IMPORTANCE OF SCIENCE AND TECHNOLOGY AT SECONDARY LEVEL EDUCATION IN PAKISTAN

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Abstract

The paper is aimed to identify scientific and technological education factors and assess their efficacy at secondary level. The survey included secondary science instructors from both public and private schools. A random sample of science instructors was chosen. The quantitative study used a questionnaire for instructors and a checklist for determinants. A checklist found suggested determinants. The pilot research verified the questionnaire. The key outcomes demonstrated that science aims are clear, rationally arranged, and of high quality. The textbook information is effective, logically organised, and pace-appropriate. Science education requires instructors to be competent and students to be motivated. Different evaluation strategies improve the effectiveness of scientific education by defining the behavioural objectives.

Keywords: Education, Science, Pakistan, Importance, School.

Introduction

We live in a scientific age. Science is easily observed in every sector and nook. Science knowledge is becoming increasingly important. Whether an industrialised city dweller or an ignorant rural farmer, both are interacting with science at their own level (Faize & Dahar, 2011). According to Goodrum and Rennie (2007), the depletion of energy reserves, the search for alternative energy sources, pollution, new diseases and their cures, abandoning old tools, learning to use new machines, meeting the nutritional needs of a rapidly growing population, the desire to find better means of comfort, and other factors have fueled a thirst for scientific phenome understanding. People may not understand scientific theories and regulations, but they are curious about how a modernised machine works and what new features it has. Science's development and decline affect a community's growth and demise. A country that has advanced in science and technology is more developed than one that has not (Faize & Dahar, 2011).

Science's techniques and ideas are vital to everyone in three ways. The first is in their own lives, so they may recognise healthy lifestyle components. The second is in their civic life, so they can make educated choices. Third, they must be able to adapt to changes in their jobs that are connected to science (TLRP, 2006). Science has tremendously influenced our life, culture, and civilisation. Its output develops human society and offers wealth (Cobern, 1998).

Pakistani schools start teaching science in first grade. It is taught with other courses in primary school. It is taught as general science in schools 6–8. In grades IX and X, science is organised into three branches: physics, chemistry, and biology. Also, some science students choose computing as an elective. Arts students must study broad science as a required course. In grades IX and X, pupils take an external test administered by a secondary school board. Science students apply to universities or higher secondary institutions after class X. Some private schools also offer Cambridge or London University O and A level curricula. According to Malik (1983), science course content in Pakistan is laden with facts; science professors are not excellent at teaching science; laboratory work is disregarded; course content is obsolete; and memorising is the preferred technique of learning. This condition may lead to a loss of interest in science. Currently, science enrolment is declining globally. The advanced nations may fail to generate the next generation of scientists, engineers, and notably scientific instructors (Rowlands, 2008). But Rowlands lacks proof. Data from one state or area cannot be extended to the whole planet. In actuality, the author is referring to the United States, where young people are not interested in physics. However, in Western Europe, Physics is quite popular in the Netherlands and Scotland, whereas in Eastern Europe, Physics is very popular in several nations. We live in a scientific age that demands scientific knowledge (Mathews, 2000). It is a social, cultural, and historical output that may benefit all mankind. Although science has caused many evils and difficulties, it is ultimately science that can save the world and solve the issues it has caused (Rowlands, 2008). The power of scientific discoveries to help mankind cannot be overestimated. Rowlands has inflated the role of science in saving the planet. Any study of recent wars undermines this argument, as skilled scientific usage causes tremendous pain. Science can reveal amazing insights. But science can never guarantee that its findings be applied ethically. It all relies on how man uses science. It may be both productive and detrimental.

Background

In today's society, science is becoming increasingly important. In order to increase students' performance, new teaching aids and instructional methodologies are provided each semester. Hussain and Reid (2006), on the other hand, asserted that science students in secondary school have expressed dissatisfaction with the link between what they learn in school and what they experience in their daily lives. This accounted for a considerable proportion of science students who dropped science subjects in the later stages of secondary school as a result of this phenomenon.

