

A Study on the Conceptual Understanding Level of the Students of Trained and Untrained Physics Teachers

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Abstract

The study investigated the conceptual understanding level of 10th grade students of trained and untrained Physics teachers in boys' secondary schools of district Karak, Khyber Pakhtunkhwa-Pakistan. The objectives of the study were; (1) to find out the conceptual understanding level of the students of trained Physics teachers; (2) to investigate the conceptual understanding level of the students of untrained Physics teachers; and, (3) to explore the difference between the conceptual understanding levels of the students of trained and untrained teachers of Physics.

Descriptive Research Strategy was used. Population of the study was all the 10th grade students of trained and untrained Physics teachers of district Karak. Multistage sampling technique was used and total 400 students were selected randomly as sample of the study. A self-developed test was administered as an instrument for the collection of data. The test covered the contents of physical quantities, properties of matter, force, work, power and energy and gravitation.

The results of the study revealed that in the selected contents, the overall conceptual understanding of the students of trained Physics teachers was hardly satisfactory. While the

conceptual understanding level of the students of untrained Physics teachers was good. Although there was no vital difference, however, the conceptual understanding level of the students of trained Physics teachers was comparatively poorer than the conceptual understanding level of the students of untrained Physics teachers.

Keywords: Conceptual understanding level, trained teachers, untrained teachers, students, Physics contents, secondary level

1. Introduction

Teaching is the process of engaging people with commitment and enthusiasm to learn something. Through teaching, knowledge, information and expertise are imparted to the learners. In imparting knowledge, various teaching methods are required to be used so that to make the learners understand easily. To make the positive environment for learning and engage all the learners in the process of learning, there is a need of using various teaching methods and activities. Such need can be fulfilled by teacher (Hattie, 2009).

Along with the use of various teaching methods, teachers are required to have deep subject matter knowledge of the subjects they are supposed to teach in the classroom. Teachers having poor subject matter knowledge cause the barriers in the learners' achievement (Coe, R et al. 2014). The subject matter knowledge of teachers depends upon their back ground and the institutions from where the teachers have acquired their undergraduate education i.e. from primary level up to the highest level of their degrees they have obtained.

Specific skills are required for the use of various activities and methods for which teachers are responsible to apply in the classroom. For teaching in an effective way in the classroom, the teacher needs to understand fully the materials to be taught, the situation and the condition of the learners along with the teaching methods (Ponte & Chapman, 2008). These skills can be acquired in the teachers training programs. Various institutions and organizations offer training programs for producing skilled man power (Alsohamy, 2002). In the same way, for preparation of individuals to teach in the classroom, pre-service and in-service trainings are arranged. Pre-service teachers' training programs intend to equip the prospective teachers with the skills of using various teaching methods and activities in the classroom for making fruitful teaching-learning process. For the increase in the ability of teachers to handle different teaching situations effectively, teacher education program is the ultimate source, as it has been found out by the research studies that efficiency in the teaching has a vital role in the learning and its outcome (Mohamed, Valcke, & de Wever, 2016; Meroni, Vera-Toscan, & Costa, 2015).

Without effective teaching in the classroom, the conceptual understanding of students especially in science topics is weakened because of their pre instructional misconception, immature and intuitive conceptions. All these are based on the learners' experiences they encounter in their daily lives (Hestenes et al., 1992; Vosniadou, 2013; Bigozzi et al., 2014). Conceptual understanding produces an awareness of consistency and rationality of the subject matter (Entwistle, 1995). It facilitates the elucidation of fundamental mechanism and process (Graesser, Olde, & Lu, 2001) and it shows the way to enhance the students' performance

(Mayer, 1989). It enables the learners to apply and transfer the knowledge learned in a better way (Novak, 2002). Nieswandt (2007) also explains the conceptual understanding as, “the involvement of demonstrating, the ability to recognize new information as something different from one's current understanding and beliefs, to identify inconsistencies, and to construct explanations to reconcile knowledge conflicts or to seek connections among diverse pieces of information” (p. 909).

