that deaf students also have the same capabilities for Cognitive development as normal students have (Physics, 2012).

It has also been observed by different researchers that teachers and instructors also play an important role in the Cognitive development of young students. Effective use of language by teachers and instructors can help students to effectively communicate the concepts with peers. An effective teacher is not only able to understand Cognitive concepts effectively but also has the capabilities to handle complex and abstract thinking concepts (Rombout et al., 2021; Haug & Mork, 2021).

2.2 Description of the Thinking Science Cognitive Acceleration Intervention

The Thinking Science Cognitive Acceleration intervention is based on the higher-order thinking skills program developed by Adey and his companions in the United Kingdom (Epstein, 1986).

This classroom intervention program is consists of 30 reasoning activities that are developed by science teachers in the period of two years and these activities are particularly designed for the age group of 7-9 years. According to this intervention program students are required to have more focus on activities rather than standard science lessons content. All of these pedagogical practices are considered the most effective classroom practices for the reasoning and Cognitive development of young students (Baker et al., 2001; Jones & Gott, 1998).

It has been proposed by Tudge (1993) that assessments based on Cognitive conflict create a social connection between students and they find out many ways to address the issue and it is considered as "an effective method of developing Cognitive/reasoning skills among student". Recent research conducted by (Mercer, 2010) has depicted that along with reasoning and thinking skills language also has a significant connection for students' social and mental process of thinking in classroom activities and such kind of communication has a great effect on the Cognitive development of young students (Mercer, 2010).

2.3 Historical Bases of Cognitive Acceleration Through Science Education (CASE)

There are many studies conducted to find out the effect of the CASE project developed by Adey and Shayer based on the Cognitive theory of Jean Piaget. Many findings show that during the 1960s and mid-1970s many of the teachers have shown interest in the CASE program and few of them conducted some unique researches to make modifications in the CASE program with operational reasoning. Lovell (1961) conducted new research with the experiment of 200 respondents from the age group of 8 years and above and tested 10 issues of logical thinking growth and development following the main practices of the Inhelder and Piaget program. Jackson (1975) also

conducted research with 48 children of normal intelligence from the age group of 5 to 15 years and 40 abnormal children from the age group of 7 to 15 years. The findings of his study showed that after the consistency of six activities from the CASE program there was a significant effect on the psychological development of children (Jackson, 1965).

There are many studies conducted to find out the development of Piagetian Stages among young student and Shayer, Murawski (2012) found that children in the early stages of Cognitive development are more likely to develop operational reasoning and formal operational stage of Cognitive development as compared to those students who do not follow early stages of Cognitive development. They found these results by practicing classroom activities suggested by Inhelder.

Researcher's Analysis about Section 1: Cognitive Acceleration Approach

After reviewing the literature on the Cognitive Acceleration teaching approach researcher has analyzed that a Cognitive Acceleration teaching approach is a teaching approach that enhances the general thinking ability of students and encourages them to think beyond the results. It has been analyzed from the literature that the base of Cognitive Acceleration was initiated with the Piaget and Vygotsky theory of learning of doing. The main focus of the Cognitive Acceleration teaching approach is on thinking lessons and creative activities. With the analysis of previous studies on Cognitive Acceleration teaching approach, it has been found that logical reasoning and critical thinking is a necessary component needs to be focused by teachers while planning for content delivery. As the world is moving towards an accelerated pace, it has become a dire need to equip students with logical reasoning and critical thinking to understand the concepts effectively and generate healthy and logical discussion with new ideas and thoughts. According to the researcher's analysis, Cognitive Acceleration

is not only an effective approach in teaching science subjects but English, mathematics, and other theoretical subjects can also be taught effectively with the implementation of the Cognitive Acceleration teaching approach. After reviewing the thinking lessons used by different researchers in the Cognitive Acceleration teaching approach it has been analyzed by a researcher that teacher education programmes should also focus on arranging thinking activities for prospective teachers which will enhance their intellectual abilities and skills to generate healthy discussion with logical reasoning. The main purpose of teaching is not only delivering the information traditionally but in the modern age, it has become important to equip students with certain skills to compete with the market and global demands. Teaching is a profession that is a central component of any nation, so it needs to be focused more as compared to any other profession. If teachers would be skilled and trained with global demands outcomes of that nation would be significant and competitive for everyone. So Cognitive Acceleration teaching approach can produce effective skills among prospective teachers in the future.

Section 02: Reasoning/Thinking Skills

Reasoning and thinking skills are considered the most important and basic skills needed to be developed among students from the very basic level. It is to be believed that if teachers would be trained with reasoning and thinking skills effectively then he/she will be able to train students effectively. Section 2 of the literature review describes the detail of thinking skills and reasoning skills by explaining the characteristics of critical thinkers and different types of reasoning skills that can be effective used by teachers during teaching learning process. Let's have a look on the detail of section 2.

Thinking and sense-making allude to students' capacities to consider and utilize knowledge definitively. In any subject, just presenting students to points isn't sufficient, nor is it enough for students to know just how to perform methodology. They need to create basic speculation abilities to succeed in the subject and different everyday issues and learning. Addressing thinking and sense-making shouldn't be extra trouble if you are working with students who are struggling simply in learning strategies. In actuality, the structure that an emphasis on thinking brings can give essential help for understanding and preceded learning (Baker et al., 2001; Limbach & Waugh, 2010; Kanari & Millar, 2004).

Many studies have proposed thinking as an important component in science and math education (Kanari & Millar, 2004; Lawson, 1995; Park and Han, 2002; Türkmen, 2006; Oehrtman and Lawson, 2008). It is observed that thinking helps students to enhance their understanding abilities and skills to assess the problem logically in an innovative way. So it is recommended that thinking is a powerful tool for students in the learning process to find out new ways to analyze the problem from all perspectives, making suitable assumptions, arriving at suitable solutions, and most importantly defending their decisions (Hall et al., 2007; Hudspeth & Pribram, 1990; Murawski, 2012; Hugerat et al., n.d.; Endler & Bond, 2014).

The reasoning is characterized as the demonstration of utilizing motivation to get an end from specific premises. Most commonly reasoning is subdivided into two main categories called deductive reasoning (general to specific) and inductive reasoning (specific to general). Deductive thinking assumes a significant job in logical clarification and forecast (Moore et al., 2012). Given general causal laws furthermore, articulations depicting starting condition deductive thinking can be seen as a particular space of information. On the off chance that instructors educate solely in a way that

favours their students' less favoured learning styles, the students' distress level might be sufficiently incredible to interfere with their learning (Venville & Oliver, 2015; Hooda & Devi, 2018; Moore et al., 2012; Hugerat et al., n.d.).

2.4 What is Critical Thinking?

Critical thinking is the most common phrase of the teaching-learning process of school and college settings. Commonly, the concept of critical thinking has a history of 2500 years back and has its roots in the mid-late 20th century. Critical thinking helps students to create and apply new thoughts to make their thinking more improved. Generally, an individual is a scholar to the extent he improves his thinking abilities consistently (Güner & Erbay, 2021; Warburton & Torff, 2005; Kavenuke et al., 2020)

These foundations of critical thinking are developed by John Dewey, Ludwig Wittgenstein, and Jean Piaget. Robert Ennis in one of his studies conducted in the 1960s proposed to encourage the use of reasoning abilities in the teaching-learning process according to the learning environment and thinking capabilities of students. It is to be considered that an ideal critical thinker always makes the right decision and logically presents information by showing good behavior (Haug & Mork, 2021; Limbach & Waugh, 2010).

2.5 Characteristics of a Critical Thinker

Critical thinkers are those who think beyond the normal thinking and generate critical thoughts and information as a scholar (Retnawati, Hadi, & Nugraha, 2016). The use of different critical thinking techniques makes them expert in thinking and they become more frequent to generate new thoughts and information critically with a logical decision. Most importantly, critical thinkers view a problem or argument from different perspectives and find out different thoughts thinking diversely and logically to make a fruitful decision. They are always ready to face any kind of challenges

regarding thoughts, arguments, and disagreement from their decision (Kanari & Millar, 2004).

Critical thinkers always make wonderful choices to make their decisions and prove their decisions as the best impression going beyond their limitations and restrictions following rational reasoning and critical thoughts. Generally Critical thinkers (Nugraha et al., 2016) :

- Encourage the personal point of view
- Take the problem as a new challenge
- Make a goal before a decision
- Decide with evidence
- Prefer to listen to others' point of view
- Think before acting.
- Avoid personal emotions and biases
- Engage in active listening

2.6 Higher Order Thinking Skills and their Importance in Teaching-Learning Process

Education is known as an important component of any nation to achieve a public vision. Education helps a system to produce better citizens by showing the importance of hard-working to grow and develop. Public authorities, policy makers, teachers, curriculum experts all are considered the lead role to make an educational system successful. They also work as a partner to achieve the aims and objectives of educational policies by performing a tough job to prepare educated societies across the country (Quamruzzaman, Rodríguez, Heymann, Kaufman, and Nandi, 2014).

A good education system demands qualified and trained teachers with all necessary skills required to make an educational system successful (Purnomo, 2017).

Many of the researchers proposed that teachers have a great commitment towards quality education (Gil-Flores et al., 2017; Hu et al., 2017; Stylianides & Stylianides, 2007). Quality of education can be maintained by incorporating 21st-century skills in teachers.

In the teaching-learning process, HOTS can be easily taught to young students by giving them more and more practice exercises of HOTS (Zehra & Garisson, 2011; Limbach & Waugh, 2010). These learning styles demand more trained and skilled teachers as compared to traditional teachers, so before students, it is essential to train teachers with HOTS skills for an effective teaching-learning process.

2.6.1 Problem-Solving Skills

Problems are a fundamental part of the existence of the people. In some cases, the people put into activity techniques and approaches all alone to give answers for issues, while, in different cases, they need to acquire support and help from others (Güner & Erbay, 2021). At the point when certain issues are capable by the people in instructive organizations in gaining a productive comprehension of academic ideas and inside work settings, inside the course of execution of occupation obligations, they acquire support and help from teachers, individual students, partners, administrators, and bosses. Thusly, critical thinking abilities can be created all alone just as through acquiring support and help from others (Mokhtar et al., 2013).

Inside classroom settings of instructive establishments at all levels, the educators need to actualize instructing learning techniques and instructional methodologies in such a way that the people arise into solid issue solvers. While inside preparing and improvement programmes the individuals from the associations should be effectively-prepared as far as sharpening of critical thinking abilities. In this way,

with the obtaining of legitimate preparation and guidance, the people can improve their critical thinking abilities in a useful way (Vidergor & Krupnik, 2015).

2.6.1.1 Problem-Solving Processes

In the current presence, people are utilizing the web in producing mindfulness as far as critical thinking abilities and critical thinking measures. Aside from the web, speaking with others in an efficacious way is additionally viewed as one of the essential methods of enlarging one's information and comprehension regarding critical thinking measures. To give answers for different issues, the critical thinking measures should be completed gainfully (Belgin Bal İncebacak & Esen Ersoy, 2016).

2.6.1.1.1 What is the Problem?

Before placing into activity the critical thinking measures, the people need to direct an investigation of the issue. They should be very much aware as far as the issues. Issues can likewise be opportunities. They may permit the people to see things diversely and to get things done alternately. At times, the issues become boundaries inside the course of the execution of assignments and exercises. Thus, they can be positive just as negative (Güner & Erbay, 2021). At the point when the issues are positive, are opportunities and assist the people with creating the ideal results and upgrade their career possibilities, at that point, the people focus towards the reinforcement of critical thinking abilities and in placing them into activity in a beneficial way (Vantieghem et al., 2020). Then again, when the issues end up being boundaries inside the course of accomplishment of objectives and goals, at that point also measures should be placed into activity to address them. Inside instructive establishments and business settings, when there is an event of issues, the educators and supervisors clarify as far as them (Zoe, 2020).

2.6.1.1.2 What are the Causes of Problems?

Issues happen because of the event of certain components. Henceforth, there are reasons for issues. The people should be very much aware regarding reasons for issues. For example, when students experience issues in schools inside the course of learning academic ideas, they know that these issues can be addressed, when they procure help from their educators, individual students, or family members (Warburton & Torff, 2005). Then again, when there is an event of issues inside the course of the usage of occupation obligations, support and help is gotten from bosses or partners in tackling them. These issues are clear; they are capable by the people on a less continuous or more regular premise. In any case, there is the event of issues seeing someone also (Rombout et al., 2021). These are disillusioning and are unwanted. The people would prefer not to go over these issues. At the point when these issues happen, the people need to lead an investigation of the causes. At the point when the causes are distinguished properly, the people will have the option to strengthen their critical thinking abilities and agreeably put them into activity in the critical thinking measures (Kavenuke et al., 2020).

2.6.1.1.3 What are Possible Alternatives to the Problem?

At the point when alternatives are to be given, one needs to guarantee they are viable and advantageous. After one is very much aware of the issues, they need to put focus on the alternatives. When there is more than one alternative is accessible, the people need to direct their examination and actualize the other options, which are best and helpful. In cases, when the issues are major, there is an association of conversation gatherings also. In the conversation gatherings, there are conversations among the individuals from the associations. They are at different levels in the chain of importance, for example, heads, supervisors, administrators, etc. when the conversation

gatherings might be long, though, in different cases, they might be brief. Consequently, the individuals from the associations need to work determinedly to distinguish the potential other options. Subsequently, distinguishing proof of the potential options in contrast to the issue is one of the basic factors that should be thought about in the usage of critical thinking measures (Güner & Erbay, 2021; Su & Long, 2021).

2.6.1.1.4 Which Alternative Should be Applied?

At the point when the alternatives are multiple, the people need to place into activity dynamic abilities. They need to settle on wise and gainful alternatives regarding making the choice of the other options and placing into activity the most proper one (Limbach & Waugh, 2010). In the understanding of the previous research studies, it is hard for people to determine the most reasonable other option. In such cases, thoughts and proposals are gotten from others also. Especially, in instructive institutions and business settings, support and help are gotten from teachers, directors, managers, associates, and individual students. In such cases, acquiring thoughts and proposals from others is sensible. There are a few tasks and projects, which are done by the people exclusively. In such cases, they need to settle on choices all alone. Regularly, when they are to be tested and supervisors and teachers are placing into activity the assessment techniques, at that point the people need to settle on choices all alone as far as the choice of options. In this way, it tends to be expressed; choosing the most appropriate option is one of the essential variables in the viable usage of the critical thinking measures (Barak et al., 2007; Gallagher et al., 2012).

2.6.1.1.5 Evaluation of the Problem-Solving Methods

Assessment is known as being available to proceeding with criticism and changing strategies in a like manner. After the people have produced mindfulness and are well-equipped regarding techniques and systems to give answers for issues, they

need to assess them. Placing into activity, assessment strategies will help in producing the ideal results and any inconsistencies or limitations will likewise be recognized. The people, in administrative roles, are very much aware as far as different kinds of assessment techniques. They set up as a regular practice these strategies consistently to guarantee that people are doing their tasks and activities in an efficient and good way (Hu et al., 2017).

An assessment of the critical thinking techniques can utilize both, quantitative and subjective information or blended strategies approach. Both these strategies can end up being effective and beneficial and contribute to producing the ideal results. The people, who are engaged in giving answers for the issues need to enlarge their insight and comprehension as far as these techniques (Retnawati et al., 2018). At the point when the issues are major and are affecting the associations and individuals to a huge degree, at that point critical thinking techniques should be placed into activity to address them. Subsequently, it tends to be expressed; assessment of the critical thinking techniques is viewed as one of the vital variables, which should be recognized consistently (Belgin Bal İncebacak & Esen Ersoy, 2016).

Researcher's Analysis about Section 2: Reasoning/Thinking Skills

After reviewing many of the studies about critical thinking and reasoning skills it has been analyzed from the researcher that critical thinking is a device that enhances the thinking and intellectual abilities of an individual. Critical thinking is not only enhanced through science and mathematics problems but also through addressing the general problems with logical reasoning. In the teaching-learning process, teachers must focus on the inquiries that enable students to think deeply and answer logically. Critical thinking was initiated with the Socratic Questions but unfortunately, these Socratic questions are rarely used in the teaching-learning process. Every educational

institution has a mission of producing critical thinkers but lacks having trained teachers with critical thinking skills. Higher-order thinking skills are as much important in the teaching-learning process as other essential components. Teacher education programmes must focus on curricular and co-curricular activities highlighting the importance of logical reasoning and critical thinking skills among students and teachers. While planning for the teaching-learning process teachers should also plan pedagogical activities where logical reasoning can be used effectively. As in the previous section, it was analyzed from the studies that a Cognitive Acceleration teaching approach is an effective approach for the development of reasoning and Cognitive skills among students, so training institutions can arrange training sessions and workshops for teachers to highlight the importance of Cognitive Acceleration teaching approach in the teaching-learning process. They can be trained with different reasoning skills and techniques that can be practiced in the teaching-learning process. It is reviewed from the previous studies that reasoning skills among students cannot be enhanced only with specific exercised or skills but different kinds of activities according to thinking abilities of students can be used to enhance the thinking abilities of students.

Section 3: Pedagogical Content Knowledge and Pedagogical Skills

Teaching can be as more effective as much teachers are trained with latest pedagogical skills and practices. An effective teacher always know what kind of pedagogical techniques can be effectively used to make learning environment interesting and informative for students. Section 3 of the literature review describes the need of pedagogical knowledge and content knowledge among teachers. Let's have a look on the detail of section 3.

The teaching method is regularly confused for curriculum. The instructional method is the connection between learning procedures and culture and is resolved dependent on a teacher's convictions about how learning ought to, and does, happen (Vantieghem et al., 2020). The instructional method requires important classroom connections and regard among teachers and students. Research has indicated that instructors do affect students, as do classroom managements concerning educational programmes and evaluation. Positive pedagogic teacher-student connections are accepted to be important for compelling instructing and figuring out how to happen (Wekerle & Kollar, 2021).

Teaching is a complex, multi-faceted activity, containing both intellectual and passionate agreement. Instructors decide, take part in regular cooperation and use different types of information and abilities to connect with students and encourage their learning (Santos & Castro, 2020). Educators and students are consistently seeing someone. It has been proposed that having a superior comprehension of student-educator educational connections gives numerous bits of knowledge into the pre-service instructor training programmes just as enlistment programmes (Kavanagh et al., 2020)

2.7 Pedagogical Content Knowledge

In the past 20 years, analysts have utilized pedagogical content knowledge to allude to a wide scope of parts of subject matter knowledge and the instructing of subject matter knowledge and have utilized it contrastingly across and even inside branches of knowledge. These analysts refer to pedagogical content knowledge as specific content knowledge and allude to it as the investigation of educator information in manners that take care of the part of the content in instructing. So pedagogical content knowledge is a combination of educator understanding that consolidates content

(topic), teaching method (instructional strategies), and student attributes (Haug & Mork, 2021).

It has been recommended that content knowledge is novel to instructing; a sort of topic explicit expert information. This thought of pedagogical content knowledge has continuous allure as it spans content knowledge and the act of educating. Pedagogical content knowledge is frequently not recognized from different types of educator information (Kavenuke et al., 2020). Educating requires an exceptional sort of content information. Instructing includes telling students the best way to take care of issues, responding to students' inquiries and checking students' work, requests a comprehension of the content of the school educational plan. Instructors do different experiences to help the learning of the students. Instructors should realize the subject they educate as the pedagogical content knowledge is tremendously essential to instructing (Belin & Akar, 2020; Su & Long, 2021).

2.8 The Need for Pedagogical Knowledge in the Teaching Profession

Mastering the information on instructional methods is the ideal preparation for future instructors. There are misconceptions between what an instructor knows and what he does in the classroom. This misconception has a significant impact on how students learn (Wekerle & Kollar, 2021). At the point when it is referred to as instructive information required by an instructor in the classroom, a special combination of content expertise and pedagogical skills is referred to. This blend addresses a specific type of understanding of the content of teaching (Santos & Castro, 2020). For the teaching of any kind of content (philological, numerical, natural, creative, and so on), there is essentially profoundly established information on instructional method in an educator's character. The instructing incorporates both

educational hypotheses instructed during beginning training, too the experience aggregated in everyday educating exercises (Merofio et al., 2021).

Dominating the information on instructional method represents how the educator changes the subject of a researcher discipline in an open type of correspondence with students. To show content, educators must comprehend the subject profoundly and adaptable. Just in this manner will assist students with making their semantic guide, to move to start with one thought then onto the next, or to interface a point with another (Kavanagh et al., 2020; Haug & Mork, 2021).

Researcher's Analysis about Section 3: Pedagogical Content Knowledge and Pedagogical Skills

After reviewing the different studies about PCK and PS researcher has analyzed that without PCK and pedagogical skills no teaching-learning process is completed. An effective and successful teacher has PCK along with subject matter knowledge and uses pedagogical practices effectively according to the nature of the subject, topic, and need of students. Effective pedagogical practices help teachers in continuous professional development and give a chance of improvement in the teaching-learning process. Pedagogical content knowledge helps teachers to deliver content using a variety of teaching methods and learning activities giving students a chance to directly participate in learning. Effective pedagogical practices make a relationship between theory and practice and create meaningful interaction between student and teacher. Practicing effective pedagogical practices can improve the quality of teaching and equip students not only with theory but with pedagogical skills as well. The use of pedagogical practices trains students to tackle the new demands and needs in the teaching-learning process. So it can be said that pedagogical content knowledge is the combination of content and pedagogy that is uniquely constructed by the teachers keeping in view the

students' learning needs, subject demands, and most importantly understanding level of students.

2.9 Research Gap from Previous Findings

Literature shows that many of the studies addressed Cognitive Acceleration from different aspects. A study was carried out by Mousa (2002) to explore the effects of using Adey and Shayer's training program on the achievement and Acceleration of the 1st secondary students' mental development in the Oman Sultanate. The sample of the study was selected from two classes: one of them represented an experimental group of 41 students, while the other represented the control group of 40 students. The results revealed significant differences in favour of the experimental group on abstract thinking and academic achievement.

Mbano (2003) investigated the impact of a Cognitive Acceleration program on the performance of secondary school students in Malawi. The age of the study sample ranged between 16-17 years. The findings showed significant differences in favour of males of the experimental groups in physics, biology, English, and mathematics while female students of the experimental group excelled their peers at the control group in physics only.

