



Examining Physics: Narratives of Lahore-Based Secondary School Academies' Teachers and Students

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Abstract

The goal of the qualitative narrative study was to determine whether there were any variations between Lahore-based academy teachers' and students' difficulties understanding Physics subject and those found in the literature. Open-ended of six Physics teachers and five students' focus group interviews were conducted. The study's findings were in line with the body of literature. Due to poor mathematical and memorization abilities, and outdated teaching techniques, physics students experienced difficulties. Teachers of physics agreed that a lengthy and inadequately designed curriculum, as well as a lack of materials for practical labs were obstacles to effective education. Technology was rated by both students and teachers as the most significant and useful resource for resolving their instructional and learning concerns in the physics classroom. It is, however, require a government financial, technical, and training support for integrating technology into education.

Keywords: Insufficient Content, Mathematical skills, abstract Concepts

1. Introduction

In all over the world, young students' reducing interest generally in science and specifically in Physics is a great concern (Steidtmann, Kleickmann, & Steffensky, 2023). Therefore, all over the world, at policy level, several efforts have been underway to make Physics teaching more attractive and more appealing to students. In Pakistan, narration of science as a school subject can clearly validate the current problems of science teaching and learning. Both teachers and students misinterpreted science concepts presented in the textbooks (Nasr & Soltani, 2011; Niazi, 2010). Science as an individual subject included in primary education in 1959. To host a more technical and scientific schooling, after 1970 practical work of 25 % weightage were introduced in secondary science subjects. To counter the shortage of science teachers, untrained and underqualified teachers were inducted. After nineteen years, in 1989, the Institute for the Promotion of Science Education and Training (IPSET) was formed for science teachers' in-service training (Halai, 2008). The wide policy gaps in supporting science teaching and learning resulted in chronological teachers' deficiencies in developing skills and experiences on hands-on experiments, adequate subject knowledge and faith in science (Faize & Dahar, 2011). Moreover, In-service trainings failed to empower teachers on using modern teaching method in their science classrooms (Tahir, 2011). School science curriculum is overloaded with outdated information-based content for memorization. Accordingly, lecture was the most common teaching method that altogether ignored the practical part of scientific content and support rote memorization practice (Iqbal, Azam, & Rana, 2009; Jessani, 2015; Malik, 2007). Supplementary, Pakistan's assessment system itself is a barrier to conceptual understanding of science concepts. Rind and Malik (2019) found that Sindh secondary school examination board (BISE) developed science papers that had majority of the items measured only students' comprehension and memorizing skills. Every year, many of the same things had been repeated word for word.

Specific to the subject Physics, the National Education Policy as well as Physics National Curriculum clearly guided stakeholders to cultivate critical thinking in students by using activity-based, cooperative learning and critical thinking pedagogy (Jamil, Muhammad, Masood & Habib, 2020). Nevertheless, it is far-fledged dream without answering the problems of inaccessibility of classrooms, trained physics teachers, laboratories, libraries and technology in a large majority of secondary schools (Khan, Khan & Rashid, 2020). The current study was designed to see any differences from literature in Lahore-based academy teachers and students' problems related to content comprehension of Physics.

2. Literature Review

Considerable amount of science students found Physics as the most demanding than other science branches and, therefore, few picked Physics whenever they got option (Oon & Subramaniam, 2011). All over the world students are losing their interest in Physics considering it a difficult subject as it is largely correlated with quantities and calculations (Mualem & Eylon, 2007; Mulhall & Gunstone, 2008; Owen et al. 2008). Physics and mathematics have relationships in building the students' Physic-based problem-solving skills (Liu and Liu, 2011). Students expected to relocate graphical representation to mathematical form. Şahin, and Yağbasan (2012) identified there were too many formulas and complex concepts in Physics outline; students' lack strong Physics content knowledge; explanation of concepts to everyday problems and envisaging the Physics concepts appeared hard to understand and; most importantly, teaching the subject in limited time was a challenge for teachers as well.

