Developing Academic Administration Guidelines of Safety Scientific Experiment for Primary School Students of Shenzhen Fuyuan School, China

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Received : April 27, 2025
Revised : May 5, 2025
Accepted : June 24, 2025

Abstract

The safety of scientific experiments is an important criterion to measure the level of primary school science education further effectively. This is a relatively difficult issue to manage and requires more in-depth study. This study has two purposes: 1) to explore the needs and existing problems of scientific experiment safety guidelines; 2) to establish scientific experiment safety management guidelines. Shenzhen Fuyuan School currently has 46 science teachers. Collected data and information are analyzed, interpreted, and presented in the form of frequencies, percentages, means, and standard deviations. The main findings of this study are as follows: 1) The needs and existing problems of scientific experiment safety issues are at the "highest" level; 2) Experimental safety management policy: (1) Adopt people-oriented concepts and methods to establish a people-oriented quality education model; (2) It is necessary to further carry out experimental safety training and other advanced safety management concepts that are in line with international standards, and further strengthen the exchange of experience; (3) The scientific management process needs to be continuously improved and needs to be guided by practice More scientific and refined. It is necessary to formulate continuing teaching education goals and development plans focusing on talent cultivation, improve relevant scientific experiment safety management procedures, further strengthen corresponding controls and inspections, further establish specialized control units, and promote the overall improvement of scientific experiment safety awareness.

Keywords: Primarily School Student, Safely of Scientific Experiment

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Introduction

Science is the knowledge system formed by human beings based on studying natural phenomena and discovering natural laws, as well as the cognitive process of obtaining these knowledge systems and the methods used in this process. According to different research objects, science can be divided into branches such as physics, chemistry, biology, astronomy, and earth science. These branches have different research methods and some common scientific methods, showing the trend of mutual penetration and cross-integration. Science provides the theoretical basis for technology and engineering. The mutual promotion of science, technology, and engineering has been enhanced day by day, which has promoted the development of productive forces, economic prosperity, and social progress, promoted the transformation of people's production methods and lifestyles, and improved the material civilization level of human society; The unique way of thinking, way of thinking, spiritual power and values have improved the spiritual civilization level of human society (Lewis & Litai, 2003, pp. 926-942).

A compulsory education science course is a comprehensive basic course that embodies the essence of science and has strong practicability. (Gilbert, 2000, pp.3-17). Science courses help students maintain their curiosity about natural phenomena, from being close to nature to being close to science, to gain a preliminary understanding of the entire natural world, to understand the relationship between science, technology, society, and the environment, to develop basic scientific abilities, and to form a basic attitude towards scientific knowledge and social responsibility, gradually establish a correct world outlook, outlook on life, and values, and lay a good foundation for future study, life, and lifelong development; it is conducive to improving the scientific quality of the entire nation, promoting economic and social development, and building a technologically powerful country. Teachers' professional development in laboratory practice, consciously or unconsciously, plays an important role in cultivating students' positive attitudes toward scientific experiments and should be supported. Considering that students' positive attitude towards science courses will also affect students' course choices in the next stage of education and future career choices, the layout of science classrooms should attract students' attention, increase students' interest, and enhance students' interest.

Curiosity leads them to have a positive attitude towards science lessons. Teachers should be provided with on-the-job training for science courses as courses that develop students' hands-on skills, creativity, and ways of thinking, as well as the laboratory practices that are integral to the course and through activities that encourage students to participate in activities. "Elementary school science is a subject that integrates physics, chemistry, biology, and geography. Suppose a

science teacher wants to lead elementary school students into the mysterious kingdom of scientific knowledge. In that case, it must be realized through the important carrier of scientific experiments in the classroom. In teaching, classroom experiments run through the entire science teaching activities, so how to ensure the safe development of science classroom experiments is worth thinking about for all science teachers. In 2019, the Ministry of Education of China issued the "Opinions on Strengthening and Improving Experimental Teaching in Primary and Secondary Schools" (from now on referred to as "Opinions"). That experimental operation will be included in the junior high school academic proficiency test before 2023. The test scores will be used as the basis for high school enrollment. It can be seen that experimental teaching in primary and secondary schools has been included in the important content of the measurement and evaluation of students' academic levels. Experimental teaching will be carried out more widely, and safety issues in the experimental teaching process will inevitably be taken seriously. highlight.