In the development of conceptual understanding cognitive processes are involved, for example, summarizing, explaining new concepts, and applying the newly learned information in unfamiliar contexts, including everyday life phenomena (Anderson & Krathwohl, 2001). Eberlein et al. (2008) narrate that for students to develop conceptual understanding they need to come out from the practice of rote memorization of terms and become able to make connections among ideas, concepts, and topics in different contexts. It requires going beyond facts and figures and learning to explore information in such a way which encourages higher levels of cognition (Thadeane, 2012).

It is evident from the research that the conceptual understanding of students in sciences including Physics depends on the teachers’ effectiveness (Darling-Hammond, 2000). As educational research has shown that the main significant factor that can play vital role in students’ learning is the effectiveness of teacher (Marzano, 2007). While effectiveness of teachers can be conditioned with the trainings they receive in their pre and in-service training programs, and then they will be able to play their essential role (Fazio, 2010).

A research study conducted by Matsler (2010), revealed that the classroom practices of teachers can be improved through their pre-service training programs. Such trainings are effective in enhancing students’ interest and achievement in science. Through training, teachers can be changed and consequently their students’ learning and understanding level can be improved. In the absence of training there are lacks of evidences which support the positive change in learners’ achievement (Gibbs & Coffey, 2004).

The role of teachers while teachings of science in schools have been under discussion because of the low performance showed by students in TIMSS (Trends in International Mathematics and Science Study) and in PISA (Program for International Student Assessment) studies (Organisation for Economic Co-operation Development [OECD], 2018). Similar to the above, the students’ performance in Physics is also poor. They have shown no significant performance in Physics for the last twenty years (Stephens et al., 2016).

In such situation, it is pertinent to focus on determining the role of pre-service training of teachers in the development of students’ conceptual understanding in the subject of Physics. The focus of this study will be on the conceptual understanding at secondary level of those students whose teachers received pre-service training (trained teachers) and those whose teachers who didn’t receive pre-service training (untrained teachers). The main variable in investigating the conceptual understanding of students was to know whether the conceptual understanding of the students of trained teachers was better than the conceptual understanding of the students of untrained teachers. The conceptual understanding of students of both types of teachers was checked in the concepts of physical quantities, properties of

matter, forces, work, power and energy and gravitation.

2. Statement of the Problem

Conceptual understanding is the creation of confidence and satisfaction among the students and enabling them to elucidate the contents taught to them (Entwistle, 1995). Conceptual understanding is highly valued in education and as compared to mere memorization or rote learning, conceptual understanding and learning is of great importance and preference. In science education, understanding the scientific concepts has been traditionally one of the primary goals at all levels of formal education (Chaimala, 2009). Keeping in view the importance of conceptual understanding, this study focused on investigating the conceptual understanding of students of trained and untrained teachers.

3. Significance of the Study

This study will be significant both for teachers, principals and policy makers. The teachers and the schools' leadership will be informed through this study about the conceptual understanding level of their students. In light of the results of this study, teachers and leadership will become able to take necessary measures for enhancing the understanding level of their students. The results of this study will also provide the information to the policy makers about the usefulness, effectiveness or inappropriateness and ineffectiveness of the existing teachers' training programs.

4. Method and Procedure of the Study

The level and difference in the conceptual understanding of the students of trained and untrained teachers was investigated in this study. The objectives and research questions of the study were as follows.

4.1 Objectives of the Study

- 1) To investigate the conceptual understanding level of the students to whom trained teachers taught Physics.
- 2) To explore the conceptual understanding level of the students to whom untrained teacher taught Physics.
- 3) To find the difference in the level of conceptual understanding of the students of trained and untrained Physics teachers.

4.2 Research Questions of the Study

- 1) What is the level of conceptual understanding of the students of trained teachers of Physics?
- 2) What is the level of conceptual understanding of the students of untrained teachers of Physics?
- 3) Is there any difference between the conceptual understanding levels of the students of trained and untrained teachers of Physics?

5. Research Methodology

This study was descriptive in nature. For the collection of data, survey technique was

practiced. A self-developed test was administered, and before administering the test, opinion of subject experts was sought and the test was validated through pilot testing. The test covered the areas of the five chapters of the secondary school textbook of Physics.