Saleh (2005) conducted a study to investigate the effect of a training program of Cognitive Acceleration on Cognitive development among sixth-graders in Gaza. The sample of the study consisted of 331 male and female students distributed into an experimental group of 170 students and a control group of 161 students. The results of the study showed significant differences between the mean scores of the two groups in favour of the experimental group on the Cognitive development scale.

Gallagher (2008) investigated the impact of a teaching program based on Cognitive Acceleration on improving thinking among a sample of 4 to 6-year-old

children. The study sample consisted of 44 participants of a basic school in Ireland; 20 of them represented the experimental group and 24 students represented the control group. The results revealed that the students of the experimental group improved significantly in thinking compared to those of the control group.

Mustafa (2012) conducted another study to investigate the effects of a training program based on Adey and Shayer's Cognitive Acceleration model on developing critical thinking and successful intelligence among a sample of fifth graders in Jordan. The sample of the study consisted of experimental and control groups of 128 male and female students. The results revealed significant differences between the mean scores of students of the experimental and control groups in favour of the experimental group, and they also revealed significant differences on the critical thinking scale between males and females in favour of males. However, the results revealed no significant differences attributed to the gender on the successful intelligence scale.

It is shown from the different findings of the studies that there is a need to research to check the effect of Cognitive Acceleration on the development of prospective teachers. As it is shown from the previous literature that it is not necessary only that a teacher should have reasoning abilities but having pedagogical skills to deliver that reasoning knowledge is necessary for an effective teaching-learning process. Keeping in view the previous findings and gap from the previous researches the study was designed to check the effect of Cognitive Acceleration on the development of prospective teachers' reasoning and pedagogical skills.

2.10 Overview of the Chapter

Teachers today are expected to be equipped with content knowledge and pedagogical content knowledge to cope with 21st-century teaching-learning challenges. Developing reasoning and critical skills among students have become a necessary

component in the teaching-learning process to meet the global demands. Critical thinkers are encouraged to participate in logical discussions and decisions to generate logical information. The Cognitive Acceleration teaching approach allows the teacher to use thinking skills effectively in their teaching-learning process. Cognitive Acceleration enables prospective teachers to train themselves with the latest pedagogical skills needs to be used in 21st-century classrooms. The reasoning is not only thinking logically but also speaking logically, teachers are the focal point for enhancing students' reasoning ability and that can be only enhanced through maximum use of thinking activities. It is not only planning thinking activities but also effectively implementing those thinking activities is also important, so there is also a need to train teachers with effective use of thinking skills. A lot of studies have been reviewed about the Cognitive Acceleration teaching approach which results show a positive effect of thinking lessons on the intellectual development of students. But there is still a need to explore the Cognitive Acceleration teaching approach concerning the teaching-learning process, pedagogical skills, and effect on prospective teachers.

CHAPTER 3

RESEARCH METHODOLOGY

Research methodology is known as the procedure of research systematically designed by a researcher according to the research objectives of the study. This chapter deals with the research design of the study, population, sample and instrumentation, procedure of the experiment, intervention, data collection, and data analysis of the study. The research methodology of the study is written very carefully keeping in mind the main research objectives and procedure of the study. Detail of every phase of research methodology of the study is as follows.

3.1 Research Design

The study was experimental and quantitative. True-experimental pre-test post-test control group design was followed for the study. This research design controls the assignments of subjects to the experimental and control group. It also controls the timing of the independent variable (treatment) and all the conditions under which the experiment takes place. Two groups, the control group, and the experimental group were formed for the experiment. Two pre-tests and post-test were used to check the effect of the Cognitive Acceleration teaching approach on the reasoning and pedagogical skills of prospective teachers. Symbolic representation of the research design is as;

$RO_1 \quad X_1 \quad O_2$

$RO_1 \quad X_2 \quad O_2$

Where R=Randomization, O_1 = pre-test and O_2 =post-test

X_1= Experimental Group

X_2 = Control Group

3.2 Population

The population of the study was all prospective teachers enrolled in the BS Education program in the Department of Education at International Islamic University Islamabad. The population of the study consisted only of female prospective teachers. The total population of the study was 250 enrolled prospective teachers.

Table 3.1

Population size of prospective teachers in the Department of Education at IIUI

Sr. No	Gender	Population
1	Female	250

3.3 Sample and Sampling Technique

As the study was true experimental, so sample of the study was selected through simple random sampling technique. The sample of the study consisted of prospective teachers from the BS Education program studying pedagogical course "Teaching of General Science subject". The sample of the study was 64 prospective teachers from the Department of Education at International Islamic University Islamabad during the Fall 2020 semester and these prospective teachers were from Batch Spring 17 and Spring 18. Key features of the selected prospective teachers were as following;

- Prospective teachers enrolled in BS Education Program
- Prospective teachers studying pedagogical course "Teaching of General Science"
- Prospective teachers who have passed the content courses of "General Science" in the previous semester

3.4 Instrumentation

To collect the data from the control group and experimental group four instruments were used for the study. They were as;

- Classroom Test of Scientific Reasoning (CTSR)
- Pedagogical knowledge test
- Observation Protocol
- Perception Scale

3.4.1 Preparation of Research Instruments

Research instruments of the study were selected and prepared according to the research design and objectives of the study. Instruments were also prepared under the proper guidance of the supervisor and experts to maintain the validity and reliability of each instrument. After the selection and construction of instruments, each instrument was validated through expert opinion, and pilot testing was done to check the reliability of the instrument.

3.4.2 Classroom Test of Scientific Reasoning (CTSR)

To measure the reasoning ability of prospective teachers CTSR (classroom test of scientific reasoning) was used as an instrument of the study. The Classroom Test of Scientific Reasoning (CTSR) 2000, developed by A. E. Lawson, is designed to assess students' scientific literacy and thinking skills. The test measures students' ability to apply aspects of scientific and mathematical reasoning, including analyzing situations, making predictions, and solving problems. As this instrument has open access on the internet, no permission was required to use it for the study. After the thorough study of CTSR, it was felt by the researcher that the language of some statements is difficult for students and some statements are very basic according to university level students. So keeping in view the understanding level of selected prospective teachers some

statements of CTSR were rephrased with simple and clear language and some statements in the form of situational judgments were also added in the CTSR and it was used as a modified version of CTSR in the study. The modified version of CTSR consisted of three main sections including scientific reasoning, conditional reasoning, and situational judgment. CTSR was used for both pre-test and post-test of the study but for the post-test order of the statements was changed. (Attached as APPENDIX I)

3.4.3 Pedagogical knowledge test

To measure the knowledge of pedagogical skills among prospective teachers a pedagogical knowledge test was constructed by the researcher. This test was measuring the knowledge of pedagogical skills through the content of "Teaching of G. Science" being taught during experiment. After the careful and in-depth review of "Teaching of General Science" content a pedagogical knowledge test was developed. The pedagogical knowledge test was consisted of MCQs and short question answers. Content of pedagogical knowledge test was consists of concepts taught from the given outline of Teaching of General Science subject. The validity of the pedagogical knowledge test was also tested through expert opinion. The language of pedagogical knowledge test was simple and easy to understand for prospective teachers. (Attached as APPENDIX II)

3.4.4 Observation Protocol

To observe the pedagogical practices of prospective teachers of the control group and experimental group, a self-developed observation protocol was used by the researcher. Observation protocol was consisted of five main pedagogical practices including planning instruction and designing learning experiences, instructional delivery, classroom management, monitoring, assessment and evaluation, and

professional responsibilities. Pedagogical practices of the prospective teachers were observed on three points rating as;

3 – Meets expectations in all respects

2 - Meets expectations in some respects

1 - Meets expectations in no respects

After the careful construction of the observation protocol, it was validated by expert opinion by selecting the teachers frequently teaching pedagogy subjects. (Attached as APPENDIX III)

3.4.5 Perception of prospective teachers about their learning experiences with Cognitive Acceleration teaching method

A self-developed perception scale was used to find out the prospective teachers' perception about a different perspective of the experiment. This perception scale was used only for the experimental group. Statements of the perception scale were about different activities, content, and tasks performed by prospective teachers and researcher during the experiment. A five-point rating scale was used to rank the perception of prospective teachers. The rating scale was as 1=Never, 2=Seldom, 3=Sometimes, 4=Often, and 5=Always. The perception scale was consisted of 33 statements, and all were related to experiment tasks and activities. (Attached as APPENDIX IV)

3.5 Validity of the Instruments

Validity is known as the degree to which an instrument measures what needs to be measured. The validity of an instrument helps to consequently understand the scores of an instrument. The validity of an instrument is as much important as the reliability of an instrument. If the instrument does not function according to desired objectives/tasks then the instrument is not considered a valid instrument. The validity

of an instrument is measured through content, concurrent, predictive, and construct validity.

Before pilot testing, all four research instruments including CTSR, Pedagogical knowledge test, Observation Protocol, and Perception scale were validated through expert opinion.

To check the validity of the Classroom Test of Scientific Reasoning (CTSR) three experts from the department of education were selected having enough experience of teaching general science. After the feedback and suggestions given by expert opinion on CTSR, certain changes were made in CTSR. These changes were as;

- Rephrased certain statements in easy language for better understanding of students
- Removed some statements according to experts' suggestions as these statements were indicating repetition of concepts
- Changed statements orders to make it simpler and more understandable for students.
- Decided total marks and time for performing the CTSR test.

The pedagogical knowledge test was validated by three experts having enough experience in teaching pedagogy subjects. After expert opinion suggestions and feedback following changes were made in the pedagogical knowledge test.

- Decided total marks and time for performing pedagogical knowledge test.
- Rephrased certain questions according to the understanding level of students.
- Removed some statements as per experts' suggestion

- Reconsidered all questions according to marks and time duration of the test.

Observation protocol was also validated before data collection. Teachers supervising teaching practice students were selected for expert opinions of observation protocol validation. No changes were made in the observation protocol as it was suggested Appropriate by experts.

The validity of the perception scale was also checked through expert opinion from the department of education teachers. In the light of their suggestions certain changes were made in the perception scale as under;

- Revised the rating scale
- Rephrased certain statements according to suggestions
- Certain statements were removed
- Some statements were rewritten into two statements as they were reflecting two concepts in one statement.

3.6 Pilot Testing

After validation of all research instruments, pilot testing was done to check the reliability of the CTSR and Pedagogical knowledge test. For pilot testing, 40 prospective teachers who had studied series of content courses of General Science and pedagogical course of General Science were selected as participants of pilot testing. These participants were from the BS Education program of Department of Education at International Islamic University, and these were from 8th semester but none of them was selected as a participant of the experimental or control group.

3.7 Reliability of Instruments

The reliability of an instrument is as much important as the validity of an instrument. The reliability of an instrument represents whether the instrument is reliable

to collect the data from the sample or not. Reliability is also known as a qualification for constructing a good test. If all items of a test are correlated with each other and have balance item difficulty that test is considered a reliable test. Before data collection reliability of CTSR and pedagogical knowledge test was computed. As both tests were combinations of MCQs and open-ended questions, so for MCQs item analysis was done for both tests by calculating difficulty index and item discrimination for each MSQs. Detail of calculated item discrimination and difficulty index for both tests (CTSR and pedagogical test) is as followed.

Table 3.2

Item Analysis for Classroom Test of Scientific Reasoning (CTSR)

Item #	Difficulty Index	Item Discrimination	Decision
1 (a)	0.51	0.29	Item included in the test
1 (b)	0.31	0.25	Item included in the test
2 (a)	0.26	0.34	Item included in the test
2 (b)	0.21	0.32	Item included in the test
3 (a)	0.31	0.42	Item included in the test
3 (b)	0.26	0.41	Item included in the test

4 (a)	0.36	0.52	Item included in the test
4 (b)	0.29	0.49	Item included in the test
5 (a)	0.39	0.39	Item included in the test
5 (b)	0.31	0.37	Item included in the test
6 (a)	0.41	0.61	Item included in the test
6 (b)	0.39	0.61	Item included in the test
7 (a)	0.31	0.59	Item included in the test
7 (b)	0.29	0.51	Item included in the test
8 (a)	0.38	0.55	Item included in the test
8 (b)	0.31	0.51	Item included in the test
9	0.44	0.41	Item included in the test
10	0.39	0.39	Item included in the test

11	0.71	0.37	Item included in the test
12	0.40	0.32	Item included in the test
13	0.68	0.57	Item included in the test
14	0.61	0.68	Item included in the test
15	0.52	0.69	Item included in the test
16	0.32	0.52	Item included in the test
17	0.36	0.61	Item included in the test

Table 3.3

Item Analysis for Pedagogical knowledge test

Item #	Difficulty Index	Item Discrimination	Decision
1	0.75	0.50	Item included in the test
2	0.51	0.40	Item included in the test
3	0.31	0.26	Item included in the test

4	0.75	0.56	Item included in the test
5	0.26	0.22	Item included in the test
6	0.59	0.45	Item included in the test
7	0.46	0.41	Item included in the test
8	0.71	0.59	Item included in the test
9	0.48	0.42	Item included in the test
10	0.70	0.61	Item included in the test

3.8 Experimental Procedure

3.8.1 Formation of Group

Two groups; the experimental group and control group were formulated by pairing and simple random sampling technique for experiment. Groups were formulated on the basis of pre-test scores.

3.8.1.1 Control Group

The Control group was formulated based on pre-test scores through the random sampling technique. The "Teaching of General Science" subject was taught to the control group by the traditional teaching method. The traditional teaching method for this study was not only focusing on the lectures but was comprised of students' assignments, presentations, and quizzes.

3.8.1.2 Experimental Group

The experimental group for this study was also formulated based on pre-test scores through random sampling. The "Teaching of General Science" subject was taught to the experimental group by Cognitive Acceleration teaching approach. The Cognitive Acceleration teaching approach was comprised of activities, discussions, and presentations of material following reasoning and pedagogical skills concept.

3.8.2 Pre-Test

The pre-test was consisted of two tests; CTSR and the Pedagogical knowledge test. To check the reasoning ability of prospective teachers CTSR (Classroom test of scientific reasoning) was used, whereas pedagogical knowledge test was used to assess the pedagogical skills of prospective teachers. A pedagogical knowledge test was consisted of MCQs and short question answers. Items of pedagogical knowledge test were consisting of the content from the given outline of the "Teaching of General Science" subject.

3.8.3 Treatment

Treatment for the study was formally started after the pretest and formation of the control group and experimental group. The treatment duration for the experimental group was four months (whole semester). The experiment was conducted from September 2020 to December 2020. Details of treatment for the control group and experimental group are as follows.

Table 3.4

Treatment details of experimental group and control group

Experimental Group	Control Group
The Cognitive Acceleration teaching approach was used to teach the	Treatment for the control group was followed with the traditional approach

experimental group. Lesson planning according to Cognitive Acceleration lesson plan steps was done for each lecture. Activities related to reasoning and selected pedagogical skills were also included in the experiment.

The lesson plan of Cognitive Acceleration was based on the following steps;

1. Concrete preparation
2. Cognitive conflict
3. Social construction
4. Meta-cognition
5. Bridging

The procedure for the implementation of the Cognitive Acceleration lesson plan for the experimental group was as under;

1. Concrete preparation of the lesson following proposed steps of the Cognitive Acceleration lesson plan and constituting

of teaching. The traditional approach of teaching was not only focusing upon the lecture but students' assignments, presentations, quizzes, and class participation was also included in the traditional approach. The lesson plan for each control group lecture was prepared following the traditional lesson plan format.

Steps for control group lesson plan were;

1. P.K.Testing
2. Announcement of the topic
3. Presentation
4. Association/ Application
5. Recapitulation
6. Homework

Traditional lesson plans were implemented with the following procedure;

- Used a combination of individual, paired, small group, and whole-class activities.

the different activities to reflect the general idea of the concept. • Preparation of a working paper that included the activities addressing the topic and the Cognitive process that was related to the session. • Providing appropriate support to the students while doing activities. • Focusing the students to ask questions to enhance their thinking process and to clarify their queries to interpret their thinking and control them. • Transferring the knowledge through the Cognitive Acceleration teaching approach. • Arranging different activities to enhance students' selected pedagogical skills. • Strategies including dialogue, discussion, questioning, collaborative work, worksheets, working in groups, and homework were used to implement the Cognitive Acceleration teaching approach.	• Provide opportunities for a range of skills such as discussion, writing, drawing, and viewing. • Consider ways to activate, clarify and extend prior knowledge, and to help students make connections between what they know and what they will be learning. • Make use of diagrams, illustrations, concrete materials, and multimedia technology to explore and illustrate concepts. • Allow students to use computer tools (e.g., M.S. Word, PowerPoint, graphics).

23 lectures for both the control and experimental group were delivered according to the selected approaches (Cognitive Acceleration for experimental and Traditional for

Control group). After 23 lectures, participants of both groups were assessed and compared by the presentation of a model lesson plan on the selected teaching method. An observational sheet for assessing pedagogical practices of the control and experimental group developed by the researcher was used. The observational sheet was also used to compare the pedagogical practices of the control and experimental group to check the effect of the Cognitive Acceleration teaching approach.

3.8.4 Post-Test

After the completion of the experiment, a post-test was conducted for both the experimental group and control group to evaluate the results of the experiment. Post-test was conducted after the completion of model lesson plans presentation by experimental group and control group. This time was given to participants to clear their reasoning and pedagogical skills concepts before attempting the post-tests. The post-test was also consisted of two tests CTSR (Classroom Test of scientific reasoning) for reasoning ability and pedagogical knowledge test for pedagogical skills. The order of both test items was changed in the post-test to avoid the repetition of the same answers from students. Both of the tests were following content in consistency and were not followed with order of difficulty so changing the order of test items didn't affect the difficulty order of items.

3.8.5 Model Lesson Presentations

To assess the pedagogical practices of prospective teachers in practical form, model lesson plans presentations were taken from experimental group and control group. Prospective teachers from the control group and experimental group were asked to select a topic of their own choice and prepare a model lesson plan following a teaching method with suitable A.V.Aids and present it in class. Model lesson presentations of the control group and experimental group prospective teachers were

assessed through a researcher-made observational sheet. Later on, the pedagogical practices of both groups were compared to find out the effect of the Cognitive Acceleration teaching approach on prospective teachers' pedagogical skills and practices. Model lesson presentations were planned after 23 lectures delivered through Cognitive Acceleration teaching approach and traditional approach of teaching.

3.8.6 Perception of Prospective Teachers about Experiment

To explore the perception of experimental group prospective teachers about different aspects of the experiment, a researcher-made perception scale was used. This was the last step of the experimental procedure and perceptions were collected after post-test and model lesson presentations by both the control group and experimental group. Prospective teachers were asked to rate the different tasks and activities performed by them and teacher during the experiment.

3.9 Selection of Instructor for Experimental and Control Group

The researcher herself taught both the control group and experimental group. The researcher's her-self teaching was selected to avoid the personality and teaching experience effects during the experiment, but the researcher also makes sure to avoid biases throughout the experiment.

3.10 Teaching Material for Experimental Group and Control Group

HEC approved outline for Teaching of General Science subject was used to teach control group and experimental group during experiment. The main objectives of teaching this subject are to enable students to;

1. describe the nature & importance of General science
2. understand aims and objectives of teaching of General Science
3. apply effectively the various methods & techniques of teaching General science

4. develop lesson plans for teaching different concepts in General science
5. Prepare and use inexpensive audio-visual aids for the teaching of General science

The outline contains eight chapters and the whole outline was used to teach the control group and experimental group of the study. (Attached as APPENDIX V)

3.11 Development of Lesson Plans

Lesson planning has always been considered an essential component of teaching. Lesson planning gives direction, organization, and consistency in teaching and makes the teacher more confident to deliver information. The lesson plan is also proof of efforts made by a teacher during his/her teaching. The study was conducted to find out the effect of the Cognitive Acceleration teaching approach on the cognitive and pedagogical skills of prospective teachers. As the study was experimental and was focusing on a teaching approach so keeping in mind the main objective of the study lesson plans for the experimental group according to the Cognitive Acceleration teaching approach were made. Lesson plans were made according to the "Teaching of General Science" subject outline and all topics were covered in lesson plans. 23 lesson plans of the Cognitive Acceleration teaching approach were made. All lesson plans were made before starting the experiment and all activities for the experimental group according to reasoning and pedagogical skills were selected before the experiment. Slight changes according to the situation during experiment duration were made in activities. Under the supervision of the supervisor, all lesson plans and learning activities were prepared and were validated by experts having experience in teaching this subject. Detailed lesson plans topics and objectives are given below in table form.

Table 3.5

Detail of Lesson Plans Topics and Objectives

Unit No.	Topic	No. of Lesson Plan	Objectives
01	• Definition and Nature of Science • Relationship of Science with other Subjects	01	Define science Explain the relationship of science with other subjects
01	• Science as a Product: Scientific Knowledge • Science as a Process: Scientific Method	01	Differentiate between science as a product and science as knowledge with suitable examples
02	• Aims and Goals of General Science Teaching • Aims and Objectives of Teaching of General Science	01	Understand the aims of the teaching of general science
02	• Taxonomy of Educational Objectives	01	Construct the learning outcomes according to blooms taxonomy Understand why the construction of learning outcomes is necessary for the teaching-learning process

03	• Standards, Bench Marks and SLO's • Content suggested in National Curriculum for General Science 2009	01	Analyze the national curriculum for General Science 2009
03	• The teaching-learning process and Assessment strategies suggested in National Curriculum for General Science 2009	01	Explain teaching-learning strategies suggested in the curriculum for General Science 2009
04	• Lecture Method • Demonstration Method	01	Implement teaching-learning strategies of lecture method and demonstration method during teaching practice
04	• Activity Method • Laboratory Method	01	Understand the guidelines to be followed while selecting activities for activity and laboratory method
04	• Inquiry Method • Heuristic Method	01	Construct a pedagogical activity following general guidelines of inquiry and heuristic method of teaching
04	• Problem-solving method	01	Organize an activity following problem-solving steps

	• Discovery method		Explain the advantages and disadvantages of the discovery method of teaching
04	• Project method • Assignment method	01	Differentiate process of project method of teaching and assignment method of teaching
08	• Importance of Planning in Teaching • Course planning • Unit planning	01	Explain the importance of course planning and unit planning in the teaching-learning process
08	• Daily Lesson Planning • Qualities of a good lesson Plan • Development of a model Lesson Plan	01	Demonstrate a daily lesson plan
05	• Meaning and concept of teaching techniques & strategies • Difference between method, technique, and teaching strategies	01	Differentiate between method, technique, and teaching strategy

05	• Questioning Techniques • Discussion Techniques	01	Prepare a lesson plan following questioning technique
05	• Analytic and Synthetic Techniques • Discovery and Inquiry Techniques	01	Implement analytic, synthetic, discovery, and inquiry techniques of teaching G. Science for model lesson plan
05	• Laboratory Techniques • Concept mapping and use of advance organizers	01	Reconstruct laboratory techniques of teaching during model lesson plan presentation
06	• Nature and scope of teaching aids • Need for and Importance of teaching aids • Classification of teaching aids	01	Use different types of A.V.Aids for model lesson plan presentations
06	• Principles of using Teaching Aids • Types of teaching aids for general science • Preparations of low-cost Teaching aids	01	Prepare low-cost teaching aids for model lesson plan presentations

06	• Use of ICT in teaching of General Science • Effective use of Teaching aids	01	Use teaching aids effectively for model lesson plan presentations and future teaching
07	• Measurement, Assessment, and Evaluation	01	Differentiate between measure, assessment, and evaluation
07	• Types of Assessment	01	Use suitable assessment techniques for model lesson plan presentation
07	• Test and Rubric Construction	01	Construct a sample test for science subject following test construction guidelines

Lesson plans attached as APPENDIX VII

3.12 Data Collection

The effect of the Cognitive Acceleration teaching approach was checked by;

1. Applying the CTSR before and after the completion of the experiment.
2. Applying the pedagogical knowledge test before and after the completion of the experiment.
3. Using observation protocol to assess the pedagogical practices of prospective teachers of the control group and experiment group.