The rules and regulations are not perfect, the planning and construction of the laboratory are not standardized, the laboratory teachers are lacking, the safety awareness of the laboratory teachers and students is not high, and the storage and use of dangerous goods are unscientific. Cultivating the overall scientific literacy of citizens and providing a safe and effective learning environment are issues worthy of deep consideration. For example, "Adding Safety Locks for Scientific Experiments": "With the implementation of quality education and the popularization of experimental teaching, primary school science teachers should let go of students in experimental teaching and let them fully Understand open experimental materials, discover problems through their research, acquire knowledge, and improve teaching effects. However, students have weak safety awareness and poor self-protection ability, and accidents of one kind or another often occur in experiments. commented on "Laboratory Safety Risk Control and Management" and said that the experimental safety management of primary and secondary schools is unique because the objects they protect are young children who seriously lack self-protection ability. Children are the future of the motherland. If they can get enough care at an immature age, it will reduce the risk of injury during their growth and create a sense of psychological security to grow up confidently. Therefore, strengthening the experiment Safety management is one of the important contents of safety management in primary and secondary schools today. Are safety precautions included in the lesson plan? If included, are the measures appropriate? How can teachers determine if a lesson plan is safe for students? According to (Aini, 2023, pp.116-128): "Freshmen in the Department of Chemistry at UNP study general chemistry, and each year lecturers face the reality that only 20% of the students can complete the course learning outcomes. Using a lab

manual based on guided inquiry, students can expect improvements in achieving completeness because their process skills were well developed.

Research Objectives

1. To investigate needs problems and an academic administration guideline of the safety scientific experiments for primary school students.

2. To develop an academic administration guideline of the safety scientific experiments for primary school students.

Research Method

Population and Samples

Population

The population in this research project, Shenzhen Fuyuan School was used as a case study. In this research project were divided into 2 groups, namely, 1) 10,000 students participated in safety scientific experiment in 2022 and 2) 46 teachers teaching of safety scientific experiment.

Sample

The sample groups in this research project were divided into 1 group; namely, 1) 10,000 students, who participated in safety scientific experiment in 2022; 2) 46 teachers who participated in safety scientific experiment in 2022 of Shenzhen Fuyuan School. The sample groups were derived from Taro Yamane formula (Yamane, 1967, p.887).

Research Instrument

Questionnaires: In this research project, a questionnaire was employed for the data collection. The questionnaire was divided into 1 set; namely, 1) teachers set. The questionnaire was divided into 2 parts sections,1) general information, 2) problems and needs of safety of scientific experiment. For getting a better understanding of the present status of primarily school students' safety of scientific experiment ability, the researcher chose the suitable questions from He (2012) doctoral dissertation questionnaire when she graduated from Shanghai International Studies University and compiled the primarily school students' safety of scientific experiment ability questionnaire for this study. The questionnaire was evaluated for the validity through Index of congruence (IOC) by the 5 specialists. Each question in the questionnaire was in the range of IOC 0.80 to 1.00. The reliability of the questionnaire was evaluated in terms of Cronbach Alpha Coefficient at 0.80 (Cronbach, 1951, pp. 297-334).

Data Collection

For this research project, the researcher herself collected the data and information from the sample groups. The sample groups were informed the purposes of the data collection, made an appointment. The researcher submitted a letter of permission to the school director in advance to ask a permission to collect the data and information from the samples group at Shenzhen Fuyuan School.

Data Analysis

The Data and information collected were analyzed, interpreted and then presented in terms of frequency court, percentage, mean ($\overline{X}$), standard deviation (S.D.). The Five Point Likert Rating Scale was used to evaluate the respondents' needs and problems of safety of scientific experiment. The criteria and define at the range of the mean scores as the following: The ideas and comments from the 5 specialists obtained from the focus group discussion meeting were analyzed by using Quantitative Research Method and then used to correct and improve the contents of the management guideline.

Conclusions

According to the survey of teachers' needs, we can analyze and compare the data as follows: The table provided seems to show responses from a survey concerning various aspects of support for scientific experiment application in teaching. The average current ratings by respondents are below 3.10 across all items, indicating that there is room for improvement in each area. The desired scores are near or above 4.70, which shows a significant gap between the current situation and the ideal, particularly in providing flexible scientific experiment equipment for classroom teaching (2.02) and financial support for developing scientific experiment teaching resources (1.83). The smallest gap is in the online support platform for teacher collaboration (1.70), suggesting this is an area where the school is closer to meeting teacher expectations. Overall, the data suggests that teachers feel additional support and resources are needed to effectively incorporate scientific experiments into their teaching practices. The average scores given by respondents for the benefits of using scientific experiments in teaching range from 2.78 to 3.09. This suggests a general but not strong agreement that scientific experiments have positive effects in the classroom. The largest gap between current conditions and desired conditions is for item 24, which relates to the importance of safety in scientific experiments, indicating that respondents see the most room for improvement in this area. The smallest gap is for item 18, which suggests that respondents are closest to the desired state when it comes to students being interested and motivated by scientific experiments. The overall gaps across all items are relatively consistent, ranging between 1.65 and 2.00. This consistency indicates a uniform perception that

improvements are needed across the board. Feedback from students and parents about the enjoyment of learning with scientific experiments shows the highest desired state at 4.91, reflecting a significant expectation gap. From these observations, it's clear that while there is recognition of the value scientific experiments bring to learning, there is a perceived need for improvements, particularly in safety and making learning more enjoyable.