5.1 Population

All the teachers are professionally trained in the schools run by the government i.e. public schools. One-year professional training is mandatory for teaching in the public schools. This one-year professional training coupled with one-month teaching practice as trainee teacher in schools is offered by the universities as well as the teachers' training institutes in Pakistan.

However, in the private schools, majority of the teachers have no professional training. Therefore, all the students of government and private schools in district Karak, Khyber Pakhtunkhwa-Pakistan were the population of the study.

5.2 Sample

Multistage random sampling technique was used for sample selection. In the first stage, ten each trained and untrained teachers were selected from private and public schools. Then 20 students of each trained and untrained teachers were selected randomly. So the total number of the students included in the sample was 400. Among these, two hundred (200) students were of trained teachers and two hundred (200) students were of untrained teachers.

The students of both the groups belonged to the same areas having average physical age of 15 years. The socio economics status of the students of both the groups was identical. The only difference in the sample students was that the parents of the students of untrained teachers studying in private schools pay monthly tuition fee, while the parents of the students of trained teachers studying in public schools do not pay any tuition fee.

5.3 Data Collection

Data was collected personally by the researcher. As, one can measure the conceptual understanding of students by using such questions that need the arrangement of questions and concepts that inquire about the application of knowledge (McNamara, Kintsch, Butler-Songer, & Kintsch, 1996). So, a self-developed test for the collection of data about the conceptual understanding of students in the subject of Physics was designed and was used for the sample students of both trained and untrained teachers. The test was in line with the standard expected of the 10th grade students, specified in the national curriculum. The contents of the test items were (1) Physical quantities, (2) Properties of matter, (3) Forces, (4) Work, power and energy and (5) Gravitation. The duration of the test was 30 minutes.

It was validated through five subject experts. The experts suggested some changes and these were made accordingly in light of the suggestions given by experts. After incorporating the changes, pilot testing of the test was carried out, in the schools other than the sampled one. During the pilot testing, some items were identified as difficult for students to understand. Such items were either replaced or made its language simple. The reliability of the instrument was checked through test re-test method. The reliability of the test as a whole was 0.79.

5.4 Data Analysis

The answer scripts of students were scored by the researcher himself. There were total 30 objective type items about 5 concepts in the test. About each concept there were six objective type items. Each item carried 4 marks. In this way, each concept carried 24 marks and the test as whole carried a total of 120 marks. The test was items wise checked and marked accordingly. After marking the test, the overall mean scores of the students of trained and untrained teachers were calculated manually. Similarly, the mean scores of each item were calculated separately. The results were analyzed by using the contents wise mean scores of each concept of the test through the use of descriptive statistics. The conceptual understanding level of the students was categorized according to the mean scores as given below in Table 1.

Table 1. Categorization of conceptual understanding level

Category Level	Mean Score of Conceptual Understanding			
Poor	from	0.01	to	2.00
Satisfactory	from	2.01	to	3.00
Good	from	3.01	to	4.00
Very Good	from	4.01	to	5.00
Excellent	from	5.01	to	6.00

Table 2. Contents Wise Mean of Conceptual attainment of the students of trained teachers

S.No.	Area	Mean Score	Conceptual Understanding Level
1.	Physical quantities	2.85	Satisfactory
2.	Properties of matter	2.79	Satisfactory
3.	Forces	2.82	Satisfactory
4.	Work power and energy	2.59	Satisfactory
5.	Gravitation	2.89	Satisfactory

According to Table 2, the conceptual understanding of the students of trained teachers in all the contents is satisfactory. The mean scores of the students of trained teachers in the contents of Physical quantities, Properties of matter, Forces, Work power and energy and Gravitation are above 2.00 and below 3.00.

Table 3. Contents Wise Mean of Conceptual attainment of the students of untrained Teachers

S.No.	Area	Mean Score	Conceptual Understanding Level
1.	Physical quantities	3.75	Good
2.	Properties of matter	3.42	Good
3.	Forces	3.29	Good
4.	Work power and energy	3.11	Good
5.	Gravitation	3.54	Good

The conceptual understanding of the students of untrained teachers in all the contents is good. The mean scores of the students of untrained teachers in all the contents is between 3.00 and 4.00, as shown in table 3.