4. Using perception scale to explore the experiment group perception about different aspects of the experiment including tasks and activities.

3.13 Data Analysis

Collected data were analyzed through descriptive and inferential statistics using SPSS software. The mean score was calculated using descriptive statistics and the t-test was calculated using inferential statistics. The effect size was also calculated by Cohen's d effect size formula. Details of data analysis techniques according to research objectives are as under:

Table 3.6

Summary of Data Analysis

Objective	Research question/hypothesis	Instrument	Data analysis technique
1. **To investigate the effect of the Cognitive Acceleration teaching approach on the reasoning ability of prospective teachers at the university level.**	1. To what extent the Cognitive Acceleration teaching approach affect the reasoning ability of the prospective teachers at the university level?	CTSR (Classroom test of scientific reasoning)	Mean score
2. **To find out the effect of the Cognitive**	2. To what extent the Cognitive Acceleration teaching approach	Pedagogical knowledge test	Mean score

	Acceleration teaching approach on the pedagogical skills of prospective teachers at the university level.	affect the pedagogical skills of the prospective teachers at the university level?		
3.	**To compare the Cognitive Acceleration teaching approach and traditional teaching approach concerning reasoning and pedagogical skills of prospective teachers.**	H_{01}: There is no significant difference between the mean scores on reasoning ability pre-test between the experimental and control group. H_{02}: There is no significant difference between the mean scores on pedagogical skills pre-test between the experimental and control group. H_{03}: There is no significant difference between the mean scores on reasoning ability	CTSR (Classroom test of scientific reasoning) for reasoning ability and Observation Protocol to compare the pedagogical skills of prospective teachers	t-test

	post-test between the experimental and control group. H_{04}: There is no significant difference between the mean scores on pedagogical skills post-test between the experimental and control group.	

Table 3.7

Rubrics for marking CTSR and pedagogical skills pre-test post-test

	Description of students response	Quantification
1.	**CTSR**	
	MCQs	01 Mark
	Situational Judgments	
	1. **Beginning**	01 mark
	2. **Development**	02 marks
	3. **Accomplished**	03 marks
2.	**Pedagogical knowledge test**	
	MCQs	01 mark
	Short questions answers	
	1. **Content**	02 marks
	2. **Organization**	02 marks

3.14 Threats to Internal Validity of the Experiment

The following table shows the internal threats of the experiment and how they were controlled during the experiment.

Table 3.8

Threats to the internal validity of the experiment

S.No.	Threat	How they were controlled
1	**History**	Learning material and learning environment was same for the control and experimental group.
2	**Maturation**	To control this variable, the age group for both the control and experimental group was approximately the same, and the duration of the experiment was one semester only.
3	**Testing**	Two instruments were used in pre-test and post-test and the question order of both instruments was changed after the pre-test to control the effect of the instrument.
4	**Instrumentation**	To control the instrumentation threat, two measuring instruments were used in the study. Only question order was changed for the instrument that was used in both pre and post-tests both. Instruments were carefully administered during the pre and post-test. The same learning environment was selected for pre and post-test. Furthermore, pilot-testing and validation of the instruments were also carried out.

5	**Statistical Regression**	Random selection after pairing was done to control the statistical regression. Formation of groups was done on the scores of the pre-test.
6	**Differential Selection of Participants**	A random selection for both the control and experimental group was done to control this threat. Pairing on the scores of the pre-test also helped to control this threat.
7	**Morality**	Matching and pairing helped to control this threat.
8	**Selection Maturation Interaction**	As the same age group was selected for both the control group and experimental group so selection-maturation interaction threat was also controlled. The experiment was also not too long.

3.15 Threats to External Validity of the Experiment

Table 3.9

Threats to the external validity of the experiment

S.No.	Threat	How they were Controlled
1	**Pre-Test Treatment Interaction**	To control this threat, the scores of the pre-test were not announced to the participants and were kept secret. The score of the pre-test was only used for the formation of the control and experimental group.
2	**Selection-Treatment Interaction**	The selection of participants for the control and experimental group was done randomly by pairing based on pre-test scores.

3	**Multiple-Treatment Inference**	The experimental group had received only one treatment for the four months and had consistency among the activities during the treatment.
4	**Treatment Diffusion**	To control this threat, participants of the control and experimental group were requested not to share any material, activity, or experience of the treatment with each participant of the opposite group.
5	**Experimenter Effects**	The researcher herself taught both groups to control this threat.

3.16 Ethical Considerations

Following ethical considerations were kept in mind during the study;

- All participants of the study were informed before the pre-test and were brief about the purpose of the pre-test
- The confidentiality of participants was kept sustained throughout the study
- The classroom environment was kept the same for both the control group and experimental group

3.17 Chapter Overview

This chapter explains the detailed procedure of the research methodology used for the study. As the study was true experimental, so pre-test post-test control group design was used as a research design of the study. All enrolled prospective teachers in the Department of Education were treated as the population of the study. Two pre-test post-tests were used to assess the reasoning and pedagogical skills knowledge of prospective teachers from the control group and experimental group. Pedagogical skills

were observed through model lesson plan presentations after the completion of lessons. In the end, prospective teachers' perception was also taken about the different activities of the experiment. A detailed description of lesson plans with topics and objectives is also explained in the present chapter. Experimental procedure, development of lesson plans, development of the instrument, its reliability, and validity all are explained in this chapter. Overall this chapter gives a detailed description of the research methodology.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

This chapter deals with data analysis and data interpretation of the study. Data analysis is the last but most important phase of research. The study was aimed to find out the effect of the Cognitive Acceleration teaching approach on the Cognitive and pedagogical skills of prospective teachers. Collected data from pre-test post-test, observation protocol, and perception scale were analyzed through descriptive and inferential statistics. The mean score was calculated to answer the research questions and *a t*-test was applied to test the null hypotheses of the study. Detail of analyzed data is presented in tabulated form as under.

Table 4.1

Mean scores analysis of CTSR pre-test post-test of Experimental group

	Pre-test	**Post-test**
Type of Test	CTSR	CTSR
Total number of participants	32	32
Mean score	12.15	16.00

Table 4.1 shows the analysis of the mean scores of the Classroom test of scientific reasoning (CTSR) for pre-test and post-test of the experimental group. The mean value (12.15) for the CTSR pre-test and (16.00) for the post-test shows that the Cognitive development of the experimental group was enhanced during the Cognitive intervention and they were able to perform better in the CTSR post-test. The difference in mean scores also depicts that there is a difference between Cognitive developments of the experimental group between pre-test and post-test of CTSR.

Table 4.2

Mean scores analysis of Pedagogical skills pre-test post-test of Experimental group

	Pre-test	**Post-test**
Type of Test	Pedagogical knowledge test	Pedagogical knowledge test
Total number of participants	32	32
Mean score	4.75	36.46

Table 4.2 shows the analysis of the mean scores of pedagogical knowledge test for pre-test and post-test of the experimental group. The mean value (4.75) for pre-test and (36.46) for post-test depicts that the pedagogical skills of the experimental group were much developed through experiment. The post-test mean value (36.46) shows that participants of the experimental group were much equipped with pedagogical skills at the end of the treatment as compared to before treatment. So, the Cognitive Acceleration teaching approach enhanced the pedagogical skills of the experimental group.

Table 4.3

Mean scores analysis of CTSR pre-test post-test of Control group

	Pre-test	**Post-test**
Type of Test	CTSR	CTSR
Total number of participants	32	32
Mean score	10.50	10.50

Table 4.3 presents the analysis of the mean scores of CTSR of pre-test post-test for the control group. The mean value for pre-test (10.50) and post-test (10.50) shows that participants of the control group were on the same level of Cognitive development before pre-test and after post-test. They were at the same level of Cognitive abilities as no Cognitive development treat was given to the control group. They were taught with the traditional method of teaching following lectures, activities, and presentations.

Table 4.4

Mean scores analysis of Pedagogical skills pre-test post-test of Control group

	Pre-test	**Post-test**
Type of Test	Pedagogical knowledge test	Pedagogical knowledge test
Total number of participants	32	32
Mean score	4.96	16.62

Table 4.4 presents the analysis of the mean scores of pedagogical knowledge test for pre-test and post-test of the control group. The mean value for pre-test (4.96) and post-test (16.62) depicts that pedagogical skills of participants from the control group were developed after the teaching of G. Science subject for this session. Their pedagogical skills were enhanced by practicing pedagogical activities during the teaching-learning process of the "Teaching of G. Science" subject and in the pedagogical skills post-test, they were able to perform much better as compared to the pre-test.

Table 4.5

Analysis of CTSR pre-test of the control group and experimental group

Type of test	Group	N	Mean	df	t-value	p-value
CTSR pre-test	Experimental	32	2.16	62	.594	.323
	Control	32	10.50			

P = 0.05

Table 4.5 shows the comparative analysis of the Classroom Test of Scientific Reasoning (CTSR) pre-test for the control group and experimental group. P-value (.323) and t-value (.594) analyzed that there is no significant difference between the CTSR pre-test mean scores of the experimental group and control group. Analysis shows that both the control group and experimental group were at the same level of understanding in the performance of the CTSR pre-test so the null hypothesis for the CTSR pre-test was failed to reject. Mean scores analysis for the CTSR pre-test depicts that prospective teachers from the experimental group (12.16) were able to perform better as compared to prospective teachers from the control group (10.50).

Table 4.6

Analysis of CTSR post-test of the control group and experimental group

Type of test	Group	N	Mean	df	t-value	p-value
CTSR	Experimental	32	16.00	6	8.534	.000
post-test	Control	32	10.50	2		

P = 0.05

Table 4.6 highlights the comparative analysis of the Classroom Test of Scientific Reasoning (CTSR) of post-test for the control group and experimental group. According to the p-value (.000) and t-value (8.534), it has been analyzed that there is a significant difference between the post-test performance of the control group and the experimental group. According to the analysis experimental group was much better in CTSR post-test performance than the control group. As the p-value (.000) is less than (0.05) so null hypothesis for the CTSR post-test is rejected and a significant difference is found between both groups. Mean scores analysis of CTSR post-test shows that prospective teachers from the control group (10.50) were are at the same level of understanding as they were in the pre-test whereas prospective teachers from the experimental group (16.00) were at the higher level of understanding in CTSR post-test.

Table 4.7

Analysis of pedagogical knowledge test pre-test of experimental group and control group

Type of test	Group	N	Mean	df	t-value	p-value
Pedagogical	Experimental	32	4.75	62	.372	.711
skills pre-test	Control	32	4.97			

P = 0.05

Table 4.7 presents the comparative analysis for the pedagogical skills pre-test of the control group and experimental group. P-value (.711) and t-value (.372) show that there was no significant difference between pedagogical skills pre-test mean scores of the control group and experimental group. Comparative analysis shows that both the control group and experimental group were at the same level of performance during the pre-test so the null hypothesis for the pedagogical skills pre-test was failed to reject. The mean score (4.97) depicts that prospective teachers from the control group performed slightly better in the pedagogical skills pre-test as compared to prospective teachers from the control group (4.75).

Table 4.8

Analysis of pedagogical knowledge test post-test of experimental group and control group

Type of test	Group	N	Mean	df	t-value	p-value
Pedagogical skills post-test	Experimental	32	36.40	62	17.56	.000
	Control	32	16.63			

P = 0.05

Table 4.8 presents the comparative analysis of pedagogical skills post-test for the control group and experimental group. P-value (.000) and t-value (17.56) analyze that there is a significant difference between means scores for pedagogical skills post-test of the control group and experimental group. According to comparison, it has been analyzed that the experimental group was better in pedagogical skills post-test than the control group. As the p-value (.000) is less than (0.05) so null hypothesis for the pedagogical knowledge test was rejected and a significant difference was found between the mean scores of both groups. Mean scores analysis (36.40) shows that the performance of prospective teachers from the experimental group was better in pedagogical skills post-test performance as compared to prospective teachers from the control group performance (16.63).

Table 4.9

Analysis of effect size of intervention on the experimental group

Type of test	Cohen's d value
CTSR	2.13
Pedagogical knowledge test	4.36

Table 4.9 presents the analysis for the effect size of intervention (experiment) on the reasoning abilities and pedagogical skills of the experimental group. Effect size value for CTSR (2.13) shows that there was a large effect of the Cognitive Acceleration teaching approach on the reasoning abilities of prospective teachers who participated in the intervention of the study. Effect size is decided large as CTSR value (2.13) is greater than (0.8) which is considered the large effect size value of Cohen's d formula. On the other side effect size value for the pedagogical knowledge test (4.36) also shows that there was a large effect of the Cognitive Acceleration teaching approach on the pedagogical knowledge test of prospective teachers who participated in the intervention of the study. As pedagogical knowledge test effect size value (4.36) is also greater than (0.8) effect size value so it also analyzed a large effect size. From the analysis of effect size values, it has been analyzed that the Cognitive Acceleration teaching approach had a large effect on both the reasoning abilities and pedagogical skills of prospective teachers.

Table 4.10

Analysis of Pedagogical Practices of Experimental group and control group

Pedagogical practice	Group	N	Mean	df	t-value	p-value
Planning	Experimental	32	21	3	4.453	.000
	Control	32	7			
Instructional delivery	Experimental	32	48	3	5.320	.000
	Control	32	37			
Classroom	Experimental	32	27	3	5.064	.000
management	Control	32	20			
Monitoring	Experimental	32	16	3	5.137	.000
	Control	32	12			
Professional	Experimental	32	21	3	6.025	.000
responsibilities	Control	32	13			

Table 4.10 highlights the comparative analysis of mean scores for pedagogical practices of the control group and experimental group. t-value (4.453) and p-value (.000) for planning practice analyze that the experimental group was better in planning teaching-learning activities as compared to the control group and a significant difference was found between the planning practice of both the control group and experimental group. Mean value (21) shows that prospective teachers from the experimental group were better in lesson planning practices. t-value (5.320) and p-value (.000) for instructional delivery practice highlights a significant difference between the instructional delivery practice of the control group and the experimental group. Mean scores analysis (48) shows that experimental group participants were better in instructional delivery practice as compared to control group participants. t-value (5.064) and p-value (.000) for classroom management practices show that participants from the experimental group

were much better in classroom management practices as compared to control group participants. So a significant difference was found between the classroom management practices of both the control group and experimental group. Mean score (27) depicts that prospective teachers from the experimental group were able to perform classroom management practices much better than prospective teachers from the control group. t-value (5.137) and p-value (.000) for monitoring practices highlight that prospective teachers from the experimental group were able to perform effective monitoring practices so a significant difference was found between monitoring practices of both the control group and experimental group. Means score analysis for both groups' presents that prospective teachers of the experimental group were good for monitoring practices during lesson plan presentations (16). t-value (6.025) and p-value (.000) for professional responsibilities practices present that prospective teachers from the experimental group were able to perform better as compared to control group prospective teachers so a significant difference was found between professional practices of both the control group and experimental group. The overall analysis of pedagogical practices between the control group and experimental group highlights that prospective teachers from the experimental group were able to perform pedagogical practices more effectively as compared to prospective teachers from the control group. So null hypothesis for pedagogical practices was rejected and a significant difference was found between the performance of the control group and the experimental group.

Table 4.11

Analysis of prospective teachers' perception about the experiment

S. No.	Statement	Mean value	Decision
1	I got motivation from this teaching style	4.28	Agreed at a high level
2	The course content was according to learning needs	4.75	Agreed at a high level
3	The course content was according to my expectations	4.12	Agreed at a high level
4	I have understood all the concepts from this teaching style	4.15	Agreed at a high level
5	A.V.Aids needed for this teaching style were available during the class	3.53	Agreed at a high level
6	I enjoyed all the learning activities during the class	4.18	Agreed at a high level
7	Learning activities were in accordance with the subject	4.75	Agreed at a high level
8	I had enough opportunities during the discussion to interact with my peers	4.12	Agreed at a high level
9	Proper guidance and support was provided during the assigned activities	4.68	Agreed at a high level
10	I got continuous feedback on each activity	3.84	Agreed at a moderate level

11	Enough opportunities were provided to ask the questions during the discussion	4.31	Agreed at a high level
12	I can apply the basic concepts of the subject in my daily life	4.09	Agreed at a high level
13	I had to work harder for this course as compared to other courses	3.96	Agreed at a moderate level
14	The teacher's guidelines for every activity and discussion were clear and understandable	4.71	Agreed at a high level
15	I got encouragement after studying this course	4.31	Agreed at a high level
16	I had support from my peers during the group activity	4.03	Agreed at a high level
17	The material provided for this course was up-to-date and understandable	4.71	Agreed at a high level
18	The support provided by the teacher was enough to understand the material of this course	4.53	Agreed at a high level
19	I preferred to work in group activity rather than individual activity	4.06	Agreed at a high level
20	Activities performed during this course enhanced my reasoning abilities	4.50	Agreed at a high level
21	Activities performed during this course enhanced my pedagogical skills	4.53	Agreed at a high level

22	When a topic was boring, the teacher made it interesting with examples and activities	4.25	Agreed at a high level
23	I studied this course to learn new concepts about effective pedagogical practices	5.00	Agreed at a high level
24	I had access to my teacher during the course whenever I needed	4.18	Agreed at a high level
25	Objectives, of course, were achieved during the course allocated time	4.12	Agreed at a high level
26	Assessment criteria for every task were communicated at the start of the course	4.43	Agreed at a high level
27	Assessment criteria were fair for every student	4.37	Agreed at a high level
29	I enjoyed every activity during the course	4.31	Agreed at a high level
30	I have learned a lot of new skills including reasoning and pedagogical skills	4.65	Agreed at a high level
31	I would prefer the Cognitive Acceleration teaching method for other courses as well	4.31	Agreed at a high level
32	I would like to use this teaching method during my teaching-learning process	4.46	Agreed at a high level

33	I have understood all the materials from this teaching style	4.54	Agreed at a high level

Table 4.11 presents the analysis of the mean scores of the experimental groups' perceptions about different activities of intervention (experiment). The decision for responses was taken according to three decision values decided by the researcher according to rating scale values.

1. 4.00 to 5.00 (Agreed at a high level)
2. 3.99 to 2.00 (Agreed at moderated level)
3. 1.99 and below (Agreed at the lower level)

Means scores analysis for perception statements shows that for the majority of the activities prospective teachers from the experimental group were agreed at the higher level as they were motivated by the Cognitive Acceleration teaching approach. The majority of the prospective teachers were able to understand all the concepts taught from the Cognitive Acceleration teaching approach and they were of the view that all necessary A.V.Aids needed for this teaching approach were available during the experiment. For statement 10 prospective teachers were of the view at a moderate level (3.84) that they get regular feedback about every activity performed during the experiment and for statement 13 they were also agreed at the moderate level (3.96) that it was not difficult for them to prepare this course with extra time or difficulty. For the rest of all statements prospective teachers were agreed at the high level which predicts that they were much satisfied with the Cognitive Acceleration teaching approach, all the activities performed during experiments, teaching method, A.V.Aids used during the experiment, and feedback provided on the activities performed during the experiment.

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary

The main theme of the study was based on the effect of the Cognitive Acceleration teaching approach on the reasoning and pedagogical skills of prospective teachers. According to this teaching approach having subject matter knowledge is not enough for an effective teacher, but an effective teacher must be equipped with reasoning and pedagogical skills to deliver that information. Based on this approach study was designed; a) to investigate the effect of the Cognitive Acceleration teaching approach on the reasoning ability of prospective teachers at the university level, b) to find out the effect of the Cognitive Acceleration teaching approach on the pedagogical skills and practices of prospective teachers at university level and c) to compare the Cognitive Acceleration teaching approach and traditional teaching approach with respect to reasoning ability and pedagogical skills and practices of prospective teachers. Objectives 1 and 2 were followed with the research questions whereas null hypotheses were tested for objective 3. True experimental pre-test post-test control group design was followed for the study. The target population of the study was comprised of all BS Education prospective teachers enrolled in the department of education at International Islamic University, Islamabad. Keeping in view the research design of the study sample of the study was BS Education prospective teachers studying "Teaching of G. Science" subject and the sample size was 64 prospective teachers and sample for the control group and experimental group was selected randomly after pre-test. As the study was experimental so before data collection, two groups control group and the experimental group was formed based on pre-test scores and after that control group was taught

through the traditional teaching approach, and the experimental group was taught through the Cognitive Acceleration teaching approach. After the completion of the experiment, data were collected through the Classroom Test of Scientific Reasoning (CTSR), Pedagogical knowledge test, and Observation protocol and perception scale. Collected data were analyzed by calculating mean scores to answer the research questions and by applying t-test to test null hypotheses for reasoning ability and pedagogical skills.

5.2 Findings

Findings from mean scores analysis and comparative analysis are presented below.