In the safety of scientific experiment guidelines, we identified the following highlights based on the survey results and the results of the panel discussion.

1. School Purpose: closely following the school running needs of the social and economic development of Shenzhen and its surrounding areas, adhering to the school motto of "Bowen Wen Jing Wu, Revitalizing China", and in accordance with the national education policy, carry out ideological and moral education and compulsory education, teach cultural and professional knowledge, and cultivate a sound personality. Use professional skills and knowledge to enhance physical and mental health, improve the quality of education, and cultivate students in the region who are physically and mentally healthy, and have all-round development of moral, intellectual, physical, artistic, and physical skills.

2. Educational objectives: The primary education goal is mainly to cultivate students' basic learning abilities, good personal morality, and social interaction skills. This includes strengthening the learning of basic knowledge, such as Chinese, mathematics and science, and promoting students' all-round development, including quality education in sports, art, and music. At the same time, we focus on cultivating students’ innovative consciousness and practical ability, as well as their sense of social responsibility and teamwork spirit. Primary school education aims to help students form a correct world outlook, outlook on life and values, laying the foundation for their lifelong learning and all-round development.

3. Standardize the scientific experiment management system and improve the teaching management rules and regulations, faculty management system, student management system, and logistics management system.

4. Standardize the change, termination, and modification of the scientific experiment safety management system.

Discussion

The results of a survey of Shenzhen Fuyuan school teachers provide valuable insights into the status of the application of scientific experiments in education. The survey results highlighted the perceptions and needs of both key stakeholders and revealed areas for improvement.

1. The impact of teachers' use of scientific experiments

When teachers use science experiments, students feel that they have a positive impact on their understanding and mastery of course content. This finding highlights the potential of science experiments to enhance the learning experience. Research shows that teachers' strategic and effective use of science experiments can significantly improve students' academic success. Research by Fauth (2019, pp. 1-50) highlights the positive impact of teacher competencies, including pedagogical content knowledge, self-efficacy, and enthusiasm for teaching, on student learning outcomes. Strengthen the construction of teachers' scientific experimental teaching capabilities, especially improve teachers' scientific content knowledge and experimental guidance capabilities and improve students' learning effects.

From a teacher's perspective, it is important to increase students' interest and motivation. Teachers believe that using information technology in the classroom can significantly increase students' interest and motivation. This is in line with the expectations of modern pedagogy, where engaging students' attention and creating a positive learning environment is crucial. Teachers report that the application of science improves teaching efficiency. This finding highlights the potential of experiments to streamline the educational process and make teaching more efficient and impactful. The positive correlation between the use of science experiments and teaching effectiveness shows that investing in technology can bring tangible benefits to educators.

2. Scientific experiments have positive significance for scientific learning

Teachers have observed that students are more likely to understand abstract concepts and complex knowledge when taking lessons that include science experiments. This finding highlights the role of experimentation as a facilitator of learning, especially when dealing with challenging topics. It emphasizes the potential of science to enhance understanding and knowledge retention. One surprising finding was that teachers agreed that student interest and motivation increased significantly when science experiments were used in the classroom. This unanimous agreement demonstrates a strong consensus among educators regarding the positive impact of experiments on student engagement. This consistency is uncommon in education research, which makes this finding noteworthy. The results strongly support the hypothesis that strategic integration of science experiments in educational practice has a positive impact on student engagement and teaching effectiveness. Students and teachers alike acknowledge the benefits of experimentation, emphasizing its role in improving the overall educational experience. There were no significant differences between the results and the study hypotheses. However, potential areas for improvement can be explored based on identified gaps and needs, such as the need for more comprehensive guidelines and tailored scientific experimentation plans. Rusek

(2020, p.25) points out that although experiments play an important role in education, relatively little occurs in actual teaching. This is consistent with the data question 13 I collected. The data shows that this is the biggest problem currently encountered in science teaching in our school, with a difference of 2.02. This further trigger people's thinking. Even in science teaching, science Experimental teaching can help educators and educated people to varying degrees, but due to some difficulties, it cannot be concretely used in every class.