For teaching Physics, most of the teachers spent considerable time in presenting the teaching material on white board and Physics classes filled with "chalk and talk instruction" (Angell et al. 2004, p.701). Tesch et al. (2003) found that if teachers tried to use other teaching methods, they somehow make it teacher-centered again. Teachers used limited question-and-answer strategy to involve students in discussions in Physics classrooms. Question-and-answer approach used for assessment left the students with few opportunities to give different answers, create, and interpret research findings on their own. This way, teacher-centered methods left little opportunity for students to convey their thoughts, understand others thought process, and investigate their ideas (Crowe, 2007). Similarly, the open experimentations, for most students, ended in mechanically

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following steps of the practical book as a recipe approach instead of understanding the scientific inquiry (Duit & Tesch, 2010).

Teachers need to grasp how concepts relate to daily life in order to foster conceptual understanding. Prokop, Tuncer, and Chuda (2007) studied teachers' successful methodologies that could connect Physics theories and content with students' routine knowledge in order to increase students' attentiveness in physics. Teachers who used mind maps in their teaching strategies could change students' perceptions of physics (Alebiosu & Michael, 2011). Students should be prepared for activities based on questions from their science teachers. They will pick up more questions this way, and they'll be more equipped to deal with and resolve issues in real life. Science teachers should collaborate with students to encourage and inspire inquiries, recognize individual distinctions, and provide opportunities for all learners to learn. (Bybee, Carlson-Powell & Trowbridge, 2008; Okoronka, 2004).

Another important universal issue is related to the retention of teachers and teacher training that can empower Physics teachers for effective learning in their classrooms. In developed countries like United States of America, universities are developing effective training programs to attract more Physics teachers for secondary schools (Etkina, 2010). These trainings mainly focused on content knowledge, pedagogy, and Physics teaching knowledge. Mostly Physics graduates and undergraduate courses did not include the main concepts of secondary school curriculum. Therefore, Physics graduates did not have profound comprehension of Physics concepts included in secondary school curriculum (McDermott et al, 2006). This situation required a need for specialized Physics trainings for teachers in accordance to the curriculum need of different school levels. In developing countries like Philippines, it was a challenge to provide qualified Physics instructors in secondary schools as well as the provision of appropriate teaching resources. Mostly Physics teachers in Philippine schools were underqualified, untrained, and limited struggling in their classes with limited teaching and technical resources, (Orleans, 2007).

3. Material and Methods

With the help of a qualitative narrative design researchers identified the issues of academy teachers and students in understanding concepts of Physics. Open-ended interviews were taken from six teachers (4-males and 2-female), teaching Physics at different academies. Teacher A had bachelors in Electrical engineering and nine years of teaching experience; Teacher B did Masters in Physics and teaching for four years; Teacher C had Bachelors in Mathematics, Physics, and Master in English, and had been teaching more than six years; Teacher D had Bachelor in Mathematics and Physics, and she was teaching for twelve years; Teacher E had Bachelor in Electrical Engineering and seven years of teaching experience and; Teacher F had Bachelor in Mathematics and Physics and teaching for two years. Afterwards, researchers took five focused group interviews (4 to 5 participants in one group) from twenty-four secondary school students.

4. Results and Discussion

4.1. Theme I: Teaching Physics: Teachers' Concern for Teaching Resources

Teachers face difficulties of not having many resource materials as there were certain topics in the Physics book which were not explained in required detail to be fairly comprehended by students. Students added that for some topics that were absolutely novel to them and they had to visualize and assume things on their own without having clear example. For instance, magnetic induction, electronics, and sound waves were hard for students to comprehend.

4.1.1. Insufficient Content in Textbook

Teachers shared that description of instructional content in the Physics book was not enough to understand the concepts properly. Teachers needed more content in order to make their lessons productive. Teacher A shared, "Examples are only a few and not fully explained regarding the certain topic in books. Books also lack practical aspect of physics concepts". This way daily teaching tasks became more perplexing for teachers as they also had to make up for the insufficient clarification in the textbook. According to Teacher C:

I had issues when a subject was not completely explained in the book. Some physics concepts require more theory and justification. But all we receive are definitions from our texts. And because I lack the resources necessary to effectively teach these subjects, kids don't fully comprehend them. Students become disinterested in that subject and as a result in the topic as well.