1. It was found from the analysis of the mean scores of CTSR pre-test (12.15) post-test (16.00) for the experimental group that prospective teachers from the experimental group were able to perform better in the post-test than pre-test and Cognitive Acceleration teaching approach enhanced their reasoning ability. (Table 4.1)
2. It was found from the analysis of the mean scores of pedagogical knowledge test pre-test (4.75) and post-test (36.46) for the experimental group that the Cognitive Acceleration teaching approach has a great positive effect on the pedagogical skills of prospective teachers and they were able to perform much better in post-test than pre-test. (Table 4.2)
3. It was found from the analysis of the mean scores of CTSR pre-test (10.50) and post-test (10.50) for the control group that prospective teachers from the control group were at the same level during pre-test and post-test and reasoning was not enhanced throughout the semester activities. (Table 4.3)

4. It was found from the analysis of the mean scores of pedagogical knowledge test pre-test (4.96) and post-test (16.62) for the control group that prospective teachers from the control group were able to perform better in post-test than pre-test and their pedagogical skills were enhanced during semester activities. (Table 4.4)
5. Results of the comparative analysis indicated that the p-value (.323) for the CTSR pre-test is greater than (0.05) so the null hypothesis is failed to reject that there is no significant difference between mean scores on reasoning ability pre-test of the control group and experimental group. (Table 4.5)
6. Comparative analysis showed that the p-value (.000) for CTSR post-test is less than (0.05) so the null hypothesis is rejected that there is no significant difference between mean scores on reasoning ability post-test of the control group and experimental group. (Table 4.6)
7. It was found from the comparative analysis that the p-value (.711) for pedagogical skills pre-test is higher than (0.05) so the null hypothesis was failed to reject that there is no significant difference between means scores on pedagogical skills pre-test of the control group and experimental group. (Table 4.7)
8. Analysis showed that the p-value (.000) for pedagogical skills post-test is less than (0.05) which shows that the null hypothesis was rejected that there is no significant difference between mean scores on pedagogical skills post-test of the control group and experimental group. (Table 4.8)
9. It was found that Cohen's d value for CTSR (2.13) is larger than (0.08) that depicts the Cognitive Acceleration teaching approach had a large effect on the reasoning ability of prospective teachers. (Table 4.9)

10. It was found from Cohen's d value for pedagogical knowledge test (4.36) is larger than (0.08) which shows that the Cognitive Acceleration teaching approach had a large effect on the pedagogical skills of prospective teachers. (Table 4.9)
11. Comparative analysis for planning pedagogical practices showed that the p-value (.000) is less than (0.05) so there is a significant difference between the planning instruction practices of the control group and the experimental group. (Table 4.10)
12. Comparative analysis for instructional delivery pedagogical practices showed that the p-value (.000) is less than (0.05) so there is a significant difference between instructional delivery practices of the control group and experimental group. (Table 4.10)
13. Comparative analysis for classroom management pedagogical practices showed that the p-value (.000) is less than (0.05) so there is a significant difference between classroom management practices of the control group and experimental group. (Table 4.10)
14. Comparative analysis for monitoring pedagogical practices showed that p-value (.000) is less than (0.05) so there is a significant difference between monitoring practices of the control group and experimental group. (Table 4.10)
15. Comparative analysis for professional responsibilities pedagogical practices showed that p-value (.000) is less than (0.05) so there is a significant difference between professional responsibilities practices of the control group and experimental group. (Table 4.10)

16. It was found from the analysis of the mean scores that prospective teachers from the experimental group were agreed at the higher level (4.75) that the content taught them during the experiment was according to the need of the course.
17. It was found from the analysis of the mean scores that prospective teachers from the experimental group were agreed at the higher level (4.75) that learning activities performed during experiment duration were in accordance with the course content.
18. It was found from the analysis of the mean scores that prospective teachers from the experimental group were agreed at the higher level (4.71) that guidelines provided for every activity were clear and understandable for them.
19. It was found from the analysis of the mean scores that prospective teachers from the experimental group were agreed at the higher level (5.00) that all of the participants studied the "Teaching of G. Science" subject to learn new concepts about effective pedagogical practices.
20. It was found from the analysis of the mean scores that prospective teachers from the experimental group were agreed at the higher level (4.65) that prospective teachers learned many new reasoning and pedagogical skills with the help of performed activities during the experiment.

5.3 Discussion

Logical and critical reasoning abilities enable students to understand the concepts logically and enhance the ability of students to understand the meaning, information, and implications of a concept critically. Pedagogical skills enable teachers to deliver subject matter knowledge effectively and well thought pedagogical practices also improve the quality teaching-learning process. The Cognitive Acceleration

teaching approach aims to enhance students' general Cognitive functioning to think beyond the results by practicing thinking activities.

The results of the study indicate that the Cognitive Acceleration teaching approach has a significant effect on the reasoning ability of students which are in line with the results of (Warburton & Torff, 2005; Magno, 2010; Martinez, 2006; Mousa, 2002; Mbano, 2003; Saleh, 2005; Gallagher, 2008; Mustafa; 2012). The study also found significant means scores difference between post-test scores of the control group and experimental group for reasoning abilities which are supported by (Warburton & Torff, 2005; Magno, 2010; Martinez, 2006; Mousa, 2002; Mbano, 2003; Saleh, 2005; Gallagher, 2008; Mustafa; 2012).

Results of the study inferred that prospective teachers from the experimental group have improved their thinking skills through Cognitive Acceleration lessons and rate Cognitive Acceleration teaching approach as a mode of thinking critically within the classroom which are in line with the results of (Paul & Elder, 2005; Moon, 2008 and Paul, Elder & Bartell, 1997).

As the findings of the study indicate that Cognitive Acceleration teaching approach has a significant effect on the reasoning and pedagogical skills development of prospective teachers which are also in the support of (Howley & Shamblen, 2001; Amusan, 2014) so as a recommendation there is a need to train the in-service teachers or Cognitive Acceleration teaching approach at the university level. To implement the Cognitive Acceleration teaching approach at university-level teacher training institution can disseminate information regarding the effectiveness of Cognitive Acceleration teaching approach to change the teachers' perception about teaching methodologies; sources can be provided to higher education institutions for proper

professional development of prospective teachers and in-service teachers for critical thinking approach.

Findings of the study revealed that effective use of critical thinking activities has a significant effect on the Cognitive functioning of prospective teachers which are in agreement with (Okpala & Ellis, 2005; Amusan, 2014). So as a result of the study higher education institutions can adopt the Cognitive Acceleration teaching approach in their maximum classroom with effective critical thinking activities. Teachers' training or workshop sessions can be arranged to guide the teachers about effective use of critical thinking activities with good time-management skills.

Pre-test scores of the study for reasoning abilities and pedagogical skills revealed that all prospective teachers from the control group and experimental group were at the same level of understanding whereas post-test scores showed a significant positive difference among the control group and experimental group prospective teachers which highlight the effectiveness of Cognitive Acceleration teaching approach at the university level so these study findings can be treated as a pilot study at university level and more classroom can be observed with Cognitive Acceleration teaching approach to guarantee the effectiveness of Cognitive Acceleration teaching approach for reasoning and pedagogical skills development of prospective teachers.

The study finds out that having subject matter knowledge along with pedagogical skills is necessary for the effective teaching-learning process which is in support of (Schwartz & Gess-Newsome; 2008) that teachers with subject specialization are more consistent to effective use of content with demanding pedagogical skills. So the importance of subject matter knowledge cannot be ignored in the Cognitive Acceleration teaching approach because those teachers who are specialists in subject matter knowledge are also better at topic-related pedagogical skills.

Findings of the study also indicate that proper use of instructional time also has a significant effect on the pedagogical skills development of prospective teachers that are in agreement with (Amusan, 2014) that teachers having proper lesson plans are more likely to use instructional time effectively as compared to those who don't have lesson planning. So as recommendation teachers at the university level can be trained to construct effective Cognitive Acceleration teaching approach lesson plans with effective activities for the better use of instructional time.

The experiment of study revealed that for an effective teaching-learning process a relationship between content knowledge and pedagogical skills is important which is also supported by (Appleton & Harrison, 2001; Amusan, 2014). So prospective teachers in teacher education programmes must be treated in a way they can build a relationship between their content knowledge and pedagogical skills. Academic activities can be arranged in a way that can depict the best use of content knowledge and pedagogical skills.

Observational analysis of the study highlights that prospective teachers who have learned through Cognitive Acceleration teaching approach are more successful in performing the thinking activities as compared to prospective teachers learned through traditional teaching approach, these findings are in the support of Cognitive Acceleration teaching approach principles which bring about Acceleration for the development of thinking.

To sum up, bringing a change in the teaching-learning approach with respect to reasoning development and pedagogical development is necessary for every teacher education program. It requires time effort in terms of resources, teachers' training, faculty willingness, students' motivation but nothing is impossible for a quality teaching-learning process. Moreover, there is not a single activity that can be

appropriate for critical thinking development, but different types of activities according to sources, learning level of students, and learning environment can be used to enhance the critical thinking abilities of students. Teacher education institutions can arrange different training sessions for equip teachers with effective use of reasoning and pedagogical skills. Future researchers can conduct different researches by highlighting the effectiveness of reasoning skills and pedagogical skills among prospective teachers. Future researchers can also focus to conduct experimental research to explore the effectiveness of reasoning skills and pedagogical skills among prospective teachers.

5.4 Conclusions

Based on findings it has been concluded that;

1. CTSR Pre-test analysis showed that the majority of the prospective teachers were unable to answer correctly for most of the scientific reasoning statements.
2. Pedagogical skills pre-test analysis showed that the majority of the prospective teachers were at the beginning phase of answering pedagogical answers.
3. CTSR post-test analysis showed that most of the prospective teachers from the experimental group were able to perform better in scientific reasoning statements.
4. Pedagogical skills post-test analysis showed that the majority of prospective teachers from the experimental group were able to effectively organize the content while answering pedagogical questions.
5. The Cognitive Acceleration teaching approach has a significant effect on the development of the reasoning ability of prospective teachers at the university level.

6. The Cognitive Acceleration teaching approach has a significant effect on the development of pedagogical skills of prospective teachers at the university level.
7. No significant difference was found between the pre-test mean scores on the reasoning ability of the control group and the experimental group.
8. No significant difference was found between the pre-test mean scores on pedagogical skills of the control group and the experimental group.
9. A statistically significant positive difference was found between the post-test mean scores on the reasoning ability of the control group and the experimental group.
10. A statistically significant positive difference was found between the post-test mean scores on pedagogical skills of the control group and the experimental group.
11. A significant difference was found between the observational analysis mean scores on planning practices of the control group and experimental group during model lesson plan presentation.
12. A significant difference was found between the observational analysis mean scores on instructional delivery practices of the control group and the experimental group during model lesson plan presentation.
13. A significant difference was found between the observational analysis mean scores on classroom management practices of the control group and experimental group during model lesson plan presentation.
14. A significant difference was found between the observational analysis mean scores on monitoring practices of the control group and the experimental group during model lesson plan presentation.

15. A significant difference was found between the observational analysis mean scores on professional practices of the control group and experimental group during model lesson plan presentation.
16. Analysis of perceptions analyzed that majority of the prospective teachers from the experimental group were satisfied with the Cognitive Acceleration teaching approach, activities performed during the experiment, and A.V. Aids used by the researcher during the experiment.
17. Perception analysis displayed that majority of prospective teachers from the experimental group found Cognitive Acceleration teaching approach as an effective learning approach and willing to use this teaching approach in their future teaching practices.

5.5 Recommendations

Based on findings of the study from the experiment, observational analysis and students' perception following recommendations have been drawn.

1. Analysis of findings shows that the Cognitive Acceleration teaching approach has a significant effect on reasoning abilities and pedagogical skills development of prospective teachers, so it is recommended that there is a dire need to adopt Cognitive Acceleration teaching approach at the university level to enhance reasoning and pedagogical skills of prospective teachers.
2. It is found from the study that prospective teachers from the experimental group performed better in model lesson plan presentations as compared to prospective teachers from the control group, so it is recommended that in-service teachers at the university level might be trained with the necessity of being skilled with reasoning ability and pedagogical skills at the university level.

3. It is found that the Cognitive Acceleration teaching approach has a significant effect on the pedagogical skills development of prospective teachers so teacher education programmes at higher education might focus on the implementation of the Cognitive Acceleration teaching approach with logical reasoning activities, question-answer sessions, and discussion activities.
4. Analysis of students' perception found that prospective teachers shown interest towards critical thinking activities in Cognitive Acceleration classroom, so workshops or training sessions might be arranged by training institutions to equip teachers with a Cognitive Acceleration teaching approach.

5.6 Recommendations for Future Researches

For future researchers it has been recommended that;

1. This study was conducted in the education department of International Islamic University Islamabad, whereas a future study by selecting prospective teachers from any other university can also be conducted.
2. This study was conducted by choosing the "Teaching of G. Science" subject, a future study by choosing any other pedagogical subject can also be conducted.
3. Prospective teachers for this study were selected from the BS Education program; a future study by choosing prospective teachers from B.Ed. program can also be conducted.

References

Adey, P. (1997). It all depends on the context, doesn't it? Searching for general, educable dragons. *Studies in Science Education, 29*(1), 45–92. https://doi.org/10.1080/03057269708560093

Adey, P. (1999). The Science of Thinking and Science for Thinking: A Description of Cognitive Acceleration Through Science Education (CASE). *Innodata Monographs 2.*, 1–40.

Adey, P., & Shayer, M. (1994). *Really raising standards: Cognitive intervention and academic achievement.* 222.

Adey, P. (2003). Changing minds. *Educational and child psychology, 20*(2), 19–30.

Adey, P., Hewitt, G., Hewitt, J., & Landau, N. (2004). *The professional development of teachers: Practice and theory.* Dordrecht, The Netherlands: Kluwer.

Anderson, O. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* New York, NY: Longman.

Ahmad, S., & Mustafa, Y. (2014). *The Effects of a Cognitive Acceleration Training Program on Developing the Emotional Intelligence among a Jordanian Sample of Sixth Graders. 5*(21), 165–176.

Amusan, M. A. (2014). *Instructional time, teacher quality and subject specialization as determinants of pupils' achievement in basic science and technology in Ogun State primary schools* (Unpublished doctoral thesis). University of Ibadan, Ibadan, Nigeria.

Appleton, K., & Harrison, A. (2001). *Outcomes-based science units that enhance primary and secondary science teachers' PCK.* Paper presented at the

Australian Association for Research in Education (AARE) Conference, Fremantle, Western Australia.

Baker, M., Rudd, R., & Pomeroy, C. (2001). Relationships between Critical and Creative Thinking. *Journal of Southern Agricultural Education Research, 51*(1), 173–188.

Barak, M., Ben-Chaim, D., & Zoller, U. (2007). Purposely Teaching for the Promotion of Higher-order Thinking Skills: A Case of Critical Thinking. *Research in Science Education, 37,* 353–369. http://online.sfsu.edu/jcps/Springer_sample article_references.pdf

Belgin Bal İncebacak, & Esen Ersoy. (2016). Problem Solving Skills of Secondary School Students. *China-USA Business Review, 15*(6). https://doi.org/10.17265/1537-1514/2016.06.002

Belin, M., & Akar, G. K. (2020). The effect of quantitative reasoning on prospective mathematics teachers' proof comprehension: The case of real numbers. *Journal of Mathematical Behavior, 57.* https://doi.org/10.1016/j.jmathb.2020.100757

Bowell, T. & Kemp, G. (2015). *Critical thinking: a concise guide*. Routledge Publications

Bjorklund, D. F. (2011). *Children's thinking: Cognitive development and individual differences.* New York: Wards worth Publishing.

Endler, L. C., & Bond, T. G. (2014). *Development with the Rasch Model : Empirical Evidence of Growth and Heterogeneity. January 2006.*

Epstein, H. T. (1986). Stages in human brain development. *Developmental Brain Research, 30*(1), 114–119. https://doi.org/10.1016/0165-3806(86)90139-2

Gallagher, C., Hipkins, R., & Zohar, A. (2012). Positioning thinking within national curriculum and assessment systems: Perspectives from Israel, New Zealand and

Northern Ireland. *Thinking Skills and Creativity*, *7*(2), 134–143. https://doi.org/10.1016/j.tsc.2012.04.005

Gallagher, A. (2008). *Developing thinking with four and five year old pupils: The impact of a Cognitive Acceleration program through early science skill development.* Master thesis, Dublin City University.

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior*, *68*, 441–449. https://doi.org/10.1016/j.chb.2016.11.057

Güner, P., & Erbay, H. N. (2021). Prospective mathematics teachers' thinking styles and problem-solving skills. *Thinking Skills and Creativity*, *40*, 100827. https://doi.org/10.1016/j.tsc.2021.100827

Hall, E., Hall, E., Science, S., Science, S., Unit, R., & Unit, R. (2007). Learning skills and the development of learning capabilities. *Review Literature And Arts Of The Americas*, *1501*, 1–46. https://eppi.ioe.ac.uk/cms/LinkClick.aspx?fileticket=aHg9U0gU0q0%3D&tabid=1852&mid=3614

Haug, B. S., & Mork, S. M. (2021). Taking 21st century skills from vision to classroom: What teachers highlight as supportive professional development in the light of new demands from educational reforms. *Teaching and Teacher Education*, *100*. https://doi.org/10.1016/j.tate.2021.103286

Hooda, M., & Devi, A. (2018). *Development of Reasoning Ability and Barriers among Students*. *November*.

Hu, B. Y., Fan, X., Yang, Y., & Neitzel, J. (2017). Chinese preschool teachers' knowledge and practice of teacher-child interactions: The mediating role of

teachers' beliefs about children. *Teaching and Teacher Education, 63*, 137–147. https://doi.org/10.1016/j.tate.2016.12.014

Hudspeth, W. J., & Pribram, K. H. (1990). Stages of Brain and Cognitive Maturation. *Journal of Educational Psychology, 82*(4), 881–884. https://doi.org/10.1037/0022-0663.82.4.881

Hugerat, M., Najami, N., & Abbasi, M. (n.d.). *The Cognitive Acceleration Curriculum As A Tool For Overcoming Difficulties In The Implementation Of Inquiry Skills In Science Education Among Primary School Students*. 523–534.

Howley, C., Howley, A., & Shamblen, S. (2001). Riding the school bus: A study of the rural versus suburban experience in five states. *Journal of Research in Rural Education, 17*(1), 41–61.

Iqbal, H. M., & Shayer, M. (2000). Accelerating the development of formal thinking in Pakistan secondary school students: Achievement effects and professional development issues. *Journal of Research in Science Teaching, 37*(3), 259–274. https://doi.org/10.1002/(SICI)1098-2736(200003)37:3<259::AID-TEA3>3.0.CO;2-W

Iqbal, H. M., & Shayer, M. (1995). Distribution of Piagetian Cognitive levels in middle school students and its match with science curricula. *Bulletin of Educational Research, XVII-XVIII* (1, 2).

Jackson, S. (1965). the Growth of Logical Thinking in Normal and Subnormal Children. *The British Journal of Educational Psychology, 35*, 255–258. https://doi.org/10.1111/j.2044-8279.1965.tb01811.x

Johnson, J. S. & Newport, E. L. (1993). Critical periods in second language learning: the influence of maturational state on the acquisition of English as a second

language. In M. H. Johnson (Ed.) *Brain development and cognition.* Oxford: Blackwell.

Jones, M., & Gott, R. (1998). Cognitive Acceleration through science education: Alternative perspectives. *International Journal of Science Education, 20*(7), 755–768. https://doi.org/10.1080/0950069980200701

Kozulin, A. (2003). Psychological tools and mediated learning. In Kozulin, A., Gindis, B., Ageyev, V. S. & Miller, S. M. (Eds.) *Vygotsky's educational theory in cultural context* (pp. 15-38). Cambridge: Cambridge University Press.

Kanari, Z., & Millar, R. (2004). Reasoning from data: How students collect and interpret data in science investigations. *Journal of Research in Science Teaching, 41*(7), 748–769. https://doi.org/10.1002/tea.20020

Krogh, L. & Thomsen, P. V. (2001). Teaching style and learning outcomes. *Proceedings of GIREP-conference: Physics Teacher Education Beyond 2000,* 257-260.

Kavanagh, S. S., Conrad, J., & Dagogo-Jack, S. (2020). From rote to reasoned: Examining the role of pedagogical reasoning in practice-based teacher education. *Teaching and Teacher Education, 89.* https://doi.org/10.1016/j.tate.2019.102991

Kavenuke, P. S., Kinyota, M., & Kayombo, J. J. (2020). The critical thinking skills of prospective teachers: Investigating their systematicity, self-confidence and scepticism. *Thinking Skills and Creativity, 37.* https://doi.org/10.1016/j.tsc.2020.100677

Limbach, B., & Waugh, W. (2010). Developing higher level thinking. *Journal of Instructional Pedagogies,* 9. https://aabri.com/manuscripts/09423.pdf

Lovell, K. (1961). A follow up of Inhelder and Piaget's *The Growth of Logical Thinking. British Journal of Educational Psychology, 52(2),* 143-153.

Lawson, A. E. (1995). Science Teaching and The Development of Thinking. Wadsword Publishing Company, Belmont, California.

Mousa, M. (2002). The effectiveness of Adey and Shayer's program on Physics achievement and the Acceleration of Cognitive development of 1st secondary student's in Oman Sultanate. *The 6th Scientific Conference for Education and Society Culture: The Egyptian Association of Scientific Education, Cairo,* 28-31 July, 2002, V (1), 51-87.

Mbano, N. (2003). The effects of a Cognitive Acceleration Intervention Programmes on the performance of secondary school pupils in Malawi. *International Journal of Science Education,* 25: 71-87.

Mustafa, S. A. (2012). The impact of a training program of Cognitive Acceleration on developing critical thinking and successful intelligence among a Jordanian sample of 5th graders. *Unpublished PhD Dissertation,* the University of Jordan, Amman, Jordan.

Magno, C. (2010). *The role of metaCognitive skills in developing critical thinking, Metacognition Learning,* 5, 137–156.

Martinez, M. E. (2006). *What is metacognition*? Phi Delta Kappan, 696–699.

Moon, J.(2008). *Critical Thinking: An exploration of theory and practice*. Routledge, New York.