Table 4. Over All Mean Score of students of trained and untrained teachers

Students' Status	Mean Score	Level
Students of trained teachers	2.89	Satisfactory
Students of untrained teachers	3.54	Good

The Table 4 reveals that the overall mean scores of the students of untrained teachers are higher than the overall mean scores of the students of trained teachers. Hence, it can be concluded that as a whole, the conceptual understanding of the students of untrained teachers is better than the conceptual understanding of the students of trained teachers because of attainment of high mean in the given test.

6. Discussion

The study was conducted to assess the overall conceptual understanding of the students of trained teachers and students of untrained teachers in the subject of Physics at secondary level. In majority of the selected contents, the overall conceptual understanding of the students of trained teachers govern was either poor or hardly satisfactory. It shows that the hypothesis of the study that the students of trained teachers have low level of conceptual understanding in Physics. While as a whole the conceptual understanding of the students of untrained teachers was either relatively good or very good in almost all the contents. Hence the students of untrained teachers have good level of conceptual understanding in Physics. The students of the trained teachers rarely had very good level of conceptual understanding in the selected contents. In contrast to this, the students of the untrained teachers rarely had poor conceptual understanding.

Although it is important to note that there was a little variation between the level of conceptual understanding of the students of untrained and trained teachers in some of the contents. However, in most of the contents it was found that the overall conceptual understanding of the students of trained teachers was comparatively poorer than the conceptual understanding of the students of untrained teachers. So it can be said that there is a difference between the conceptual understanding of the students of trained and untrained teachers in the subject of Physics. The better conceptual understanding of the students of untrained teachers contradicts the findings of the research study conducted by Matsler (2010), which revealed that the classroom practices of teachers can be improved through their pre-service training programs and pre-service trainings are effective in enhancing students' interest and achievement in science.

The findings of this study are also contradictory to the statement that through training, teachers can be changed and consequently their students' learning and understanding level can be improved. In the absence of training there are lacks of evidences which support the

positive change in learners' achievement (Gibbs & Coffey, 2004).

The better level of conceptual understanding of the students of untrained teachers as compared to the students of trained teachers does not mean that it undermines the importance of training. It may be because of the nature of the schools. Because untrained teachers are working in the private schools which are run by private individuals and the parents pay fee etc. directly to the schools. Probably, on one side, the parents of such students will be more concerned about the learning of their kids. On the other side, the teachers working in the private schools are answerable to both the parents and owners of the schools. While because of the complications in law it is difficult to make answerable the trained teachers to the parents and boss who are working in the public schools.

The conceptual understanding level of the students of untrained teachers was comparatively better. However, their conceptual attainment was not remarkably excellent. There may be many reasons, but the one possible reason for overall weakness of the students in the subject of Physics may be due to memorization oriented teaching methodologies and insufficient content knowledge of teachers.

The overall low level of conceptual understanding of both the students of trained and untrained teachers, confirm the results showed by students in TIMSS (Trends in International Mathematics and Science Study) and in PISA (Program for International Student Assessment) studies (Organisation for Economic Co-operation Development [OECD], 2018). The results of this study are also similar to the study conducted by Stephens et al. (2016), which shows that, the students' performance in Physics is poor and they have shown no significant performance in Physics for the last twenty years.

6.1 Recommendations

It is recommended to investigate the conceptual understanding level of girls at secondary level as well. The research on the investigation of conceptual understanding of college level students is recommended to be carried out. This study was conducted about investigating the conceptual understanding of students in the subject of Physics. Further Studies should be carried out to find out students' misconceptions in the subject of Physics.

Similar research studies are recommended to be done about the conceptual understanding of students in other science subjects. Pedagogical and content knowledge of teachers is recommended to be searched out. Subject wise in-service trainings on the enhancement of content knowledge and concept oriented teaching methodologies are recommended to be arranged for the teachers. It is recommended to make simple the process of check and balance in public schools and ensure the accountability of public schools' teachers for their negligence in teaching.

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