A country with a strong foundation in science education, on the other hand, will have an easier time developing its physical and people resources. It is often believed that a well-designed scientific education programme is the key to economic and social progress (Cobern, 1998); however, this may not always be the case (Wolf, 2004). Pakistan has achieved significant strides in the fields of science and technology since gaining independence in 1947. An inquiry of the current situation of the scientific education programme at the secondary level, on the other hand, is of particular significance. A major focus of the research project will be on identifying and addressing current issues in scientific education at the secondary level in Pakistan. The objectives of scientific education, the substance of science courses, teaching tactics, assessment, teacher training, and the availability of science equipment in the lab are all problematic areas for finding difficulties in the classroom and in the laboratory. In the following phase, the research team will look at methods to improve scientific teaching at the secondary level in Pakistan. The subject under research is so stated as follows: "Importance of Science and Technology at secondary level education in Pakistan."

Literature Review

It was noted by Jacques and Poisson (2001) that the extent of science education varies from nation to country. Science content, educational methods, scientific instruments, and ideals also change with time. Japan and Israel, for example, place a high value on technological advancements in science education. Although science content and scientific mindset are important components of English science education, a focus on the social implications of science is given more weight. In China, though, things are a little different. There are six primary areas of study in science education. Among them are the domains of expertise in the following areas: knowledge, operational competence, scientific process skill, application, creativity, and attitude.

Students' critical thinking skills should be emphasised in science classes. There will be an emphasis on context in this critical thinking. In scientific education, this approach may be applied by concentrating on the activities, challenges, and concerns that students face in their studies (Bailin, 2002).

Students learn to look at the world critically and come to conclusions based on facts and evidence. As a result of their education in science, students are better equipped to make a difference in the lives of those in need. It helps students become well-informed members of society who are able to raise important concerns in the field of science and make a positive impact on society as a whole. A thorough examination of these statements will reveal that they are all false. Because of this, it is difficult to pin down exactly what it means to be critical. Al-Qasmi (2010), in a research that is still ongoing, argues that critical thinking include questioning what, how, and why about new knowledge, as well as how the information's source and context relate to what is already known. Once there is agreement on the meaning of "critical thinking," it is untenable to argue that scientific education can produce it. Al-insight Qasmi's takes us a significant step forward. However, the question of whether or not it is 'correct' remains unanswered.. A misguided belief that science equips students to make a difference in the lives of those in need is a dangerous one. Studying the sciences can give you information, but putting that knowledge into practise is another story. Resources, political will, devotion, and so forth are all factors to consider. There is little science can do in this situation.

Pakistan's secondary education consists mostly of grades IX and X. In 1970, the federal government's education strategy stated that secondary education should serve two functions. For starters, secondary school is the last stop for the vast majority of kids. The main reason for this is because the vast majority of pupils drop out of school once they complete secondary school. As a result, secondary education should provide a strong foundation in science, technology, and vocational skills, so that students who are unable to continue their study have a wide range of options for pursuing their interests. Secondary education also serves as a stepping stone for students looking to pursue their education at a more advanced level. A excellent foundation for college and university study may be found in secondary school education. Additionally, Mohanty (2004) stated that kids might be effectively directed into a profession in science at this time.

A number of lesson plans can be used by teachers, according to Colletter and Chiapiappett (1989). It is common for some lectures to focus on delivering facts and information in a clear and concise manner. The demonstration approach, for example, is often used to demonstrate a scientific rule or concept to pupils. Discovery and inquiry tactics are two examples of activity-based education. two types of teaching styles have been categorised by Sharma (2004).

The dictatorial style: It's the old-fashioned way of doing things. It is a content-centered method of instruction where the emphasis is placed on the instructor. Students are only passive recipients of information. There's a lot of focus on how people think. Knowledge and the development of intellectual abilities are at the heart of the cognitive (Bloom, 1956) realm. Specific facts, procedural patterns, and concepts that aid in the development of intellectual talents and skills are all included in this definition of retention. Programed instruction and lecture technique are examples of authoritarian teaching methods.