McCormack, L. (2009). *Cognitive Acceleration across the primary-second level transition. July.* http://doras.dcu.ie/14886/

MCEETYA Ministerial Council on Education, & Training and Youth Affairs. (2008). retrieved from http://www.mceecdya.edu.au/verve/resource/nationaldeclarationontheeducationalgoalsforyoungaustralians.pdf

Mercer, N. (2010). The analysis of classroom talk: Methods and methodologies. *British Journal of Educational Psychology, 80*(1), 1–14. https://doi.org/10.1348/000709909X479853

Merofio, L., Calderón, A., & Arias-Estero, J. L. (2021). Digital pedagogy and cooperative learning: Effect on the technological pedagogical content knowledge and academic achievement of pre-service teachers. *Revista de Psicodidáctica (English Ed.), 26*(1), 53–61. https://doi.org/10.1016/j.psicoe.2020.10.002

Mokhtar, M. Z., Tarmizi, R. ., Ayub, A. F. M., & Nawawi, M, D, H. (2013). Motivation and Performance In Learning Calculus Through Problem-Based Learning. *International Journal of Asian Social Science, 3*(9), 1999–2005.

Moore, N., O'Donnell, J., & Poirier, D. (2012). *Using Cognitive Acceleration Materials to Develop Pre-Service Teachers' Reasoning and Pedagogical Expertise. 1*, 1–12.

Mumcu, H. Y. (2017). *European Journal of Education Studies An Analysis Of The Reasoning Skills Of Pre-Service*. https://doi.org/10.5281/zenodo.495700

Murawski, L. M. (2012). *Critical Thinking in the Classroom ... and Beyond.*

Nugraha, A. C., Retnawati, H., & Hadi, S. (2016). Vocational High School Teachers' Difficulties in Implementing the Assessment in Curriculum 2013 in Yogyakarta Province of Indonesia. *International Journal of Instruction, 9*(1), 34–48.

Okpala, C. O., & Ellis, R. (2005). The perceptions of college students on teacher quality: A focus on teacher qualifications. *Education, 126*(2), 374–383.

Orlich, D., Harder, R., Callahan, R., Trevisan, M., & Brown, A. (2010). *Teaching strategies: A guide to effective instruction.* Boston, MA: Wadstworth.

Oehrtman, M. & Lawson, A. E. (2008). Connecting Science and Mathematics: The Nature of Proof and Disproof in Science and Mathematics. International Journal of Science and Mathematics Education, 6(2):377-403

OECD. (2005).*The definition and selection of key competencies: Executive summary.* Retrieved from; http://www.deseco.admin.ch/bfs/deseco/en/index/02.parsys.43469.downloadList.2296.DownloadFile.tmp/2005.dskcexecutivesummary.en.pdf

Physics, W. S. (2012). *Reasoning Ability and Cognitive Acceleration.* 1–5.

Paul, R. W. & Edler, E. (2002). *Critical Thinking: Tools for taking charge of your professional and personal life.* New York: Pearson Education, Inc.

Park J. & Han, S. (2002). Using Deductive Reasoning to Promote The Change Of Students' Conceptions About Force and Motion. International Journal of Science Education, 24 (6): 593-609.

Paul, R. & Elder, L. (2005) *Critical thinking: tools for taking charge of your learning and your life.* Pearson/Prentice Hall.

Paul, R. W., Elder, L., & Bartell, T. (1997). *California Teacher Preparation for Instruction in Critical Thinking: Research Findings and Policy Recommendations.* Sacramento, CA: California Commission on Teacher Credentialing.

Purnomo, Y. W. (2017). The complex relationship between teachers' mathematics-related beliefs and their practices in mathematics class. *New Educational Review, 47* (1), 200–210. doi:10.15804/ tner.2017.47.1.16.

Quamruzzaman, A., Rodríguez, J. M. M., Heymann, J., Kaufman, J. S., & Nandi, A. (2014). Are tuition-free primary education policies associated with lower infant and neonatal mortality in low and middle-income countries? *Social Science & Medicine, 120,* 153–159. doi:10.1016/j.socscimed.2014.09.016.

Retnawati, H., Yogyakarta, U. N., Djidu, H., & Kartianom, K. (2018). *TEACHERS ' KNOWLEDGE ABOUT HIGHER-ORDER THINKING SKILLS AND. April 2019.*

https://doi.org/10.33225/pec/18.76.215

Rocksén, M. (n.d.). *Reasoning in a Science Classroom* (Vol. 7).

Rombout, F., Schuitema, J. A., & Volman, M. L. L. (2021). Teachers' implementation and evaluation of design principles for value-loaded critical thinking. *International Journal of Educational Research, 106*. https://doi.org/10.1016/j.ijer.2021.101731

Santos, J., & Castro, R. D. R. (2020). Technological Pedagogical Content Knowledge (TPACK) in Action: Application of Learning in the Classroom by Pre-Service Teachers (PST). *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3661054

Shayer, M., Küchemann, D. E., & Wylam, H. (1976). the Distribution of Piagetian Stages of Thinking in British Middle and Secondary School Children. *British Journal of Educational Psychology, 46*(2), 164–173. https://doi.org/10.1111/j.2044-8279.1976.tb02308.x

Scott, L. A. (2017). *21st century skills early learning framework.* Partnership for 21st Century Skill (P21). Retrieved from http://www.p21.org/storage/documents/EarlyLearning_Framework/P21_ELF_ Framework_Final.pdf.

Stylianides, G., & Stylianides, G. (2007). Investigating the guidance offered to teachers in curriculum materials: the case of proof in mathematics. *International Journal of Science and Mathematics Education, 6*, 191–215.

Su, G., & Long, T. (2021). Is the Text-Based Cognitive Tool More Effective Than the Concept Map on Improving the Pre-Service Teachers' Argumentation Skills? *Thinking Skills and Creativity, 41*, 100862. https://doi.org/10.1016/j.tsc.2021.100862

Shayer, M. and Adey, P. (2002). *Learning Intelligence: Cognitive Acceleration across the curriculum from 5-15 years.* Open University Press.

Serret, N. (2004). Leaping into unknown: Developing thinking in the primary science classroom. *Primary Science Review*, n82 p8-11.

Saleh, A. S. (2005). A proposed program for Cognitive Acceleration in Mathematics among 6th graders in Gaza Governorate. *Unpublished Master thesis*, Al-Azhar University, Gaza, Palestine.

Schwartz, R. S., & Gess-Newsome, J. (2008). Elementary science specialists: A pilot study of current models and a call for participation in the research. *Science Educator, 17*(2), 19–30.

Tudge, J. (1993). *Vygotsky, the zone of proximal development and peer collaboration: Implications for classroom practice.* In L. C. Moll (Ed.), Vygotsky andEducation: Instructional Implications and Applications of Socio historical Psychology (pp. 155–172). Cambridge, UK: Cambridge University Press.

Türkmen, H. (2006). How Should Science Be Taught by Using Learning Cycle Approach in Elementary Schools? Elemantary Education Online, 5(2): 1-15

Thompson, T. (2008). Mathematics teachers' interpretation of higher-order thinking in Bloom's taxonomy. *International Electronic Journal of Mathematics Education, 3*, 96–109. http://www.iejme.com/022008/d2.pdf

Vidergor, H. E., & Krupnik-Gottlieb, M. (2015). High order thinking, problem based and project- based learning in blended learning environments. In H. E. Vidergor & C. R. Harris (Eds.), *Applied Practice for Educators of Gifted and Able Learners* (pp. 217–232). Rotterdam: Sense Publishers. doi:10.1007/978-94-6300-004-8_11.

Vantieghem, W., Roose, I., Gheyssens, E., Griful-Freixenet, J., Keppens, K.,

Vanderlinde, R., Struyven, K., & Van Avermaet, P. (2020). Professional vision of inclusive classrooms: A validation of teachers' reasoning on differentiated instruction and teacher-student interactions. *Studies in Educational Evaluation, 67*. https://doi.org/10.1016/j.stueduc.2020.100912

Venville, G., & Oliver, M. (2015). The impact of a Cognitive Acceleration programmes in science on students in an academically selective high school. *Thinking Skills and Creativity, 15*, 48–60. https://doi.org/10.1016/j.tsc.2014.11.004

Warburton, E., & Torff, B. (2005). The effect of perceived learner advantages on teachers' beliefs about critical-thinking activities. *Journal of Teacher Education, 56*(1), 24–33. https://doi.org/10.1177/0022487104272056

Wekerle, C., & Kollar, I. (2021). Fostering pre-service teachers' situation-specific technological pedagogical knowledge – Does learning by mapping and learning from worked examples help? *Computers in Human Behavior, 115*. https://doi.org/10.1016/j.chb.2020.106617

Zehra, A., & Garisson, D. R. (2011). Understanding Cognitive presence in an online and blended community of inquiry: Assessing outcomes and processes for deep approaches to learning. *British Journal of Educational Technology, 42*(2), 233–250.

Zoe, B. (2020). 6 Ways to Enhance Your Problem Solving Skills Effectively. Retrieved July 12, 2020 from lifehack.org

APPENDIX - I

CLASSROOM TEST OF SCIENTIFIC REASONING

(MODIFIED)

Directions to Students:

This is a test just to check the reasoning ability. It will not affect your classroom teaching learning or your grades in this course. It's being used for research purpose only.

Make a dark circle on the answer sheet for the best answer for each item. If you do not fully understand what is being asked in an item, please ask the test administrator for clarification.

DO NOT GUESS WILDLY. Think and answer

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

Write your last name only _____

Your age: _____

Degree Program: _____

Semester: _____

Today's date: month/day/year _____

Test Duration: 45 minutes

Section I: Scientific Reasoning

This section consists upon 8 statements. Each statement has two parts, in the first part you have to select the correct statement and in the second part you have to give the reason of selecting the particular statement.

Read the statement carefully and select the correct statement by giving the logical reason given in the options.

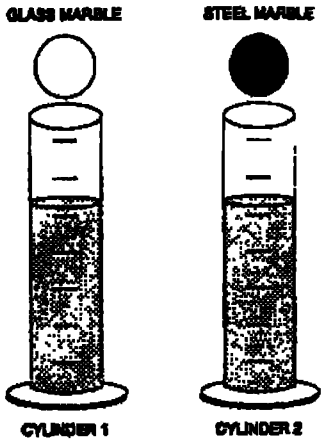
1. Suppose you have two clay balls which are equal in size and shape and they are also same in size but one ball is flattened into a pancake shape. Which of the following statement would be correct about the clay balls?
    a) The pancake-shaped piece weighs more than the ball
    b) The two pieces still weigh the same
    c) The ball weighs more than the pancake-shaped piece

    Because

    a) The flattened piece covers a larger area.
    b) The ball pushes down more on one spot.
    c) When something is flattened it loses weight.
    d) Clay has not been added or taken away.
    e) When something is flattened it gains weight.

****

2. On the right side there are drawings of the two cylinders which are filled with water at the same level. Cylinders are same in size and shape. There are also two marbles on the cylinders one is of steel and one is of glass and both marbles are same in size but steel marble is heavier than the glass marble.
When the glass marble is to be put into the Cylinder 1 the water rises to the 6th mark.
If we put the steel marble into the cylinder 2, the water will rise;



    a) to the same level as it did in Cylinder 1
    b) to a higher level than it did in Cylinder 1
    c) to a lower level than it did in Cylinder 1

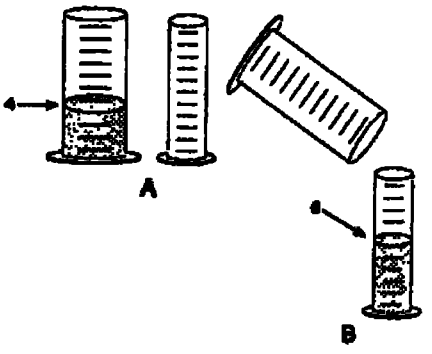
    Because

    a) The steel marble will sink faster.

b) The marbles are made of different materials.
c) The steel marble is heavier than the glass marble.
d) The glass marble creates less pressure.
e) The marbles are the same size.

****

3. On the right side drawings of narrow and wide cylinders are given. Cylinders are marked at equal space. In Cylinder A (wider) the water is filled up to the 4th mark. If we put same water into the Cylinder B (narrow) it rises to the 6th marks. Suppose both cylinders are empty and water is poured into the wide cylinder up to the 6th mark.



If we pour same water into the narrow cylinder how high would this rise?

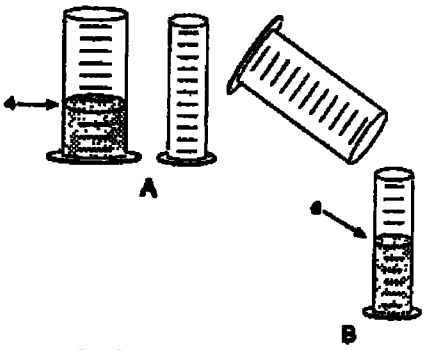
a) to about 8
b) to about 9
c) to about 10
d) to about 12
e) none of these answers are correct

Because

a) The answer cannot be determined with the information given.
b) It went up 2 more before, so it will go up 2 more again.
c) It goes up 3 in the narrow for every 2 in the wide.
d) The second cylinder is narrower.
e) One must actually pour the water and observe to find out.

****

4. If water is poured into the narrow cylinder up to 11th mark. If we pour the same water in empty wide cylinder how high would this rise?



a) to about 7 1/2
b) to about 9
c) to about 8
d) to about 7 1/3
e) none of these answers is correct

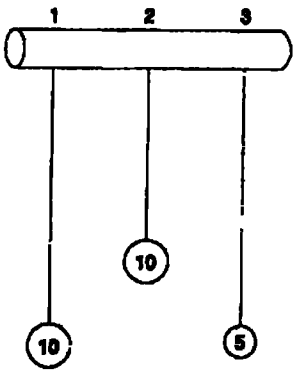
Because

a) The ratios must stay the same.
b) One must actually pour the water and observe to find out.
c) The answer cannot be determined with the information given.
d) It was 2 less before so it will be 2 less again.
e) You subtract 2 from the wide for every 3 from the narrow.

****

*

5. On the right side there is a drawing of threes strings that are hanging from a bar. Metal weights are also attached to the end of three strings. String 1 and string 3 are same in the length, but string 2 is shorter. String 1 and string 2 have 10 unit weights at the end but string 3 has a 5 unit weight at the end. All the strings can be flapped and timings can be noticed.



Suppose you want to find out whether the length of the string has an effect on the time it takes to swing back and forth. **Which strings would you use to find out?**

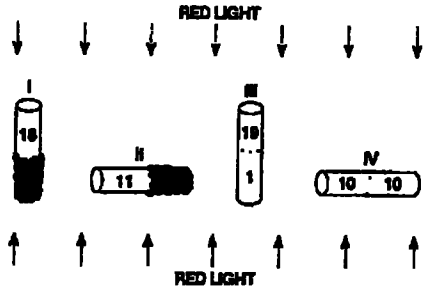
a. only one string
b. all three strings
c. 2 and 3
d. 1 and 3
e. 1 and 2

Because

a) You must use the longest strings.
b) You must compare strings with both light and heavy weights.
c) Only the lengths differ.
d) To make all possible comparisons.
e) The weights differ.

****

6. Below is the drawing of 4 glass tubes and 20 fruit flies are placed in each of 4 glass tubes. All the tubes are sealed and fruit flies cannot come out. Tube I and Tube II are partially covered but Tube III and IV are not covered. The Tubes are placed in the same



direction as shown in Figure.

After placing them in direction red light is exposed for 5 minutes. The number of flies is shown in the uncovered part of each tube. It is shown from experiment that flies move away from;

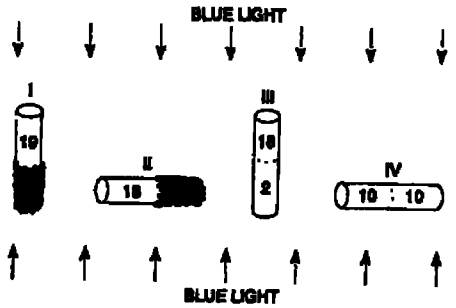
a) red light but not gravity
b) gravity but not red light
c) both red light and gravity
d) neither red light nor gravity

Because

a) Most flies are in the upper end of Tube III but spread about evenly in Tube II.
b) Most flies did not go to the bottom of Tubes I and III.
c) The flies need light to see and must fly against gravity.
d) The majority of flies are in the upper ends and in the lighted ends of the tubes.
e) Some flies are in both ends of each tube.

****

7. Now in the next experiment different light and flies were used. The results are shown in the drawing below.



These data show that these flies respond to (respond means move to or away from):

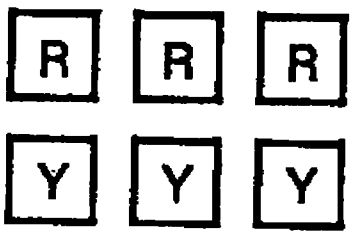
a) blue light but not gravity
b) gravity but not blue light
c) both blue light and gravity
d) neither blue light nor gravity

Because

a) Some flies are in both ends of each tube.
b) The flies need light to see and must fly against gravity.
c) The flies are spread about evenly in Tube IV and in the upper end of Tube III.
d) Most flies are placed in the lighted end of Tube II but do not go down in Tubes I and III.
e) Most flies are in the upper end of Tube I and the lighted end of Tube II.

****

8. Six square pieces of wood are packed into a cloth bag and mixed well. All pieces are similar in size and shape but different in color. Three pieces are red and three pieces are yellow.



Suppose someone has got the bag without looking at the pieces and pulls out one piece. What are the chances that piece is red?

a) 1 chance out of 6

b) 1 chance out of 3
c) 1 chance out of 2
d) 1 chance out of 1
e) cannot be determined

Because

a) 3 out of 6 pieces are red.
b) There is no way to tell which piece will be picked.
c) Only 1 piece of the 6 in the bag is picked.
d) All 6 pieces are identical in size and shape.
e) Only 1 red piece can be picked out of the 3 red pieces.

****

Section II: Conditional Reasoning

This section consists of 6 statements. You are given one or more sentences, think about and decide whether is true or not? There are three possible answers. This is what they mean:

A. YES: It must be true.

B. NO: It can't be true.

C. MAYBE: It may be true or it may not be true. You weren't told enough to be certain whether it is "YES" or "NO".

1. Suppose you know that

   The sparrow is over the hawk. Then would this be true?

   The hawk is over the sparrow.

   a. YES
   b. NO
   c. MAY BE

2. Suppose you know that

   Ali is standing near Usman. Then would this be true?

   Usman is standing near Ali.

   a. YES
   b. NO
   c. MAY BE

3. Suppose you know that

   Islamabad is near Rawalpindi. Then would this be true?

   Rawalpindi is near Islamabad.

   a. YES
   b. NO
   c. MAY BE

4. Suppose you know that

   X is next to Y. Then would this be true?

   Y is next to X.

   a. YES
   b. NO

c. MAY BE

5. Suppose you know that

   Harry is on the football team only if he has his mother's permission.

   Harry is on the football team. Then would this be true?

   Harry has his mother's permission.

   a. YES

   b. NO

   c. MAY BE

6. Suppose you know that

   Fatima is in the kitchen only if there is food in the kitchen.

   There is no food in the kitchen. Then would this be true?

   Fatima is in the kitchen.

   a. YES

   b. NO

   c. MAY BE

Section III: Situational Judgement

This section consists upon 7 statements. In this section your ability to analyze a situation will be judged. You are given with different situations with conclusions, select the best answer according to the given directions.

1. In a one day cricket match, the total runs made by a team were 200. Out of these 160 runs were made by spinners.

   Conclusions:

I. 80% of the team consists of spinners.

II. The opening batsmen were spinners.

   A. Only conclusion I follows
   B. Only conclusion II follows
   C. Either I or II follows
   D. Neither I nor II follows
   E. Both I and II follow

****

2. Government has spoiled many top ranking financial institutions by appointing bureaucrats as Directors of these institutions.

   Conclusions:

   I. Government should appoint Directors of the financial institutes taking into consideration the expertise of the person in the area of finance.
   II. The Director of the financial institute should have expertise commensurate with the financial work carried out by the institute.

      A. Only conclusion I follows
      B. Only conclusion II follows
      C. Either I or II follows
      D. Neither I nor II follows
      E. Both I and II follow

****

3. Habit of reading newspaper in decreasing among students nowadays, even in households without a TV. As a result there has been an alarming decline in the extent of readership of newspapers.

   Conclusions:

   I. Method of increasing the readership of newspapers should be devised.
   II. A team of experts should be sent to other countries to study the impact of TV on the readership of newspapers.

      A. Only conclusion I follows
      B. Only conclusion II follows
      C. Either I or II follows
      D. Neither I nor II follows
      E. Both I and II follow

Section IV: Situational Judgement

1. Suppose you are teaching to class five. You have assigned an activity to the class and all students are busy in that activity. Suddenly you noticed that one student "Fatima" is not focusing on the activity and disturbing to other students. Fatima is a bright student and her behavior is not acceptable in this situation. What will you do that "Fatima" starts doing her activity instead of disturbing others.

2. Today you come with a detailed lesson plan including activities, but students ask for a game period because they have no mood to study. What do you think it would be better to teach them in this situation?

3. Suppose you are teaching "Science" to class 10^{th}. You have planned a group activity to enhance the communication skills of the students. All students are divided into group of 4 students each. But there are two students who are not comfortable for working in group activity. What strategy you would use to solve this problem?

APPENDIX-II

Pedagogical knowledge test

Write your last name only _____

Your age: _____

Degree Program: _____

Semester: _____

Today's date: month/day/year _____

Test Duration: 45 minutes

Directions:

- Carefully read the questions
- Be clear and precise while writing your answer
- If you don't know answer of any question, go ahead for next question
- Make sure your answer is readable
- If you left with time at the end of the test go back to the questions you left out
- Don't worry about marks, this test will not affect your classroom learning and grades for this course

Section I: This sections contains MCQs about different teaching methods. Read the statement carefully and encircle the correct answer. Do remember you have to select only 1 option from the possible given option.