4.1.2. Non-Availability of Teaching Aids

Teachers thought that the Physics concepts at high school level were not much difficult. Students could understand these topics without any problems. But there were certain topics that students needed to demonstrate by doing a practical work. Some topics mandatory required practical work and without labs and equipment teachers became helpless in rationalizing those topics to students. Subsequently, students performed poorly in exams. Different visual and auditory materials helped students to learn the concepts with better understanding. At that point, teachers found it difficult to get good teaching materials to explain the topic effectively. Teachers criticized their school authority not to provide them with required teaching aids. Teacher B shared:

The biggest problem I have right now is that I don't have enough teaching materials and resources. It can be exceedingly challenging to explain a new concept using only printed scripture on sometimes. For instance, when I once mentioned calipers, the students were just staring at me and had no idea what I was talking about as they had never even once seen one. When there wasn't much content to teach, teachers had problems. As a result, the students were less focused on the subject. If the instructor did not have enough material, he/she could not make the most of the time. Teacher D explained:

Lessons, in my opinion, are driven by the teaching material. One can effectively engage the class if they have quality content and enough resources to prepare and deliver their lecture. He can effectively utilize the majority of the lecture time and accomplish his educational objective. However, I regrettably find it challenging to instruct without AV aids and instructional materials, which include experiments, real-world examples, and practical applications.

4.1.3. Insufficient Time for Teaching Concept

Physics textbook had difficult topics that give teachers and students adequate time to completely understand the theories. Most teachers complained about a lack of time. One topic cannot be finished in one sitting. Students find it difficult to understand lectures when they are given in segments by the teacher. According to Teacher F:

We are unable to finish our lecture in time due to a lack of time. Some issues require practical explanations, but owing to time constraints, it becomes hard to cover all of the material. Even if you break that material up into smaller chunks, the learning process is still disrupted and kids still don't fully grasp it.

4.2. Theme II: Learning Physics: Teachers and Students' Concern

4.2.1. Mathematical Skills

Teachers agreed that Physics had calculations that were highly mathematical at secondary level, which means that the students who were weak in mathematics, for them performing well in Physics was a real challenge. Students were more interested in theoretical topics rather than mathematical. They found derivation difficult, and did not like it because derivation was not taught until grade-8. It became problematic for students as they moved already in grade- 9 and for the first time, comprehending derivation. One Physics teacher said:

Students are more interested in a topic the more relatable it is. For instance, "Force" and "Dynamics" are challenging for pupils. These chapters are all regarded as challenging because they all employ derivation. However, because all of their prior education was based solely on theoretical studies, students prefer theory and find derivation challenging.

4.2.2. Student's Perception

Nearly all of the students in the focus group responded to the researcher's question about what they found challenging about learning physics: derivations and equations, a lot of concepts and symbols, and not enough time to prepare for topics. The majority of girls claimed that physics is challenging to understand because of has many symbols. For example, a female student stated:

I find that learning all the calculations is difficult because there are so many formulas and mathematical problems, and our class period is so short. Just a lot of computations in math confuse me.

Girls believe that performing various mathematical calculations with broad and complex formulas is quite tough in higher standards. Another person said that he had difficulty developing notions and that it was challenging for him to tie his concepts to the solutions of mathematically based problems.

There are far too many difficult-to-understand physics ideas. It is also challenging to understand mathematical calculations and formulas. I find that it can be somewhat difficult to correctly apply the concepts to the situations in order to solve them.

4.2.3. Physics abstract Concepts

Teachers had to pique pupils' imaginations in order to explain the abstract notions. Without a real example, students found it difficult to understand abstract ideas and solve conceptual physics issues by simply picturing them. Additionally, there was misunderstanding among the students on several subjects where the names or symbols were so close. Additionally, they said that the calculations were complicated because they contained numerous symbols that were identical yet have different meanings. Watt and Work are denoted by W, and Voltage, Velocity, and other terms are denoted by V. Students were required to envision specific objects without understanding what they were, which is another difficult aspect of the nonrepresentational nature of Physics. One pupil shared, "It is very confusing and problematic when I have to imagine things like magnetic fields and electricity without seeing them. Imagining things in abstract form is a lot different from what we used to do before. It's very hard to understand".