Permissive Teaching Style: This is based on the more permissive methods of today's classrooms. A learner-centered approach is used in this kind of instruction. The instructor is only a facilitator of information, while the pupils take the lead. This type of teaching emphasises the emotional rather than the cognitive aspects of learning.

Discussion

Pakistan's secondary-level scientific education was studied as part of the research project. Three surveys with closed items based on a five-point Likert scale were used to gather the data (Likert, 1932). A three-point scale was then used to aid in making inferences from the data. A chi-square test for homogeneity at a 0.05 significance level was used to assess these closed items. The final two questions were left open-ended, and the percentages derived from their frequency were translated accordingly. Scientific professors, on the other hand, have a better understanding of the goals of science education than students do. According to Bibi (2005; 2007), the same conclusion has been reached by Naeem (2007; 2008). But this is not corroborated by Akhtar (2004), who discovered that content did not aid in the achievement of scientific aims. The goals of science are well stated. According to Kiani (2002) and Rehman (2003), this is true (2004).

Many of those who took the survey felt that the knowledge covered in science classes was simply too dense. Similar results were found by Rehman (2004). Irrelevant material was another issue I found in the scientific course content, which needed to be deleted. According to the research of 'Commonwealth of Australia,' (2009), there is a problem with the scientific curriculum being overloaded.

Course materials in the sciences are also being revised. This course's material has been updated and is superior to that of the prior one. In addition, it's based on the cognitive abilities of scientific majors. Akhtar (2004), Asif (2001), and Rehman (2004) did not support this finding, however Naeem (2007) did, maybe because it was a more recent study than the previous ones. To bring the scientific course material in line with the worldwide standard, it must be reworked. In addition, Naeem (2007) and Muju (2007) have also found this (2000). The content of scientific courses does not meet the demands of either science students or society as a whole. Asif (2001), Muju (2000), and Akhtar (2004) all found the same thing, although Akhtar (2004) does not.

Another crucial component of the scientific education process is hands-on experience. Practical work is of limited value if it is completed at the time of the yearly test or towards the end of the scientific course, as is commonly done in secondary schools. When a scientific practical is conducted in conjunction with a corresponding theoretical issue, the results are the best.

Without the use of a proper teaching approach, the learning process would be rendered unproductive. It was discovered during the process of identifying the difficulties in scientific education that science instructors are competent in teaching science using the classic lecture technique and the lecture cum demonstration method, but are not competent in teaching science using activity-oriented approaches. It has also been noted by Chaudhry (1993), Iqbal (2004), and Mohanty (2004) that the professors are proficient in the lecture approach. Meanwhile, Akhtar (2004), Bibi (2005), Iqbal (2004) and Rehman (2004) all agreed that instructors are incompetent when it comes to using activity-based teaching approaches in the classroom. In their respective studies, Osborne and Simons (1996) and Mohanty (2004) came to a similar conclusion.

Students should be encouraged to ask questions throughout class and to engage in classroom discussions so that they are actively interested in the subject, says the science instructor. Meanwhile, scientific professors do not actively engage with their pupils during the course of their instruction. In the opinion of Mehmood (2007), the pupils are not engaged in the class since the teacher employs the traditional lecture technique of instruction. The reasons for not using current teaching methods in scientific classes include a limited number of science times each week, overcrowding in science classrooms, a lengthy and heavy science curriculum, and a lack of resources.

The teaching-learning process in science necessitates the use of testing to gauge students' progress and abilities. If tests are done daily or within a week after the topic, they can be beneficial, but they should not be taken later than this. When conducting tests, it's important to keep them brief and simple. A similar finding was observed in a study by Mahmood (2007), who found that Japanese teachers saw assessment as an ongoing process and an integral part of the classroom by constantly inspecting students' work, reviewing their daily notes, and fostering open communication with them.