1. **In which teaching method there is one-way communication?**
    a. Inquiry method
    b. Lecture method
    c. Lecture-cum-discussion method
    d. Activity method
2. **Two types of assignments can be used in**
    a. Inquiry method
    b. Lecture method
    c. Assignment method
    d. Lecture-cum-discussion method
3. **Which teaching method can be used for the larger number of students?**
    a. Inquiry method
    b. Assignment method
    c. Lecture-cum-discussion method
    d. Activity method
4. **In activity method of teaching the role of a teachers is as**
    a. Authority
    b. Lecturer
    c. Invigilator
    d. Facilitator

5. **How many activities can be arranged during activity method of teaching?**
    a. Five
    b. Three
    c. Six
    d. Two
6. **Which step of laboratory method involves the orientation and motivation of students?**
    a. Introductory step
    b. Actual work period
    c. Culminating activities
    d. Following the safety tips
7. **Inquiry-based learning is a form of**
    a. Inquiry learning
    b. Active learning
    c. Passive learning
    d. Scientific learning
8. **Which of following is NOT the objective of problem solving method?**
    a. Developing ability of problem solving among students
    b. Developing ability of logical interpretation among students
    c. Developing ability of solving problems in systematic manner among students
    d. Developing ability of memorizing material from the note books among students
9. **It requires active problem solving by students in finding patterns in the information through their own investigation and analysis.**
    Which teaching method is indicated by the above statement?
    a. Lecture method
    b. Demonstration method
    c. Activity based method
    d. Inquiry method
10. **Teacher is delivering a lecture on "Nature of Science". All the students are listening to teacher without asking any question. Teacher ends the lecture and give them an assignment as homework and leave the class.**
    Which teaching method was used by the teacher?
    a. Demonstration method
    b. Lecture method
    c. Inquiry method
    d. Laboratory method

Section II: certain questions are asked in this section. Briefly write the answers in the given space. If you don't know the answer of any question leave and go ahead to next question.

1. Make two full SLOs of knowledge level of Cognitive domain with the given verbs.

   (i) Define

   _____

   (ii) Recall

   _____

2. Briefly state the steps followed in the construction of lesson plan

   _____

   _____

   _____

   _____

3. Mention two situations in which lecture method is more effective than other teaching methods

(i)_____

_____

(ii)_____

_____

4. If two consecutive periods are not available for discussion method, which strategy would you use to follow the discussion method

_____

_____

_____

_____

5. Mention any three salient principles in the use of Audio Visual Aids

(i)_____

(ii)_____

(iii) _____

6. Other than writing, for what purpose a chalkboard can be used

_____

_____

_____

_____

7. List out any two important aspects related to the teaching process in which evaluation is needed

(i) _____

_____

(ii) _____

_____

8. Enlist the steps of concept mapping

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX-III

OBSERVATION PROTOCOL TO ASSESS THE PEDAGOGICAL SKILLS OF PROSPECTIVE TEACHERS

Prospective Teacher Name: _____ **Date:** _____

Time: _____ **Class Duration:** _____

Subject: _____ **Topic:** _____

Teaching method: _____

3 – Meets expectations in all respects
2 - meets expectations in some respects
1 - meets expectations in few or no respects

Statements	**1**	**2**	**3**
Planning Instruction and Designing Learning Experiences			
1. Detailed lesson plan was prepared/documented for class.			
2. Lesson plan was designed according to students' background, interest and learning needs			
3. Objectives of the lesson were written clearly and precisely			
4. Proper teaching method was selected according to the nature of the topic			
5. Instructional activity and materials for students were selected			
6. Assessment technique was selected to assess the students' learning			
7. Lesson plan was prepared according to the objectives of the lesson.			
8. A.V.Aids were selected according to the nature of the topic.			
Instructional Delivery			
1. Students' previous knowledge was checked to connect with the topic and learning goals			
2. Information was Communicated effectively and demonstrated enthusiasm during delivery			
3. Demonstrated respect for students and care about their learning			
4. Responded effectively to student questions			
5. Engaged students and facilitated discussion in class			

6. Effectively used active and collaborative learning techniques (e.g. group work or teams)			
7. Used technology effectively to enhance student learning			
8. Explained major/minor points with clarity.			
9. Defined unfamiliar terms, concepts, and principles			
10. Used good examples to clarify points			
11. Writes key terms on white board			
12. Engages students in problem solving, critical thinking and other activities to make subject matter meaningful			
13. Explained the steps/procedure of activity			
14. Helped the students where they face difficulty during activity			
15. Reviewed main points of lesson at the end			
16. Teaching technique was according to the objectives of the lesson.			
17. Use verbal, non-verbal and written communication skills during teaching.			
18. Learner-centered teaching was preferred			
Classroom Management			
1. Provided efficient student access to class materials (notes, readings, assignments, quizzes, etc.)			
2. Created a welcome learning environment that challenged and supported students			
3. Recognized and appropriately managed any kind of rudeness			
4. carefully listened student comments and questions			
5. Asked questions to monitor student understanding			
6. Waited sufficient time for students to answer questions.			
7. Restated questions and answers when necessary.			
8. Created a physical environment to engage all the students in learning			
9. Established and maintained standards for student behavior			
10. Used instructional time effectively			
Monitoring, Assessment and Evaluation			
1. Assessed students to check their understanding about topic			
2. Provided wait time (02 to 05 seconds) to students to answer a question asked by teacher			
3. Assessed all students of a class			

4. Provided feedback to students on their performance			
5. Feedback was clear i.e., understandable for audience			
6. Proper assessment techniques was used according to the objectives of lesson			
Professional Responsibilities			
1. Call students by name			
2. Treat students with respect			
3. Every student can ask questions/ give comments			
4. Teacher's voice was audible at the back of class			
5. Attentively listen to students' comments/questions			
6. Guide students about their difficulties			
7. Use body language, gestures and emotions according to the needs of classroom.			
8. Friendly and respectful to the students.			

APPENDIX-IV

PERCEPTION OF PROSPECTIVE TEACHERS ABOUT THEIR LEARNING EXPERIENCES WITH COGNITIVE ACCELERATION TEACHING METHOD

This rating scale asks you about your experiences of "Teaching of Science-A" subject through Cognitive Acceleration Teaching method. Please read the statements carefully and rate the statement according to your best responses. Remember it is only a perception about your experiences it will not affect your grades for this subject.

1= Never, 2= Seldom, 3= Sometimes, 4=Often, 5= Always

S. No.	Statement	1	2	3	4	5
1	I got motivation from this teaching style					
2	The course content was according to learning needs					
3	The course content was according to my expectations					
4	I have understood all the concepts from this teaching style					
5	A.V.Aids needed for this teaching style were available during the class					
6	I enjoyed all learning activities during the class					
7	Learning activities were in accordance with the subject					
8	I had enough opportunities during discussion to interact with my peers					
9	Proper guidance and support was provided during the assigned activities					
10	I got continuous feedback on each activity					
11	Enough opportunities were provided to ask the questions during discussion					
12	I have ability to apply the basic concepts of subject in my daily life					
13	I had to work harder for this course as compared to other courses					
14	Teacher's guidelines for every activity and discussion were clear and understandable					
15	I got encouragement after studying this course					
16	I had support from my peers during the group activity					

17	Material provided for this course was up-to-date and understandable					
18	The support provided by teacher was enough to understand the material of this course					
19	I preferred to work in group activity rather than individual activity					
20	Activities performed during this course enhanced my reasoning abilities					
21	Activities performed during this course enhanced my pedagogical skills					
22	When a topic was boring, teacher made it interesting with examples and activities					
23	I studied this course to learn new concepts about effective pedagogical practices					
24	I had access to my teacher during the course whenever I needed					
25	Objectives of course were achieved during the course allocated time					
26	Assessment criteria for every task was clearly communicated in the start of the course					
27	Assessment criteria was fair for every student					
29	I enjoyed every activity during the course					
30	I have learned a lot of new skills including reasoning and pedagogical skills					
31	I would prefer Cognitive Acceleration teaching method for other courses as well					
32	I would like to use this teaching method during my teaching learning process					
33	I have understood all the materials from this teaching style					

APPENDIX-V

COURSE OUTLINE

COURSE TITLE: Teaching of General Science- A

Level: BS Education

Course Code: ED-041 A

Credit Hours: 3

INTRODUCTION

This course **Teaching of General Science- A & B** has been developed for BS-Education 4year Program of the University which is being offered to the students with effect from Spring, 2016 semester. General Science is a compulsory subject in school curriculum. The teaching methods and techniques of teaching General Science are different from teaching other subjects. Therefore this course is designed to equip prospective teachers for teaching General Science. The content of the course gives some over view of nature and importance of General Science. The main focus of the content is on teaching methods, techniques and skills for teaching of general science in classroom. It further gives hands on experience for lesson planning for effective delivery of the content of General Science during class.Course on general science B alsoaddresses the practical aspects of General Science i.e lab and lab techniques

LEARNING OUTCOMES OF THE COURSE

After studying the course the students will be able to;

1. describe the nature & importance of General science;
2. understand aims and objectives of teaching of General Science
3. apply effectively the various methods & techniques of teaching General science;
4. develop lesson plans for teaching different concepts in General science;
5. Prepare and use inexpensive audio visual aids for teaching of General science.

COURSE OUTLINES

UNIT 01 Nature of General Science

1.1 Definition & Nature of Science

1.2 Importance of General Science in everyday life & economic development

1.3 Relationship of General Science with other subjects

1.4 Science as a product: Scientific Knowledge

1.5 Science as a process: Scientific Method

UNIT 02 Aims and Objectives of Teaching of General Science

2.1 Aims & Goals of General Science Teaching

2.2 Taxonomy of Educational Objectives

2.3 Aims/Objectives of teaching of General Science

UNIT 03 Introduction of National Curriculum 2006 of General Science

3.1 Standards, Bench Marks and SLO's

3.2 Contents suggested in National Curriculum 2006

3.3 Methodologies suggested in National Curriculum 2006

3.4 Lab activities suggested in National Curriculum 2006

3.5 Assessment strategies suggested in National Curriculum 2006

UNIT 04 Methods of Teaching General Science

4.1 Lecture Method

4.2 Demonstration method

4.3 Activity Method

4.4 Laboratory method

4.5 Inquiry method

4.6 Heuristic method

4.7 Problem solving

4.8 Discovery method

4.9 Project method

4.10 Assignment method

UNIT 05 Techniques and Strategies of Teaching of General Science

5,1 Meaning & Concept of teaching techniques & strategies

5.2 Difference between method, technique and teaching strategies

5.3 Questioning techniques

5.4 Discussion techniques

5.5 Analytic and synthetic techniques

5.6 Discovery and inquiry techniques

5.7 Laboratory techniques

5.8 Concept mapping & use of advance organizers

UNIT 06 Audio Visual Aids in Teaching of General Science

6.1 Nature & scope of teaching aids

6.2 Need & Importance of teaching aids

6.3 Classification of teaching aids

6,4 Principles of using Teaching Aids

6.5 Types of Teaching Aids for General Science

6.6 Preparations of low cost Teaching Aids

6.7 Use of ICT in teaching of General Science

6.8 Effective use of teaching aids

UNIT 07 Measurements and Assessment in General Science

7.1 Measurement, Assessment and Evaluation

7.2 Types of Assessment

Formative assessment

Summative assessment

7.3 Test and rubric construction

UNIT 08 Planning General Science for Learning

8.1 Importance of planning in teaching

8.2 Course Planning

83 Unit Planning

8.4 Daily Lesson Planning

8.5 Qualities of a good lesson plan

8.6 Development of model lesson plan

Books Recommended

1. Arends, R.I. (2007) Learning to Teach (7th Edition, McGraw Hill International Edition). Boston: McGraw Hill
2. Bloom.B.S *et al* (1956). Taxonomy of Educational Objectives, New York Mckay Co.
3. Borich, D. Gray (2013) Effective Teaching Methods: Research-Based Practice (8th Edition) 8th Edition. New York. Pearson.

4. David, M. (1997).Teaching Skills in Further and Adult Education, London, Guilds.
5. Josh, S. R. (2005). Teaching of Science, New Dehli, A.P.H Publishing Corporation.
6. Lawson, Anton. E. (1995). "*Science teaching and development of thinking*". California: Wadsworth publishing company
7. Moner, M. (1995). Learning to Teach Science, London, Faimer Press.
8. Rahman, Z.(2004).*Modern teaching methods and techniques*. NewDelhi: Anmol publications.
9. Rashid, M. (2005). Allied Material on Teaching Strategies, Course Code: 846 (M.A Education), AIOU, Islamabad
10. Rehman Mehmooda (1999). "*Teaching of science and mathematics*". Peshawar: Ijaz printer, Pakistan

APPENDIX-VI

COURSE PLANNER
(EXPERIMENTAL GROUP)

Course Outline

International Islamic University Islamabad
Department of Education

Course Title: Teaching of General Science-A	**Course Code: ED-041 A**
Program: BS 4th	**Batch:**
Teacher Name: Ms. Memoona Bibi	
Email address: memoona.bibi@yahoo.com	

INTRODUCTION

This course Teaching of General Science-A and B has been developed for BS-Education 4year Program of the University which is being offered to the students with effect from Spring, 2016 semester. General Science is a compulsory subject in school curriculum. The teaching methods and techniques of teaching General Science are different from teaching other subjects. Therefore this course is designed to equip prospective teachers for teaching General Science. The content of the course gives some over view of nature and importance of General Science. The main focus of the content is on teaching methods, techniques and skills for teaching of general science in classroom. It further gives hands on experience for lesson planning for effective delivery of the content of General Science during class. Course on general science B also addresses the practical aspects of General Science i.e. lab and lab techniques.

LEARNING OUTCOMES OF THE COURSE

After studying the course the students will be able to;

6. describe the nature & importance of General science;
7. understand aims and objectives of teaching of General Science
8. apply effectively the various methods & techniques of teaching General science;
9. develop lesson plans for teaching different concepts in General science;
10. Prepare and use inexpensive audio visual aids for teaching of General science.

COURSE OUTLINES

UNIT 01 Nature of General Science

Definition & Nature of Science

1.2 Importance of General Science in everyday life & economic development

1.3 Relationship of General Science with other subjects

1.4 Science as a product: Scientific Knowledge
1.5 Science as a process: Scientific Method

UNIT 02 Aims and Objectives of Teaching of General Science

2.1 Aims & Goals of General Science Teaching
2.2 Taxonomy of Educational Objectives
2.3 Aims/Objectives of teaching of General Science

UNIT 03 Introduction of National Curriculum 2006 of General Science

3.6 Standards, Bench Marks and SLO's
3.7 Contents suggested in National Curriculum 2006
3.8 Methodologies suggested in National Curriculum 2006
3.9 Lab activities suggested in National Curriculum 2006
3.10 Assessment strategies suggested in National Curriculum 2006

UNIT 04 Methods of Teaching General Science

4.1 Lecture Method
4.2 Demonstration method
4.3 Activity Method
4.4 Laboratory method
4.5 Inquiry method
4.6 Heuristic method
4.7 Problem solving
4.8 Discovery method
4.9 Project method
4.10 Assignment method

UNIT 05 Techniques and Strategies of Teaching of General Science

5.1 Meaning & Concept of teaching techniques & strategies
5.2 Difference between method, technique and teaching strategies
5.3 Questioning techniques
5.4 Discussion techniques
5.5 Analytic and synthetic techniques
5.6 Discovery and inquiry techniques
5.7 Laboratory techniques
5.8 Concept mapping & use of advance organizers

UNIT 06 Audio Visual Aids in Teaching of General Science

6.1 Nature & scope of teaching aids
6.2 Need & Importance of teaching aids
6.3 Classification of teaching aids
6.4 Principles of using Teaching Aids
6.5 Types of Teaching Aids for General Science
6.6 Preparations of low cost Teaching Aids
6.7 Use of ICT in teaching of General Science
6.8 Effective use of teaching aids

UNIT 07 Measurements and Assessment in General Science

- 7.1 Measurement, Assessment and Evaluation
- 7.2 Types of Assessment
  - Formative assessment
  - Summative assessment
- 7.3 Test and rubric construction

UNIT 08 Planning General Science for Learning

- 8.1 Importance of planning in teaching
- 8.2 Course Planning
- 83 Unit Planning
- 8.4 Daily Lesson Planning
- 8.5 Qualities of a good lesson plan
- 8.6 Development of model lesson plan

Books Recommenced

11. Arends, R.I. (2007) Learning to Teach (7th Edition, McGraw Hill International Edition). Boston: McGraw Hill
12. Bloom.B.S *et al* (1956). Taxonomy of Educational Objectives, New York Mckay Co.
13. Borich, D. Gray (2013) Effective Teaching Methods: Research-Based Practice (8th Edition) 8th Edition. New York. Pearson.
14. David, M. (1997).Teaching Skills in Further and Adult Education, London, Guilds.
15. Josh, S. R. (2005). Teaching of Science, New Dehli, A.P.H Publishing Corporation.
16. Lawson, Anton. E. (1995). "*Science teaching and development of thinking*". California: Wadsworth publishing company
17. Moner, M. (1995). Learning to Teach Science, London, Faimer Press.
18. Rahman, Z.(2004).*Modern teaching methods and techniques*. NewDelhi: Anmol publications.
19. Rashid, M. (2005). Allied Material on Teaching Strategies, Course Code: 846 (M.A Education), AIOU, Islamabad
20. Rehman Mehmooda (1999). "*Teaching of science and mathematics*". Peshawar: Ijaz printer, Pakistan

Schedule of semester

Start of Semester: 2nd September, 2020

Mid Term Exam: 4th - 8th November 2020

End of Classes: 26th December, 2020

Final Exam: 1st -16th January, 2020

Students' Activities

1. Students would be required to participate in discussion during and after the presentation by the teacher
2. Students would be required to select a topic of their own choice, prepare a model lesson plan and present it in front of class
3. Students will perform an activity after the completion of every lecture

Activity	Marks	Due date (Expected)
Mid Term	20	4-8 November,2020
Terminal Exam	60	1-16 January,2020
Model Lesson Plan and its Presentation	5+5 = 10	3rd – 16th December 2020
Activities (Above mentioned 3)	10	After the completion of every lecture

Evaluation Criteria

Activities	Marks Distribution
Mid Term	20
Model lesson Plan	05
Model Lesson Plan presentation	05
Activities	10
Internal Evaluation Total	40
Final Exam	60
Grand Total	100

Course Contents

Session (1.5 hours)	Unit Title (with sub titles)	Practical activity for the unit (Quiz/Assignment/ Presentation etc.)		
	Topic	Activity	Marks	Due date for submission
1. & 2.	Introductory Lecture 1.1.Definition & Nature of Science 1.2.Importance of General Science in everyday life economic development. 1.3.Relationship of General Science with other subjects	Introduction about the course. Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture
3. & 4.	1.4. Science as a product: Scientific Knowledge. 1.5. Science as a process: Scientific Method 2.1. Aims & Goals of General Science Teaching 2.3. Aims/Objectives of teaching of General Science	Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture
5. & 6.	2.2. Taxonomy of Educational Objectives 3.1. Standards, Bench Marks and SLO's 3.2. Contents suggested in National Curriculum 2009.	Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture
7. & 8.	3.3. Teaching learning process suggested in National Curriculum 2009 3.4. Assessment strategies suggested in National Curriculum 2009 4.1. Lecture Method	Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture

	4.2. Demonstration method			
9. & 10.	4.3. Activity Method 4.4. Laboratory method 4.5. Inquiry method 4.6. Heuristic method	Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture
11. & 12.	4.7. Problem solving 4.8. Discovery method 4.9. Project method 4.10. Assignment method	Lecture and explanation of the concepts Will perform activity at the end of the lecture		After the completion of respective lecture
13. & 14.	8.1. Importance of planning in teaching 8.2. Course Planning 8.3. Unit Planning 8.4. Daily Lesson Planning 8.5. Qualities of a good lesson plan 8.6. Development of model lesson plan	Lecture and explanation of the concepts Will perform activity at the end of the lecture		
15. & 16.	5.1. Meaning & Concept of teaching techniques & strategies 5.2. Difference between method, technique and teaching strategies 5.3. Questioning techniques 5.4. Discussion techniques	Lecture and explanation of the concepts Will perform activity at the end of the lecture		
17. & 18.	5.5. Analytic and synthetic techniques 5.6. Discovery and inquiry techniques Revision for mid-term Exam	Lecture and explanation of the concepts Will perform activity at the end of the lecture Revise the course for midterm. Answer the queries of students		

19. & 20.	Mid-term Exam 5.7. Laboratory techniques 5.8. Concept mapping & use of advance organizers	Invigilate Lecture and explanation of the concepts Will perform activity at the end of the lecture	20	4th November 2020
21. & 22.	6.1. Nature & scope of teaching aids 6.2. Need & Importance of teaching aids 6.3. Classification of teaching aids 6.4. Principles of using Teaching Aids 6.5. Types of Teaching Aids for General Science 6.6. Preparations of low cost Teaching Aid	Lecture and explanation of the concepts Will perform activity at the end of the lecture		
23. & 24.	6.7. Use of ICT in teaching of General Science 6.8. Effective use of teaching aids 7.1. Measurement, Assessment and Evaluation	Lecture and explanation of the concepts Will perform activity at the end of the lecture		
25. & 26.	7.2. Types of Assessment 7.2.1. Formative assessment 7.2.2. Summative assessment 7.3. Test and rubric construction	Lecture and explanation of the concepts Will perform activity at the end of the lecture		
27. &	**Presentations of model lesson plan**	Lecture and explanation of the concepts		

28.	**Presentations of model lesson plan**	Will perform activity at the end of the lecture Will present their model lesson plans	10	3rd December 2020
29. & 30.	**Presentations of model lesson plan** **Presentations of model lesson plan**	Will present their model lesson plans Will present their model lesson plans	10 10	9th December 2020 10th December 2019
31. & 32.	**Presentations of model lesson plan** **Revision of course for final exam**	Will present their model lesson plans Revision of the course for final exam	10	16th December 2020

COURSE PLANNER
(CONTROL GROUP)

Evaluation Criteria

Activities	Marks Distribution
Mid Term	20
Assignment 01	05
Presentation 01	03
Assignment 02 (Model Lesson Plan)	03
Presentation 02 (Model Lesson Plan)	02
Activities	04
Internal Evaluation Total	40
Final Exam	60
Grand Total	100

Course Contents

Session (1.5 hours)	Unit Title (with sub titles)	Practical activity for the unit (Quiz/Assignment/ Presentation etc.)		
	Topic	Activity	Marks	Due date for submission
1 & 2	Introductory Lecture 1.1. Definition & Nature of Science 1.2. Importance of General Science in everyday life economic development 1.3. Relationship of General Science with other subjects	Introduction about the course. Lecture and explanation of the concepts		
3 & 4	1.4. Science as a product: Scientific Knowledge. 1.5. Science as a process: Scientific Method	Lecture and explanation of the concepts		