Teachers faced difficulties in topics that were not relatable to real-life examples. The school B students perceived that Physics topics were hard to understand and dry. They found no application to daily life and not able to related it to their immediate environment and accordingly they did not comprehend those topics. They believed that Physics teachers could make this dull subject interesting for them if they had passion for Physics themselves.

On the other hand, Teacher F considered that most students faced troubles with concepts of electronics and magnetism for the reason that they cannot visualize these terminologies.

Students find it challenging to understand abstract concepts like magnetic and electric fields since it is very difficult for them to picture and understand things without experiencing or seeing them. Students can more easily understand a subject if they are shown how it is used in daily life.

4.2.4. Methodology

Mostly Physics instructors agreed that Physics concepts were not presented to students with references to be used in everyday examples, and students found these topics difficult to understand. Teachers pointed out that they did not get teaching skills outside of traditional techniques that was a key reason behind lack of interest in learners. Teacher A shared, "Many Physics teachers do not know how to get students to engage in group activities or discussions so they turn to the traditional way of teaching. Most of them teach as they are taught". Teacher C reinforced the lecture method because of its suitability:

The lecture method is most frequently employed. We also employ many formats, including audio, video, and practical. Usually, we demonstrate a straightforward practical in class right immediately that is simple to do. We cannot employ a differential method to address students' individual needs. Also, parents dislike it as they feel that we are underestimating their child's talents. We have to use the lecture technique for everyone in the class.

According to Teacher F best way to teach was to teach comprehensively and explain each and everything in detail without leaving any topic unnoticed. And he also stated that we should use everyday life examples presented near us to explain. The best teaching way is to explain each and everything to the students. One topic at a time should be delivered to students. They should be introduced to nature and real-time examples first and then relate those phenomena to the topics in their lecture.

4.2.5. Students Perception

Students shared that how would they want their teacher to modify their teaching method to make it interesting. After acknowledging their teachers as good at their job, students stated that teachers must introduce more practical experiments, classroom activities and conversation, to them as well as they should use apple time to describe difficult concepts. Students shared their concerns on their little participation in the decisions related to the course work as their teachers solely planned everything by themselves. The student said:

I desire teachers would give us more responsibility for carrying out experiments, taking ownership of our classwork, and assigning us work to complete. I think I would really like spending less time doing theory and more time solving mathematical problems. It's hard to recall everything he taught us since we don't need all of it.

During the focus group talks, some students voiced their dissatisfaction with the instructor's only verbal answers to their physics questions. Additionally, they are unwilling since they frequently do not get the opportunity to ask inquiries. They might prefer the question written on the board and, occasionally, the explanation, so they can copy it and understand it later. One pupil stated:

I enjoy how she asks us questions to guide our learning, but it worries me when she simply speaks something out loud without writing it down on the board. In order for me to record the response into my notebook and comprehend it after class, I wish she would write it on the board.

Nearly all students mention that they wanted the teacher to post the problems on the board when asked how they wanted the Physics instructor to change their teaching technique or make Physics questions easier to read. They also require a challenging whiteboard discussion of the entire course. Students also expressed the opinion that the teaching of physics was frequently dry, which made sessions dull. They suggested that there should be more activities and conversations to foster connections and allow students to learn from one another. Additionally, students like hands-on activities because they view them as enjoyable and cooperative, which makes the lesson more fun to learn. Student shared, "In my opinion some group work activities and class discussions to get us to work remove every single student's strong points and flaws to get improved outcomes in class". Other thought that their teacher could not use another method than lecturing as there were many topics to complete in short time.

4.3. Theme III: Strategies to Overcome Difficulties

Teachers and students both agreed that they use internet sources to solve problems when they face complications during teaching and learning. Various internet platforms, educational videos and websites are used in this regard. Students said that whenever they face problem they ask help from teachers or they use different books and key books to find the answers to their problems. Teachers also mentioned that they discuss their problems with their colleagues or experts in the field to get better command on the topic. Teacher said that he uses different books from different orders in order to understand the topic in depth. Teacher D said, "Whenever I have to prepare a topic for my lecture I consult different sources like books and journals from different authors in this way I get a better grip on the topic with multiple examples and methods to teach." Majority of the teachers said that they use internet more often to resolve their problems because resources on internet are limitless. One teacher said:

Books are limited. We cannot find answer to every question in books and we don't have a lot of books so I search on internet because you can search everything on it and can find your answer. There are multiple websites where you can ask questions and experts give their answers. You can also watch lectures on YouTube.