The science teachers are competent in developing assessment exams when it comes to their proficiency in testing and evaluation. Both Bibi and Iqbal are against this. Science teachers' ability to keep track on their pupils' development on a frequent basis split views. Teachers and students in the sciences agree that teachers are capable of frequently assessing students' progress, however headmasters and science specialists disagree. If a teacher does not offer feedback to pupils after testing and tracking their progress, it is useless. After an evaluation, the science professors are capable of delivering comments to pupils.

When it comes to Pakistan's examination system, it stresses the importance of comprehending concepts. There is a lot of overlap between Arif (1998) and Rehman (2004). At the same time, the testing method places a heavy emphasis on memorization. Similar results were found by Shirazi (2004), Iqbal (2004), and Rehman (2004). Furthermore, Crighton, Arian & Bethal (1995) and Osborne (2000) showed that the test system places a heavy premium on memorising specific critical concepts and facts, while overlooking other important aspects of the subject matter.

Having no emphasis placed on the application of concepts is another another flaw in the examination process. It is also corroborated by the findings of Asif (2001), Shirazi (2004), and Rehman (2004) It was also noted that the test system lacks the implementation of concepts of Crighton, Arian, and Bethal (1995). Internal assessment in science should be given due consideration. This may encourage students to work consistently rather than cramming for exams by having them prepare only a fraction of the material. The findings of Shirazi (2004) and Rehman (2004) were likewise consistent. Instead of a single integrated test, the boards of intermediate and secondary education now administer two independent exams for grades IX and X. This is an improvement over the previous method. According to those who took part in the survey, one of the problems with pre-service teacher preparation is the overemphasis on theoretical work at the expense of practical experience. Science instructors, according to Yulaelawati (2000), are unable to undertake laboratory work. This reaction might be influenced by the amount of time and marks allotted to theory in various courses. The findings of Anees (2005) are likewise supported by this research. Additionally, pre-service teachers are not appropriately taught in assessment and testing strategies for science instructors. According to Shirazi (2004), the same finding was found In addition, science instructors lack training in instructional design. It was found by Husain (1998) that low-cost teaching tools can help scientific teachers better understand their subjects. Guidance and counselling approaches and current teaching methods are taught to instructors. A similar conclusion was made by Khan (1998), who advocated for mandatory advising and counselling at the B.Ed. and M.Ed tiers of education. That pre-service teachers should be trained in current teaching practises is not supported by Aness (2005).

Professional trainers are involved in in-service training for teachers, and the training increases their ability to teach effectively. Thus, it is strongly advised that science instructors receive frequent in-service training in order to keep up with the latest developments in their field. Schoolteachers should be taught how to assess and evaluate their pupils, according to students in the science department. Students may be unhappy with the way their science teachers grade their work or set homework assignments. It was suggested that instructors in Pakistan should be educated in paper setup, testing and assessment methodologies by Arif (1998), Shirazi (2004), Iqbal (2004) and Bibi (2005) who all reported comparable results. They also said that instructors of science should be given more training in current teaching methods. There is a possibility that the pupils are simply receiving lectures from their lecturers. Husain (2004) came to the same conclusion that I did. Science majors also advocated for teacher training in hands-on lab experiences for instructors of the subject matter.

Among the other issues raised by the open-ended questions on Pakistani secondary scientific education, we found a dearth of science teachers and overcrowding in the classrooms. Poor science background, a lack of parental support for their children's education, an uninteresting course topic, less science courses per week than required, and a lack of effective oversight by the education office are among the other issues that have been found.

There were a number of responses to the open-ended question about how to improve science education in Pakistan: regular supply of science equipment to schools; teaching through activities; more science teachers; better facilities for science teachers; and better teaching in primary and middle schools. Respondents also advocated for the use of modern teaching methods, adequate funding for science education, regular monitoring of the science education programme, regular in-service teachers training, merit-based admission to science classes, appointment of competent science teachers based on merit, and close collaboration with private sector institutions.