	2.1. Aims & Goals of General Science Teaching 2.3. Aims/Objectives of teaching of General Science			
5 & 6	2.2. Taxonomy of Educational Objectives 3.1. Standards, Bench Marks and SLO's 3.2. Contents suggested in National Curriculum 2009.	Lecture and explanation of the concepts Will perform activity at the end of the lecture	1	After one week of topic completion
7 & 8	3.3. Teaching learning process suggested in National Curriculum 2009 3.4. Assessment strategies suggested in National Curriculum 2009 4.1. Lecture Method 4.2. Demonstration method	Lecture and explanation of the concepts		
9 & 10	4.3. Activity Method 4.4. Laboratory method 4.5. Inquiry method 4.6. Heuristic method	Lecture and explanation of the concepts		
11 & 12	4.7. Problem solving 4.8. Discovery method 4.9. Project method 4.10. Assignment method	Lecture and explanation of the concepts		
13 & 14	8.1. Importance of planning in teaching 8.2. Course Planning 8.3. Unit Planning 8.4. Daily Lesson Planning	Lecture and explanation of the concepts		

	8.5. Qualities of a good lesson plan 8.6. Development of model lesson plan			
15 & 16	5.1. Meaning & Concept of teaching techniques & strategies 5.2. Difference between method, technique and teaching strategies 5.3. Questioning techniques 5.4. Discussion techniques	Lecture and explanation of the concepts		
17 & 18	5.5. Analytic and synthetic techniques 5.6. Discovery and inquiry techniques Revision for mid-term Exam	Lecture and explanation of the concepts Revise the course for midterm. Answer the queries of students		
19 & 20	Mid-term Exam 5.7. Laboratory techniques 5.8. Concept mapping & use of advance organizers	Invigilate Lecture and explanation of the concepts	20	4th November 2020
21 & 22	6.1. Nature & scope of teaching aids 6.2. Need & Importance of teaching aids 6.3. Classification of teaching aids 6.4. Principles of using Teaching Aids 6.5. Types of Teaching Aids for General Science 6.6. Preparations of low cost Teaching Aid	Lecture and explanation of the concepts Will perform activity at the end of the lecture	1	After one week of topic completion

23 & 24	6.7. Use of ICT in teaching of General Science 6.8. Effective use of teaching aids 7.1. Measurement, Assessment and Evaluation	Lecture and explanation of the concepts		
25 & 26	7.2. Types of Assessment 7.2.1. Formative assessment 7.2.2. Summative assessment 7.3. Test and rubric construction	Lecture and explanation of the concepts Will perform activity at the end of the lecture	1 1	After one week of topic completion After one week of topic completion
27 & 28	**Presentations of model lesson plan** **Presentations of model lesson plan**	Lecture and explanation of the concepts Will perform activity at the end of the lecture Will present their model lesson plans	10	3rd December 2020
29 & 30	**Presentations of model lesson plan** **Presentations of model lesson plan**	Will present their model lesson plans Will present their model lesson plans	10 10	9th December 2020 10th December 2020
31 & 32	**Presentations of model lesson plan** **Revision of course for final exam**	Will present their model lesson plans Revision of the course for final exam	10	16th December 2020

APPENDIX-VII

COGNITIVE ACCELERATION LESSON PLANS

Cognitive Acceleration Lesson 1

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Definition and Nature of Science; Relationship of Science with other Subjects

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson introduces the concept of general science. The word science comes from Latin word "Scientia" meaning "Knowledge". In more contemporary terms, science is a system of acquiring knowledge based on the scientific process or method in order to organize a body of knowledge gained through research. Further nature of science with its characteristics will be explained to students with relevant examples. How science is to be integrated into other disciplines would also be discussed and explained with examples. 3 activities for this lesson are to be arranged. First activity contains two parts, in the first part students have to write a definition of science in their own words and in the second part they have to arrange the different phrases according to domains of science. Second activity would judge their decision power about the correlation of science with other subjects whereas third activity would assess their reasoning ability by giving the description about the picture.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some introductory questions will be asked to students to check their prior knowledge about the science and their interest level towards science subject. A question "What do you think what is science" will be asked from all students and 2 minutes would be given to think about the answer. After	Students will answer to the teachers for a question "What do you think what is science" Will listen the teacher carefully to perform the activities at the end

	students' answers a brief introduction about the concept of science will be given to the students.	
Step 02: Cognitive Conflict	Students would be given 5 minutes to discuss with peers and write 2 points about science teaching. After that nature of science and science in 3 domains would be discussed with the students. After a brief introduction students would be divided into groups and notes would be distributed among students.	• Will write 2 points about science teaching. • Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For better understanding of the students teacher will explain how science in integrated in daily life and different disciplines.	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	Three activities with the gap of 5 minutes will be distributed among the students. **Activity 01:** Keeping in mind the definitions of science discussed earlier, take a moment and write down your definition of science in the text box Recall 3 domains of science and arrange in order **Activity 02:** From the given situations identify the correlation of science with particular subject **Activity 03:** See the pictures pasted below and write description whatever you observed from the picture Teacher will continuously guide the students about how to solve the activities and will be supported where they become fail.	Will perform Activities

Cognitive Acceleration Lesson 2

Teacher's Name: Memoona Bibi **Class:** BS Education
Semester: Fall 2019 **Subject:** Teaching of G. Science- A
Topic: Science as a Product: Scientific Knowledge
Science as a Process: Scientific Method
Teaching Method: Cognitive Acceleration
Time Duration: 90 minutes

Overview of the lesson

This lesson explains the science as a product (scientific Knowledge) and science as a Process (scientific process). Teacher will explain how science works as a product and process by giving the proper examples. 2 activities will be arranged at the end of the lesson to judge the learning and reasoning ability of the students. Scientific knowledge is known as a fact that is acquired through the scientific method and scientific method is known as a method of procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	"How science works as a product and process?" will be main question under discussion. 5 minutes will be given to students to discuss in pair about science as a product and process. Teacher will give a brief introduction about science as a product and science as a process from the given notes	• Will discuss about science as a product and as a process • Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.

	Will divide students in groups to discuss the provided notes Teacher will be there as a facilitator to guide them	
Step 03: Social Construction	For better understanding of the students teacher will explain how science works as a product and process through PPT by giving proper examples	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	3 activities will be arranged to assess the students' learning and reasoning ability **Activity 1:** Recall the steps of Scientific method and rewrite in the spaces below **Activity 2:** Read the story carefully and fill in the blanks by the given words at the end of the story	Will perform Activities

	Activity 3: Read the given article in pairs and identify the steps of scientific method. Teacher will continuously guide the students about how to solve the activities and will be supported where they become fail.	

Cognitive Acceleration Lesson 3

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Aims and Goals of General Science Teaching

Aims and Objectives of Teaching of General Science

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson will explain the basic difference between aims, Goals and objectives. Major aims and objectives for teaching of science at different level will be discussed in the lesson. Harmonious development of child's personality and social efficiency etc. are the general aims of education. If science teaching is to be made effective, then its aims should be in consonance with the general aims of education.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction.	Will answer to the questions and ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	"Why science should be teach?" will be main question under discussion. 5 minutes will be given to students to discuss in pair about purpose of teaching science. Teacher will give a brief introduction about aims, goals and objectives of teaching science at different level	• Will discuss about purpose of science teaching • Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.

	Will divide students in groups to discuss the provided notes Teacher will be there as a facilitator to guide them	
Step 03: Social Construction	For better understanding of the students teacher will explain how the terms aim, goal and objective are different from each other Teacher will differentiate with the help of chart	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 1:** Read the statement carefully and decide whether it is aim, objective or goal. **Activity 2:** Choose the following objectives of teaching science according to the level.	Will perform Activities

Cognitive Acceleration Lesson 4

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Taxonomy of Educational Objectives

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson will explain the Blooms Taxonomy of Educational objectives by explains its three domains. Bloom's taxonomy is a set of three hierarchical models used to classify educational learning objectives into levels of complexity and specificity. The three lists cover the learning objectives in Cognitive, affective and sensory domains. In one sentence, **Bloom's Taxonomy is a hierarchical ordering of Cognitive skills that can,** among countless other uses, **help teachers teach and students learn.** Work sheets and activities will be arranged for the better understanding of the students.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about the objectives making will be given using examples from daily life.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	Introduction about Blooms taxonomy of educational objectives will be given to the students. Domains and sub domains of educational taxonomy with examples will be discussed. Three domains:	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.

	Cognitive (about knowing) affective (about attitudes, feelings) psychomotor (about doing)	
Step 03: Social Construction	How to construct program and learning outcomes will be discussed by examples. Rules of constructing outcomes will be discussed. **ABCD Structure of a Learning Outcome:** **Audience/Who** **Behavior/What** **Condition/How** **Degree/How much**	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	3 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Distinguishing between program and learning outcomes **Activity 02** Learning outcomes components exercise **Activity 03** Writing outcomes practice	Will perform Activities

Cognitive Acceleration Lesson 5

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Standards, Bench Marks and SLO's
Content suggested in National Curriculum for General Science 2009

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson will explain standards, benchmarks and SLOs. Standards are published documents that establish specifications and procedures designed to ensure the reliability of the materials, products, methods, and/or services people use every day. Benchmark is known as Standard, or a set of standards, used as a point of reference for evaluating performance or level of quality. Benchmarks may be drawn from a firm's own experience, from the experience of other firms in the industry, or from legal requirements such as environmental regulations. Student learning outcomes or SLOs are statements that specify the knowledge (Cognitive), skills (psychomotor), and perceptions (affective) students will be able to demonstrate when they have completed or participated in the academic program and/or learning experience. National curriculum 2006 will also be reviewed w.r.t. suggested content for science.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about the standards, benchmarks and SLOs will be given with proper examples.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	A brief description about the curriculum standards, benchmarks and SLOs will be given by teacher.	• Will discuss the given notes with group members. • Will write main points from the given notes and

	Students will be divided into groups and will asked to discuss the notes with group members.	questions they need to be asked.
Step 03: Social Construction	For better understanding of the students teacher will briefly explain the content suggested in national curriculum 2006 through a chart.	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Decide whether it is learning strand, benchmark or SLO **Activity 02** Decide contents and SLOs for the given learning standard Teacher will continuously guide the students about the	Will perform Activities

	activities and will support students where they become fail.	

Cognitive Acceleration Lesson 6

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science-A

Topic: Teaching learning process and Assessment strategies suggested in National Curriculum for General Science 2009

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson will explain the basic concept of teaching learning process and assessment techniques. The role of learning is extremely important in the preparation of adolescents and youth for citizenship in a democratic society. The learning process represents the channel through which the adolescents strive to acquire the habits, skills, knowledge, attitude, values and appreciation, which are necessary for effective participation in a democracy. Learning therefore becomes a process by which changes in behavioral patterns are produced through experience. Educational assessment or educational evaluation is the systematic process of documenting and using empirical data on the knowledge, skill, attitudes, and beliefs to refine programmes and improve student learning.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about teaching learning process and assessment will be given using examples from daily life.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	Introduction about teaching methodologies and assessment strategies suggested by	• Will discuss the given notes with group members. • Will write main points from the given notes and

	National Curriculum 2009 will be given by the teacher. Students will be divided into groups and will asked to discuss the National Curriculum 2009 document given to them.	questions they need to be asked.
Step 03: Social Construction	For better understanding of the students teacher will give examples of teaching methodologies and assessment strategies to the students.	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Read the given Curriculum carefully and highlight following points 1. Objectives 2. Content	Will perform Activity

	3. Pedagogy 4. Learning environment 5. Assessment Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 7

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Lecture Method, Demonstration Method

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson will introduce the general methods of teaching science. The main aim of teaching science is to create a scientific awareness among the students and this can only be achieved if the teaching is effective and based on the principles of teaching. How the students will learn effectively, depends on the teaching methods that the teacher adopts. There are many of the effective and efficient methods of science teaching which could be made use of, to bring out the expected outcome from students. **Lecture method** is the oldest method of teaching. It is based on the philosophy of idealism. This method refers to the explanation of the topic to the students. The emphasis is on the presentation of the content. The teacher clarifies the content matter to the students by using gestures, simple devices, by changing voice, change in position and facial expressions. Teachers are more active and students are passive but the teacher also asks questions to keep the students attentive. A method demonstration is a teaching method used to communicate an idea with the aid of visuals such as flip charts, posters, power point, etc. A demonstration is the process of teaching someone how to make or do something in a step-by-step process. As you show how, you "tell" what you are doing.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about the teaching methods and types of teaching methods will be	Will answer to the questions and will ask if they have any query from the previous lesson

	given using examples from daily life.	
Step 02: Cognitive Conflict	Introduction about lecture method and demonstration method of teaching will be given with its importance and scope. Students will be divided into groups and will be asked to discuss the notes with peers about lecture method and demonstration method.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the	Will perform Activities

	students' learning and reasoning abilities **Activity 01** "Students are passive listeners in lecture method". Write down your views about it **Activity 02** Take a topic of your own choice and prepare a 5 minutes demonstration. Write down main steps of your demonstration. Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 8

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Activity Method, Laboratory Method

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

This lesson explains the activity and laboratory method of teaching general science. Activity-based learning as the name suggests is a process whereby students actively engaged in the learning process rather than just sitting and listening to the lesson. It is based on the core premise that learning should be based on doing some hands-on experiments and discussion, practical activities, analysis and evaluation of the topic under discussion. The models of activity-based learning suggest that all learning activities involve some kind of learners' experiences which emphasizes observing and doing. Laboratory method is one of the important methods of teaching science and it forms an integral part of effective science teaching. Under this method, teacher encourages the students to derive various scientific laws and principles on their own by getting personally involved in the experiment work. For science teaching, this method is used to maximum possible extent by the teachers.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about lecture method and laboratory method will be given using examples.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Major concepts of activity method and laboratory method will be explained by the teacher. Students will be divided into groups and asked to discuss provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Being a prospective teacher, what activities would you suggest for teaching general science at primary level? **Activity 02** Enlist the main steps of laboratory method of teaching science Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activities

Cognitive Acceleration Lesson 9

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Inquiry Method, Heuristic Method

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Inquiry-based learning is an approach to learning that emphasizes the student's role in the learning process. Rather than the teacher telling students what they need to know, students are encouraged to explore the material, ask questions, and share ideas. Inquiry-based learning uses different approaches to learning, including small-group discussion and guided learning. Instead of memorizing facts and material, students learn by doing. This allows them to build knowledge through exploration, experience, and discussion. The word "heuristic" is derived from the Greek word heurisco" meaning "I find out" and the "Heuristic Method" is one in which the pupils are left to find out things for themselves. Children are placed, as far as possible, in the position of discoverers and instead of being told the facts; they are led to find out things for themselves. Through this method the pupils are made to learn. The Heuristic method was, for the first time, coined by Dr. H. E. Armstrong (1888-1928), Professor of Chemistry at City and Guild Institute Kensington. This method of teaching is of a very recent origin. First it was used in Science and its success led it to be adopted in the teaching of all subjects in the School Curriculum. The aim of this method is to develop the scientific attitude and spirit in pupils. The spirit of enquiry prompts the pupils to learn. This method insists on truth, whose foundation is based on reason and personal experiences.

Steps	Teacher Activity	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about inquiry method and heuristic method	Will answer to the questions and will ask if they have any query from the previous lesson

	of teaching will be given by the teacher.	
Step 02: Cognitive Conflict	Basic concepts of inquiry and heuristic method of teaching will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Following the Inquiry method of teaching how would you teach to your class? **Activity 02** Write down 2 differences between inquiry and heuristic method of teaching. Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activities

Cognitive Acceleration Lesson 10

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science- A

Topic: Problem solving method, Discovery method

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Problem-solving is a process—an ongoing activity in which we take what we know to discover what we don't know. It involves overcoming obstacles by generating hypotheses, testing those predictions, and arriving at satisfactory solutions. Problem-solving is, and should be, a very real part of the curriculum. It presupposes that students can take on some of the responsibility for their own learning and can take personal action to solve problems, resolve conflicts, discuss alternatives, and focus on thinking as a vital element of the curriculum. It provides students with opportunities to use their newly acquired knowledge in meaningful, real-life activities and assists them in working at higher levels of thinking. Discovery learning is a technique of inquiry-based learning and is considered a constructivist based approach to education. It is also referred to as problem-based learning, experiential learning and 21st century learning. It is supported by the work of learning theorists and psychologists Jean Piaget, Jerome Bruner, and Seymour Papert. The label of discovery learning can cover a variety of instructional techniques. According to a meta-analytic review conducted by Alfieri, Brooks, Aldrich, and Tanenbaum (2011), a discovery learning task can range from implicit pattern detection, to the elicitation of explanations and working through manuals to conducting simulations. Discovery learning can occur whenever the student is not provided with an exact answer but rather the materials in order to find the answer themselves.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about problem solving method and discovery	Will answer to the questions and will ask if they have any query from the previous lesson

	method of teaching will be given by the teacher.	
Step 02: Cognitive Conflict	Basic concepts of problem solving method and discovery method of teaching will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Choose a topic and explain how would you teach with problem solving method? **Activity 02** What are your views about discovery method of teaching general science? Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activities

Cognitive Acceleration Lesson 11

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Project method, Assignment method

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

The project method is a teacher-facilitated collaborative approach in which students acquire and apply knowledge and skills to define and solve realistic problems using a process of extended inquiry. Projects are student-centered, following standards, parameters, and milestones clearly identified by the instructor. Students have control over the planning, refining, presenting, and reflecting of the project. Through projects, students are engaged in innovation and creativity. An assignment is a teaching method that aims to have students independently acquire academic competences, this can be both in an individual or group context. No contact hours are offered for completion of the assignment, the students have to carry out the task in their own time. This concerns the student(s) to work independently, supervised by the teacher.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about problem project method and assignment method of teaching will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of project method and assignment method of teaching will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** What types of projects can be assigned in your subject to teach through project method?	Will perform Activities

	Activity 02 What is the role of a teacher in assignment method of teaching? Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 12

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Importance of Planning in Teaching, Course planning, Unit planning

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Planning for the classroom is an important part of educating and behavior management. Proper classroom planning will keep you organized and on track while teaching, thus allowing you to teach more and manage less. Planning a teaching program, teaching all placed in a pre-course exam. To help teachers to organize teaching and learning process according to the aim of the course is placed. So the lesson plan must include details of specific programmes such as the intended concepts / principles of instructional content and learning activities, Instruction media Assessment / evaluation and the period of the teaching. Everything must be included with the lesson plans organized. Course planning refers to planning courses of instructions. It serves as a guide for the teacher as well as for the students in creating conductive atmosphere for worthwhile learning and purposeful activities. Unit plans consist of concepts and learning goals that are taught over a period of time and are woven together, often across subject areas. A unit plan lasts two or three weeks (or longer) and includes several standards, skills, and desired outcomes for interconnected learning.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about planning in teaching will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of course and unit planning will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Why planning is important in teaching? **Activity 02** Course Planning is better or Unit Planning? How? Teacher will continuously guide the students about how to solve	Will perform Activities

	the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 13

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Daily Lesson Planning, Qualities of a good lesson Plan, Development of a model Lesson Plan

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Lesson plan is a teacher's detailed description of the course of instruction or "learning trajectory" for a lesson. A daily lesson plan is developed by a teacher to guide class learning. Details will vary depending on the preference of the teacher, subject being covered, and the needs of the students. Whether you teach several subjects or teach in a specific content area, lesson plans matter. The quality of your lesson plans will in great part determine how efficiently class time is used and how much content your students learn each period. Lesson plans don't have to be lengthy. The main thing is to make sure they contain the main elements of the lesson. They're meant to guide your instruction so you can maximize classroom time.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about daily lesson planning will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	Basic concept of daily lesson plan will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and

		questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Choose the topic of your own choice and make a daily lesson plan following the daily lesson plan steps. Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activity

Cognitive Acceleration Lesson 14

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Meaning and concept of teaching techniques & strategies

Difference between method, technique and teaching strategies

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Education, as with other industries, has evolved in leaps and bounds in recent years. Traditional pedagogical techniques, based on a teacher explaining a topic and students taking notes, may still be useful on occasion, but education today revolves more around encouraging the student to awaken their curiosity and desire to learn. A number of different teaching techniques have emerged due to this change in education. Many of these teaching techniques are not actually new! The use of technology in the classroom has simply given education a new lease of life allowing us to approach old ideas in new ways. Whether you've been teaching two months or twenty years, it can be difficult to know which teaching strategies will work best with your students. As a teacher there is no 'one size fits all' solution, so here is a range of effective teaching strategies you can use to inspire your classroom practice.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about teaching techniques and strategies will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concept of method, technique and teaching strategies will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Choose the best teaching techniques for science subject **Activity 02**	Will perform Activity

	Identify which is method, technique and strategy Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 15

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Questioning Techniques, Discussion Techniques

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Gaining an understanding of the specific types of questions you ask not only helps you achieve better answers and build stronger relationships, but it'll also help you avoid misleading people, or worse, prevent you from suffering a dreaded communication breakdown. Discussions may occur among members of a dyad, small group, or whole class and be teacher-led or student-led. They frequently involve discussion of a written text, though discussion can also focus on a problem, issue, or topic that has its basis in a "text" in the larger sense of the term (e.g., a discipline, the media, and a societal norm). Other terms for discussions used for pedagogical purposes are instructional conversations and substantive conversations. A defining feature of discussion is that students have considerable agency in the construction of knowledge, understanding, or interpretation. In other words, they have considerable "interpretive authority" for evaluating the plausibility or validity of participants' responses.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about techniques will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of questioning and discussion techniques will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** How discussion and questioning techniques can be used in teaching learning process?	Will perform Activity

	Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 16

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Analytic and Synthetic Techniques, Discovery and Inquiry Techniques

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Analytic techniques are used for unfolding of the statement in question or conducting its different operations to explain the different aspects minutely which are required for the presentation of pre-discovered facts. The procedure adopted is to go 'from unknown to known' and find out desired results. The great psychologist, Thorndike, supported this technique. He believed that through analysis, the highest intellectual performance of the mind is possible. Synthetic technique is opposite of analytic as synthesis is compliment of analysis. Child proceeds from known to unknown. Facts already known are applied to new situations so that the combination of known facts help us to find new facts. Discovery/ Inquiry Method is a technique of inquiry-based instruction and is considered a constructivist based approach to education supported by the work of learning theorists and psychologists such as Jean Piaget, Jerome Bruner and Seymour Papert. The idea of this philosophical movement suggests that students 'learn by doing'. Discovery learning can occur whenever the student is not provided with an exact answer, but rather, the materials to find the answer themselves. Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge and is a method of instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies or performing experiments.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction.	Will answer to the questions and will ask if they have any query from the previous lesson