Most of the students said that their complications were solved by their teachers. And they used different methods and techniques to solve the problems. One student said, "If there are some problems in understanding we ask our teacher. If we have trouble in theory then we write in our own words according to our concepts and our teachers also help us to learn theory through reading". Most of the students agreed that majority of their problems were solved by their teachers. Their teachers used various methods and techniques

5. Discussion

The findings of the study were consistent with the literature and Pakistani students and teachers faced common issues as elsewhere in effective handling of Physics concepts in secondary classrooms. Physics students faced problems because of weak mathematical skills, lack of memorizing skills, and traditional teaching methods. Physics teachers shared that extensive and ill-prepared Physics curriculum, and insufficient resources in practical labs and audio-visual aids were the barriers for effective instruction. Students and teachers both recommended the use of technology as the most important and effective source for solving their instructional and learning issues in Physics classroom. However, government financial, technical and training support in infusing technology in instruction is a far-fetched dream. Whatever teachers and students were skilled to do was to operate the basic searching tools.

Internet and modern technologies have provided a wide range of reliable support to get a range of solutions for academic problems. In Pakistan, different studies had provided the substantial data on assorted use of modern technologies in facilitating teaching and learning. Studies supported that technology Afzal, Safdar, and Ambreen (2015) identified that physics students themselves consider technology based- teaching and material were more applicable, comprehensible, and

manageable, than the traditional teaching means (Abdusselam & Karal, 2020; Zhai & Chen, 2019). Rehman, Zhang, Mahmood, and Alam (2021) identified that students can acquire complex concepts with the help of computer simulations. They used interactive computer simulation program (PhET) for teaching weight and mass to secondary school students. The effects of PhET on the conceptual understanding of the students was significant. Students shared that they memorized physics concepts because they were unable to apply the theories to actual situations to resolve difficult problems. Teachers shared that with PhET simulation supported students to accurately measure the mass of an object, attention on instruction, and participation in discussion. From Malaysia, Zakaria, Phang, and Puspanathan (2019) acknowledged the link between conventional teaching, ill-resourced labs and students' poor understanding of Physics concepts. They found significant impact of Mobile Computer-based Physics Laboratory (MCPL) use on students' conceptualization of Forces and Motion as they were able to see the concepts in actual. All the studies acknowledged the inequalities of human, academic and technical resources existed in urban and rural, public and private, and low-income and high-income schools (Khan, Khan & Rashid, 2020; Rehman, Zhang, Mahmood & Alam, 2021). Especially, unfavorable working environment for male teachers (Nawaz, 2022). The promising results of studies on limited sample require government commitment to generalize and actualize the findings with obligatory continuous teacher training, research and resources on actual schools.

6. Conclusion and Recommendations

Universally at secondary level, the most prevailing problems of physics concepts comprehension and problem solving is related to the students' mathematical skills. It is strongly advised to include mathematical computations to make the lessons easier to understand with logical thinking. Additionally, more hands-on activities and mathematical illustrations would boost students' grasp of and motivation in learning physics. The synergic difficulty of physics and math concepts can easily relate with the teaching methods of mathematics and science in earlier grades. As grades proceed, Math becomes a difficult subject for most of students because of its abstract nature, unmemorable answers to questions and bargained practicality in common days life activities. It may not true in real sense, but narrow-written textbook contents and assessments, teaching methods, ill-furnished labs and lack of supporting technology make it so. Students with already compromised math skills also found it difficult to solve Physics problems in higher grades.

The modern technology is a great platform for teachers and students to expend their knowledge and skills both in content and pedagogy. But we should not put the whole responsibility on teachers or students to use their own resources and untrained technological skills to get benefit. Teachers need to get training on subscribing and using websites and channels. Their content specific trainings must incorporate use of internet resources, gadgets and to get most from the latest versions of technological features. In this regard, formation of and access to school Physics learning communities and technology teachers can provide an incessant knowledge formation and sharing.

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