Prospects of Science and Technology

Despite the fact that we've acknowledged the challenges and roadblocks that our scientific education programme faces, the likelihood of a more developed programme in the near future remains quite high. Science education and teacher training research is rising in scope as more colleges open their doors. Educator trainers with advanced degrees are also on the rise. University departments are becoming more advanced. Competition for teachers is increasing, and the minimum education level has been increased. Teachers' compensation is also on the rise. Teachers are getting better training in new technology, as well as their existing curricula are being updated. The usage of computers in the classroom has skyrocketed in recent years. They are encouraged to undertake lab work on a regular basis by the science professors.

It is also being worked on to improve the assessment mechanism. An equal amount of attention is paid to both objective and subjective evaluations in the test system. 9th and 10th graders must also complete a substantial amount of hands-on work. Government and non-government organisations also seek to promote scientific education in the United States. The next section highlights a few of these points. In rural Pakistan, the Scientific Education in Pakistan Group (SEPG) has correctly highlighted the issue of science education. This is a result of a scarcity of scientific tools and infrastructure. Students in Pakistan's remote communities will be able to conduct experiments utilising a mobile science lab thanks to this project. This is critical because it bridges the gap between theory and practise. It will also help students acquire a visual and intuitive knowledge of the material investigations. As a result, rural children will have a better understanding of science-related topics like sanitation, safe drinking water, and the environment, and they will develop a scientific outlook. The organisation will also strive to encourage young people to pursue a career in science. As a result, more kids will choose to study science.

Another initiative aimed at enhancing Pakistan's scientific, technological, and educational landscape is Science, Technology, and Education in Pakistan (STEP). Students, scholars, researchers, and policymakers from all walks of life will be invited to share their thoughts on current educational and technological policies in Pakistan. Secondly, it aims to establish and discover new strategies to promote Pakistani scientific education.. For one thing, it seeks to connect academic institutions, research groups, and businesses from across the world. Having this information is incredibly beneficial. The majority of the barriers caused by a lack of resources and funding will be eliminated by strong coordination between the public and commercial sectors as well as other research institutions. Meanwhile, the long-term benefits from sharing knowledge would be substantial.

National Institute for Science and Technical Education (NISTE) also contributes to the improvement of technical education and science education. As a result, Pakistani students now have more hope for a better future in science. Pakistan's scientific education is in need of improvement, according to NISTE. This institution is very cognizant of the training needs of its educators. A well-coordinated system of training and retraining our students and teachers is in place. According to this program's goals, it also intends to develop science and technical education in line with the most recent trends, practises, as well as the current requirements of scientific and technology domains. Science curricula have been continually reviewed, revised and updated by NISTE, which has done an excellent job. It has produced research-based curriculum, textbooks, instructional materials, and training programmes for teachers in order to achieve this goal. Furthermore, it plays a notable role in coordinating the national and provincial levels of the government. Consistency in the policies and processes of both policy-making and policy-implementing agencies is essential. This would need a committed and engaging leader. Leadership is responsible for setting the course of the organization's activities and ensuring that its objectives are met with the least amount of waste and effort possible. Hope for a better tomorrow suggests that a strong scientific education programme is extremely likely, and that China will join the ranks of the world's most sophisticated nations.

Recommendation

The researcher made the following suggestions in light of his observations and conclusions:

1. While all stakeholders were able to agree that scientific teaching objectives were clear and achievable, they disagreed on the same statements and how well they were understood by teachers and students alike. There is a pressing need for significant improvements in scientific education. They may be improved to be more practical, clear, specific, attainable, quantifiable, and in line with the demands of the twenty-first century, so that all stakeholders can come to an agreement. This may be accomplished by rewriting the curriculum and including all stakeholders in the process.

2. Curriculum experts, topic specialists, science teachers, representatives of examination boards, and members of the local community can be included in a review to eliminate obsolete and unnecessary items.

3. Secondary-level science course material has failed to fulfil the demands of both the individual and the community. Reviewing and gradually raising the content of scientific courses to meet worldwide standards is one option. An objective comparison of the national scientific curriculum with that found in more developed nations can help attain this goal, and any adjustments made should be integrated into the national curriculum.