	Introduction about techniques will be given by the teacher.	
Step 02: Cognitive Conflict	Basic concepts of analytic and synthetic techniques and inquiry and discovery techniques will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Read the information/material carefully and identify which techniques are being used in the process? Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activity

Cognitive Acceleration Lesson 17

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Laboratory Techniques, Concept mapping and use of advance organizers

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Laboratory techniques can be conveniently divided into three parts or steps namely, introductory steps, Work Period and Culminating activities. A concept map or conceptual diagram is a diagram that depicts suggested relationships between concepts. It is a graphical tool that instructional designers, engineers, technical writers, and others use to organize and structure knowledge. Concept mapping is a great way to build upon previous knowledge by connecting new information back to it. This post explores the uses of concept mapping and provides tools for creating concept maps on the computer. An advance organizer is a very useful tool for teachers to help students understand, retain and remember new learning material. An advance organizer is a tool used to introduce the lesson topic and illustrate the relationship between what the students are about to learn and the information they have already learned. They are used during expository instruction, which is the use of an expert to present information in a way that makes it easy for students to make connections from one concept to the next. By using an advance organizer to link the new information to old information, the new information can be remembered more easily. There are three basic purposes of advance organizers. First, they direct students' attention to what is important in the upcoming lesson. Second, they highlight relationships among ideas that will be presented. Third, they remind students of relevant information that they already have.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction.	Will answer to the questions and will ask if they have any query from the previous lesson

	Introduction about web organizers and concept mapping will be given by the teacher.	
Step 02: Cognitive Conflict	Basic concepts of laboratory techniques, concept mapping and advance organizers will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Construct a concept map from the phrases given below. Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activity

Cognitive Acceleration Lesson 18

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Nature and scope of teaching aids

Need and Importance of teaching aids

Classification of teaching aids

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Teaching aids are an integral component in any classroom. The many benefits of teaching aids include helping learners improve reading comprehension skills, illustrating or reinforcing a skill or concept, differentiating instruction and relieving anxiety or boredom by presenting information in a new and exciting way. Teaching aids also engage students' other senses since there are no limits in what aids can be utilized when supplementing a lesson. Teaching aids prove to be a formidable supplement for teachers when the reinforcement of a skill or concept is necessary. Not only do they allow students more time to practice, but they also present the information in a way which offers students a different way to engage with the material. Of course, this is important in order to reach the various learning types in the class. There are three main kinds of aids including Visual Aids, Audio Aids and Audio - Visual Aid.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction teaching aids will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of teaching aids and its classification including importance of teaching aids will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** See the pictures given below and identify its type of teaching aid	Will perform Activity

	Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 19

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Principles of using Teaching Aids

Types of teaching aids for general science

Preparations of low cost Teaching aids

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Audio-visual aids combined with the good text-books and a competent instructor form an excellent combination in teaching of general science. The use of audio visual materials in the teaching of science has value for children of all ages in school. However, they extend greatly the mental vision of students at any level. Classroom boredom often preys on students in science classes due to the fact that students have to learn science in the most illogical way: repeating what written in science book to memorize it without actual understanding of the subject. Nevertheless, you can still be the teacher of the year if you know what it takes to ignite hearts for science: teaching aids for science. Low cost no cost materials are the teaching aids which require no cost or available cheaply, and developed by locally available resources and expedite the process of learning in the classroom. Low cost no cost materials are developed from the waste and help the teachers in making the teaching interesting and concrete.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about low cost teaching aids will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of principles for teaching aids, teaching aids for general science will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Read the information/material carefully and decide which	Will perform Activity

	teaching aid can be used to teach the given ideas? Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 20

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Use of ICT in teaching of General Science

Effective use of Teaching aids

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Information and Communication Technology (ICT) in education is the mode of education that use information and communications technology to support, enhance, and optimize the delivery of information. Worldwide research has shown that ICT can lead to an improved student learning and better teaching methods. The Mobile learning (m -learning) as a form of e -learning is a rising trend where the education has outgrown the physical constraints of the classrooms and acquired mobility. Students' access information whenever and wherever they want, and institutions that provides such advanced technological terrains is rising in number day by day.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about ICT will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	Basic concepts of ICT in general science will be explained by the teacher. Students will be divided into groups and asked to discuss	• Will discuss the given notes with group members. • Will write main points from the given notes and

	the provided notes with group members.	questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Choose a topic of your own choice and explain how would you teach it by using	Will perform Activity

	ICT and different teaching aids effectively? Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	

Cognitive Acceleration Lesson 21

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Measurement, Assessment and Evaluation

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Measurement refers to the process by which the attributes or dimensions of some physical object are determined. One exception seems to be in the use of the word measure in determining the IQ of a person.

Assessment is a process by which information is obtained relative to some known objective or goal. Assessment is a broad term that includes testing. A test is a special form of assessment. Tests are assessments made under contrived circumstances especially so that they may be administered.

Evaluation is perhaps the most complex and least understood of the terms. Inherent in the idea of evaluation is "value." When we evaluate, what we are doing is engaging in some process that is designed to provide information that will help us make a judgment about a given situation.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about assessment will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson
Step 02: Cognitive Conflict	Basic concepts of measurement, assessment and evaluation will be explained by the teacher. Students will be divided into groups and asked to discuss the	• Will discuss the given notes with group members. • Will write main points from the given notes and

	provided notes with group members.	questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words
Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Read the text given below and decide whether it is measurement, assessment or evaluation? Teacher will continuously guide the students about how to solve the activity and will	Will perform Activity

	support the students where they become fail.	

Cognitive Acceleration Lesson 22

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Types of Assessment

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

Formative assessment is an integral part of teaching and learning. It does not contribute to the final mark given for the module; instead it contributes to learning through providing feedback. It should indicate what is good about a piece of work and why this is good; it should also indicate what is not so good and how the work could be improved. Summative assessment demonstrates the extent of a learner's success in meeting the assessment criteria used to gauge the intended learning outcomes of a module or programmes, and which contributes to the final mark given for the module. It is normally, though not always, used at the end of a unit of teaching. Summative assessment is used to quantify achievement, to reward achievement, to provide data for selection (to the next stage in education or to employment). For all these reasons the validity and reliability of summative assessment are of the greatest importance.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students. Topic of the day will be announced with the brief introduction. Introduction about assessment types will be given by the teacher.	Will answer to the questions and will ask if they have any query from the previous lesson

Step 02: Cognitive Conflict	Basic concepts of formative and summative assessment will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	An activity will be arranged to assess the students' learning and reasoning abilities **Activity 01** Read the text below and identify the types of assessment. Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activity

Cognitive Acceleration Lesson 23

Teacher's Name: Memoona Bibi **Class:** BS Education

Semester: Fall 2019 **Subject:** Teaching of G. Science - A

Topic: Test and Rubric Construction

Teaching Method: Cognitive Acceleration

Time Duration: 90 minutes

Overview of the lesson

In education terminology, rubric means "a scoring guide used to evaluate the quality of students' constructed responses". Rubrics usually contain evaluative criteria, quality definitions for those criteria at particular levels of achievement, and a scoring strategy. They are often presented in table format and can be used by teachers when marking, and by students when planning their work. Rubrics, when used with formative assessment purposes, have shown to have a positive impact on students' learning. A scoring rubric is an attempt to communicate expectations of quality around a task. In many cases, scoring rubrics are used to delineate consistent criteria for grading. Because the criteria are public, a scoring rubric allows teachers and students alike to evaluate criteria, which can be complex and subjective. A scoring rubric can also provide a basis for self-evaluation, reflection, and peer review. It is aimed at accurate and fair assessment, fostering understanding, and indicating a way to proceed with subsequent learning/teaching. This integration of performance and feedback is called ongoing assessment or formative assessment. Several common features of scoring rubrics can be distinguished, according to Bernie Dodge and Nancy Pickett,

- focus on measuring a stated objective (performance, behavior, or quality)
- use a range to rate performance
- Contain specific performance characteristics arranged in levels indicating either the developmental sophistication of the strategy used or the degree to which a standard has been met.

Steps	Description	Students' Activity
Step 01: Concrete Preparation	Some questions from the previous lesson will be asked from the students.	Will answer to the questions and will ask if they have any query from the previous lesson

	Topic of the day will be announced with the brief introduction. Introduction about test construction will be given by the teacher.	
Step 02: Cognitive Conflict	Basic principles of test and rubric construction will be explained by the teacher. Students will be divided into groups and asked to discuss the provided notes with group members.	• Will discuss the given notes with group members. • Will write main points from the given notes and questions they need to be asked.
Step 03: Social Construction	For the better understanding of the students teacher will play a role of facilitator by giving proper examples and explaining the points	Will listen carefully and write the questions to be asked at the end
Step 04: Meta-Cognition	Now students will be asked to present whatever they have discussed with the peers. Teacher will play role as a facilitator and guider during the presentation of the students. Students will be encouraged to present their thinking in their own words rather than copying from given notes.	• Will present whatever they discussed with peers • Will be encouraged to present in their own words

Step 05: Bridging	2 activities will be arranged to assess the students' learning and reasoning abilities **Activity 01** Which points would you follow while constructing a general science test for your class? **Activity 02** Make the rubrics for the given Performa Teacher will continuously guide the students about how to solve the activity and will support the students where they become fail.	Will perform Activities

APPENDIX-VIII

TRADITIONAL LESSON PLAN

Teacher's Name: Memoona Bibi

Class: BS Education

Subject: Teaching of G. Science- A

Topic: Taxonomy of Educational Objectives

Teaching Approach: Traditional Approach

Time Duration: 90 minutes

By the end of the lesson students will be able to;

- Describe the blooms taxonomy of educational objectives
- Understand the different levels of blooms taxonomy
- Remember the rules of Learning Outcomes

S.No.	Steps	Description	Students activity	W. Board writing
1.	**P.K.Testing**	What was your aim of getting admission in BS Education? Do you make objectives in your daily life? Have you ever studied how to construct learning objectives for different levels?	Will answer the questions	
2.	**Announcement of the topic**	Today we will discuss about the educational objectives, taxonomy of educational objectives and how to construct the learning outcomes according to educational taxonomy.	.	Taxonomy of educational objectives
3.	**Presentation**	One of the most widely used ways of organizing levels of expertise is	Will listen the lecture.	Cognitive domain

		according to Bloom's Taxonomy of Educational Objectives. Bloom's Taxonomy uses a multi-tiered scale to express the level of expertise required to achieve each measurable student outcome. Organizing measurable student outcomes in this way will allow us to select appropriate classroom assessment techniques for the course. Three domains: cognitive (about knowing) affective (about attitudes, feelings) psychomotor (about doing) **Program outcomes** examine what a program or process is to do, achieve, or accomplish for its own improvement and/or in support of institutional or divisional goals; generally numbers, needs, or satisfaction driven. **Learning outcomes** examine cognitive skills that students develop through department interactions; measurable, transferable skill development. They are statements indicating what a participant (usually students) will know, think, or be able to do as a result of an event, activity, program, etc.	Note down the main points. Answer the questions asked by teacher. Will practice the construction of learning outcomes.	Affective domain Psychomotor domain ABCD of learning outcome Audience Behavior Condition Degree

		Rules of constructing outcomes will be discussed. **ABCD Structure of a Learning Outcome:** **Audience/Who** **Behavior/What** **Condition/How** **Degree/How much**		
4.	**Association**	**Activity** Writing outcomes practice	Will solve the activity	
5.	**Recapitulation**	In educational setting construction of objectives follow the Blooms Taxonomy of Educational Objectives that is consists of three domains. While making the learning outcomes ABCD structure must be followed.		
6.	**Homework**	Construct three learning outcomes of knowledge level of cognitive domain on the topic of your own choice by following the ABCD structure of learning outcomes.		

APPENDIX-IX

RUBRICS FOR OBSERVATION PROTOCOL

3 – Meets expectations in all respects: Master teacher performance that meets very demanding criteria
2 - Meets expectations in some respects: Performance is mediocre; no teacher should be content to remain at this level
1 - Meets expectations in no respects: Unacceptable performance leading to an improvement plan and intensive support

1. Lesson Planning			
	3 **Meets expectations in all respects**	**2** **Meets expectations in some respects**	**1** **Meets expectations in no respects**
a. Documentation	Has prepared a detailed lesson plan mentioning the objectives of the lesson, teaching method, A.V.Aids, students' activity and assessment technique.	Has prepared detailed lesson plan but assessment techniques are not mentioned.	Doesn't documented the lesson plan. Teach with random selection.
b. Knowledge	Has fully command on the subject matter knowledge and child development knowledge. Also has command other than bookish examples. Has command ideas and how to teach them to the students	Has enough bookish knowledge and child development knowledge but lack in other examples. Has some ideas about students' learning.	Has bookish knowledge but has pronunciation and vocabulary problem. Don't know any example other than book example. Doesn't has ideas about the students learning and how to teach them.
c. Standards	Has prepare a detailed lesson plan that is aligned with the objectives of the lesson. Ideas, examples and activities planned are covering the levels of Blooms Taxonomy.	Lesson plan is in detailed and has enough connection with objectives. Examples and activities do not cover the levels of Blooms Taxonomy.	Lesson is planned but is not aligned with the objectives of the lesson. Examples and activities are not planned.
d. Engagement	Has well designed lesson plan in a way to motivate the students.	Has well planned lesson but activities are not in a manner to engage the students.	Didn't Planned Lesson in a way to motivate the students for active learning.

	Has planned activities in a way to engage the students in active learning.	Activities are out dated.	No activity is planned to engage the students.
e. Technology	Selected Proper use of technology and was according to the nature of topic.	Selected Appropriate technology but was unable to use during the lecture.	Didn't selected technology for the better understanding of the students.
f. Learning needs	Selected the Material and technology of the lesson according to the learning needs, styles and interests of the students.	Planned lesson with some thought to adjust the learning needs, styles and interests of the students.	Planned lesson with no learning needs, styles and interests of the students.

2. Instructional Delivery

	3 **Meets expectations in all respects**	**2** **Meets expectations in some respects**	**1** **Meets expectations in no respects**
a. Expectations	Shows clear expectations, importance and determination to master the students with material.	Tells students that subject matter is important for them and ask them to do hard work.	Leaves the students hopeless.
b. Background knowledge of the students	Activates students' previous knowledge and vocabulary by asking relevant questions and students' experiences etc.	Is to some extent successful in activating the students' previous knowledge and vocabulary.	Didn't ask any question related to background knowledge testing.
c. Language	Presented material explicitly with well-chosen examples. Uses appropriate language for the delivery of instruction.	Used clear explanations, appropriate language and examples to present material.	Presented material in a confusing way by using inappropriate language.
d. Connections	Involved all the students to engage them in active learning by making connections with real life examples.	Attempted to involve students to be actively involved but some of the students were disengaged.	Delivered passive lecture by giving textbook or worksheet material to the students.
e. Material clarity	Explained the material in understandable language by giving real examples. Break down the difficult concepts in simple steps by using effective strategies.	Explained the material without examples. Could not explained the difficult concepts in simple way.	Just read out the textbook material and asked students to red by self.

f. Strategies	Used a wide range of well-chosen, effective strategies, questions, materials, technology, and groupings to accelerate student learning.	Used a limited range of classroom strategies, questions, materials, and groupings for students' learning.	Used only traditional strategy and failed to accelerate the students' learning.
g. Activity for students' understanding	Arranged proper activity for the students' aligned with objectives and nature of the topics. Proper time was given for the activity by explaining all steps of the activity.	Activity was arranged according to the nature of the topic. Time was given but steps were not explained.	Delivered the lectured through textbook material for all the time without any individual or group activity for the students.
3. Classroom Management			
	3 **Meets expectations in all respects**	**2** **Meets expectations in some respects**	**1** **Meets expectations in no respects**
a. Expectations	Was direct, specific, consistent and persistent in communicating and achieving the expectations of the lesson	Clearly communicated the expectations for students' behavior for lesson.	Didn't give any importance to the expectations to meet the objectives o the lesson
b. Relationship with students	Showed warmth, caring, respect, and fairness for all students and built strong relationships.	Was fair and respectful toward most students and built positive relationships with some.	Was sometimes harsh, unfair, and disrespectful with students and/or did favouritism.
c. Respect	Created a climate of respect that disruption of learning was impossible.	Win the respect of some students but there was regular disruption in the classroom.	Was not respected by students and the classroom was frequently disorganized and sometimes dangerous.
d. Social interaction	Used examples and activities that successfully developed the positive social interaction and skills.	Explained for positive social interaction but was unable to construct social interaction among students during examples and activities.	Delivered the lecture without constructing any social interaction among students.

e. Time and self-management	Completed the lesson within planned time. All the planned activities were completed. Planned material was delivered successfully.	Completed the lesson within planned time with all planned activities but couldn't delivered all the planned material.	Failed to complete the lesson within planned time. Activity was planned but was not done.
f. Class-routine	Started the lesson on time and completed on time. Completed all the tasks in routine.	Started the lesson on time but failed to complete on time. There was disturbance in the routine of the class.	Was failed to start the lesson on time and to maintain the routine of the class.
g. Awareness about classroom rules and regulations	Briefly guide the students about the rules for asking questions, performing activities and maintaining the discipline in the classroom.	Announced the rules for performing the activity but discipline was maintained during the classroom activities.	Couldn't maintained the discipline during activities and class routine.

4. Monitoring, Assessment and Evaluation			
	3 **Meets expectations in all respects**	**2** **Meets expectations in some respects**	**1** **Meets expectations in no respects**
a. Criteria	Clearly explained the criteria of a good work with examples. Clearly explained the feedback criteria for activities	Told students some of the some of the points to complete good work. Highlight the main points of the activities feedback.	Expected from students to already know criteria of a good work. Conducted activities without feedback criteria.
b. Assessment	Give students a well-constructed diagnostic assessment up front and used the information to fine-tune instruction. Used a variety of effective methods to check for understanding; immediately break down confusion and clarifies. Used we-selected assessment technique to check the understanding of the students.	Did a quick K-W-L (Know, Want to Know, Learned) exercise before beginning a unit. Used normal methods (e.g., thumbs up, thumbs down) to check for understanding during instruction. Used normal technique to assess the students' understanding.	Started the instruction without diagnosing students' skills and knowledge. Uses ineffective methods ("Is everyone with me?") to check for understanding. Didn't assess the students' understanding.

c. Recognition	Used data from interim assessments to adjust teaching, re-teach, and follow up with failing students. Gave positive reinforcement on the correct answer and well-done activities.	Returned tests to students and follows up by clarifying a few items that caused problems. Motivate the students to answer the questions and performing the activities.	Didn't give any feedback to students about their tests, assignments. Ignored the students who performed activities effectively.
d. Support	Make sure that students who need specialized diagnosis and help receive appropriate services immediately.	Sometimes didn't refer students promptly for special help.	Ignored the students for special services.
e. Closing	Properly summarized and assessed what students learn and apply it to real-life situations and future opportunities.	Brought closure to lesson and asked students to think about applications.	Moved on at the end of the lesson without closure or application to real-life situations and future applications.

5. Professional Responsibilities

	3 **Meets expectations in all respects**	**2** **Meets expectations in some respects**	**1** **Meets expectations in no respects**
a. Language	In professional contexts, speaks and writes correctly, briefly, and expressively. Uses correct grammar, syntax, usage, and spelling in professional contexts.	Periodically makes errors in grammar, syntax, usage and/or spelling in professional contexts.	Frequently makes errors in grammar, syntax, usage, and/or spelling in professional contexts.
b. Punctuality	Carries out tests conscientiously and punctually, keeps all records, and is never late.	Is punctual with, duties, and tests; keeps accurate records.	Forget to bring tests, is late, and makes errors in records and deadlines.
c. Professionalism	Presents as an exemplary professional and always observes appropriate boundaries.	Occasionally acts and/or dresses in an unprofessional manner and/or violates boundaries.	Frequently acts and/or dresses in an unprofessional manner and violates boundaries.

d. Judgment	Is invariably ethical, honest, and straightforward, uses flawless judgment, and respects confidentiality.	Sometimes uses questionable judgment, is less than completely honest, and/or discloses student information.	Is frequently unethical, dishonest, uses poor judgment, and/or discloses student information.
e. Openness	Actively seeks out feedback and suggestions from students and cooperative teacher and uses them to improve performance.	Is somewhat defensive but does listen to feedback and suggestions.	Is very defensive about criticism and resistant to changing classroom practice

APPENDIX-X

CERTIFICATE FOR TOOL VALIDATION

Pedagogical knowledge test

For the research Entitled as

The Effect of Cognitive Acceleration Approach for the Development of Reasoning and Pedagogical Skills of Prospective Teachers

By

Ms Memoona Bibi

Ph.D Scholar

Department of Education, Faculty of Social Sciences, International Islamic University, Islamabad, Pakistan

This is to certify that the Pedagogical knowledge test developed by the scholar towards her research has been validated by me. I find it that it has been adequately designed to assess the pedagogical skills of the prospective teachers.

It is considered that the instrument adapted for the research is according to the objectives of the research and it also assures adequate face and content validity. It can be used for experiment by the researcher with fair amount of confidence.

Name: Dr. Zarina Akhlaq

Designation: Assistant Professor

Institution: IIUI

Signature:

Date: 25 Oct. 2022

CERTIFICATE FOR TOOL VALIDATION

Classroom Test for Scientific Reasoning

For the research Entitled as

The Effect of Cognitive Acceleration Approach for the Development of Reasoning and Pedagogical Skills of Prospective Teachers

By

Ms Memoona Bibi

Ph.D Scholar

Department of Education, Faculty of Social Sciences, International Islamic University, Islamabad, Pakistan

This is to certify that the Classroom Test for Scientific Reasoning adapted by the scholar towards her research has been validated by me. I find it that it has been adequately modified to assess the reasoning skills of the prospective teachers.

It is considered that the instrument adapted for the research is according to the objectives of the research and it also assures adequate face and content validity. It can be used for experiment by the researcher with fair amount of confidence.

Name: Dr Zarina Akhlaq

Designation: Assistant Professor

Institution: IIUI

Signature:

Date: 25.04.2021