4. A proper connection between theory and practise is needed. When doing the needed practical work, it should not be done towards the conclusion of the course or right before an annual test.

5. It is possible for science teachers to incorporate inquiry-based teaching and open-ended inquiry-based experiments into a single lesson. Additionally, frequent in-service training sessions may be organised to educate instructors how to use current teaching approaches combined with hands-on lab activities to help them better understand the concepts they'll be teaching.

6. Students' performance in science can be assessed at least once a week by the science instructor. Teachers of science can use short, multiple-choice, matching, fill-in-the-blank, or other types of assessments to achieve this goal.

7. Assessment goals may be given proper consideration in the test system. At the 'O' level international secondary test, the University of Cambridge assigns 30 percent of the grade to recalling knowledge, 35 percent to comprehending concepts, 15 percent to problem solving, and 20 percent to experimental abilities and exploration.

8. It is possible for teachers training institutions to focus equally on theoretical and practical aspects of teaching. You can extend the time and duration of your practise teaching sessions in order to gain additional hands-on experience in the classroom.

9. In addition, pre-service training institutes can educate instructors assessment and testing procedures, the creation of low-cost teaching aids, and how to perform science practicals at the appropriate level.

10. Inspecting the progress of the scientific education programme can be done by the education offices in a planned or unexpected manner. Separate education supervisors in the sciences may be hired to keep an eye on the progress of pupils, instructors' availability, and the activities taking place in the lab and on school projects.

11. The financial consequences and the development of the various stakeholders' capabilities are critical if the offered ideas are to be implemented. An increase in the GNP's education budget to 4 percent is essential.
This may be accomplished with the help of international donors and a reduction in federal and provincial governments' additional spending. For their part, the public schools and private sector institutions should work together to share resources including physical and human capital.

Conclusion

The following conclusions were obtained from the research. Achievable goals for scientific education have been clearly identified and communicated to science instructors and students. The scientific course content is overloaded (lengthy) and contains irrelevant stuff. Updated and relevant science content is provided to pupils. However, it fails to satisfy the requirements set out by the world community. Aside from that, students and society as a whole aren't getting what they expect from scientific classes. The government's newly updated science content is superior than the prior one. Lecture and demonstration techniques of instruction are well-suited to this scientist, but activity-based approaches are beyond her scope of expertise. They don't use current teaching methods since there are fewer scientific classes each week, an overloaded science syllabus, and cramped classrooms. Rather than waiting until the end of the semester or the week before final exams to complete scientific practicals, students should complete them in conjunction with the course's relevant theory.

During class, the scientific professors do not engage the pupils in any meaningful way. The focus is on the teacher. Teachers, on the other hand, have no problem with students interrupting their lectures to ask questions. It is best to perform the evaluation as soon as possible, but no later than the next week. Teaching cannot take place without assessing the pupils, and this is done through the use of brief oral examinations, quizzes, and short questions. Teachers of science are skilled in creating assessment tools, analysing the results of those tools, and following up with students on a regular basis to see how they're progressing. Understanding ideas and rote learning are key components of Pakistan's test process, yet concepts aren't applied in any meaningful way. In light of the evaluation outcomes, the scientific instructors also enhance their teaching tactics. The students who took the survey unanimously agreed that the importance of self-evaluation should be recognised in the final test.

Separate tests for grades 9 and 10 are also preferable to the old combined exam since they are more rigorous and comprehensive. Pre-service teacher education is of high quality.

However, the theoretical aspects of teaching are given greater attention, while the practical aspects are overlooked. Students aspiring to be science teachers receive instruction in a variety of instructional strategies, including mentoring and counselling and the use of current teaching practises. In spite of this, they are not educated in the creation of instructional aids or in the assessment and testing methods. Scientific instructors must be trained in testing and assessment methods, current teaching methods, and doing science practicals. It was discovered that the majority of science labs had scientific instrumentation. Most of the schools had a display table, electricity, water, physics-related tools, glassware, charts, models, and microscopes to use. Gas, chemicals, racks, shelves, and multimedia projectors were all absent in the science labs.

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