Overall, the findings highlight the importance of science in modern education. Both students and teachers recognize its positive impact on learning outcomes and teaching effectiveness. The gaps and needs identified, particularly in the use of scientific experiments and increasing teachers' participation in science-related training, provide Shenzhen Fuyuan School with actionable insights to strengthen its ability to teach and educate. This study of guidelines for the safe management of scientific experiments highlights the need for sound policies, teacher training, and infrastructure to reduce risks and enhance the educational experience. Future research directions could focus on developing more detailed and specific experimental safety guidelines to accommodate different educational levels and environments. Policy recommendations might include stricter enforcement of safety standards, regular safety audits, and integrating safety education into teacher training programs. Practical recommendations may involve developing innovative educational techniques to safely simulate experimental conditions, thereby reducing risk while maintaining educational value.A detailed exploration of the Guidelines for Academic Management of Science Experiment Safety highlights the critical role these factors play in ensuring a high-quality and safe educational experience. These insights could have a significant impact on related fields by providing a framework for developing safer and more effective educational practices to meet the changing needs of students and educators in science.

According to Ole (2020, p.7) conducted a research project titled "Effect of a Developed Physics Laboratory Manual on the Conceptual Understanding of Industrial Technology Students." the results indicated strong support for utilizing the learning material for instructional and institutional use. The study aimed to determine the effect of a developed laboratory manual in Physics on the conceptual understanding of Industrial Technology students. This study used a pretest-posttest matched group design with experimental and control groups consisting of 21 students each that had undergone matching procedures. Descriptive statistics like mean and standard deviations and t-tests were used to interpret and analyze the data. Cohen's d-effect size measure was also employed to measure the practical significance of the instructional material. This effect size can be operationally defined as learning gains due to experimental treatment. Findings suggest that the developed laboratory manual in Physics was effective in enhancing the students' conceptual understanding during their Physics laboratory class.

Limboo (2021, pp.97-11) conducted a research project titled "Safety Practices in the Chemistry Laboratories of Higher Secondary Schools of Samtse District: A Case Study in Bhutan." the results indicated that the schools had good safety practices with adequate laboratory facilities and safety skills. The schools were also aware of emergency planning and chemical storage and

labeling. However, schools lacked properly trained safety practitioners. It was also observed that chemicals and waste materials were disposed of without treatment. Further, it was also observed that there were shortages of safety gloves, goggles, fume hoods, and pipette fillers.

These studies collectively emphasize the importance of innovative educational strategies, safety practices, and technology integration in science education. They highlight the need for pedagogical adaptation for foreign students, the benefits of research activities in developing cognitive independence, the role of socio-scientific topics in education, the necessity of basic equipment for effective science teaching, and the advantages of immersive technologies like VR in enhancing learning outcomes. Safety in laboratories is also underscored, with studies pointing out both the strengths and areas for improvement in current practices. These insights suggest a multifaceted approach to science education that includes enhancing pedagogical methods, integrating technology, and maintaining rigorous safety standards to improve overall educational quality and student engagement in science. In summary, while these studies all affirm the positive impact of scientific experiments on the educational process, differences in the focus and specificity of the interventions help to elicit nuanced insights. Understanding the diverse contexts of scientific experiments can guide customized approaches to enhance education more effectively.

Suggestion

Education Reform Suggestions

Based on the research, in order to promote the more effective application of scientific experiments in education, the following education reform suggestions are put forward:

1. Comprehensive update of curriculum design: In response to the needs of students in science courses, educational institutions should review existing courses to ensure that they are in sync with current technological developments. Integrate scientific experiment training courses to enable students to master the latest experimental methods, enhance academic competitiveness, and cultivate students' innovative awareness.

2. Innovation in teaching methods: Encourage teachers to adopt more innovative teaching methods, including the transformation of identities in the education process. Train teachers to use scientific experiments to improve teaching effectiveness and stimulate students' interest in learning.

3. Establish a scientific experiment support system: Schools need to establish a complete scientific experiment support system to ensure that students and teachers can receive timely technical support and training. This will help solve the problems students encounter in using scientific experiments while increasing teachers' teaching confidence and efficiency.

4. Develop clear IT integration guidelines: In response to students’ concerns about the lack of clear guidelines for the application of scientific experiments, schools should formulate detailed IT integration guidelines. This includes how teachers can effectively integrate technology into instruction to improve student academic performance.

5. Strengthen interdisciplinary cooperation: Promote cooperation between different subject areas and achieve the integration of multidisciplinary knowledge applications. Interdisciplinary collaboration helps create a more comprehensive and diverse learning environment that enables students to flexibly apply science skills across disciplines.

These reform proposals aim to better adapt the education system to the needs of modern society, ensure that students and teachers make full use of scientific experiments, and improve the quality and effectiveness of education.

Practical advice

1. Develop personalized science course training plans: Schools can develop personalized science course training plans for students and teachers, and provide targeted training based on the levels and needs of students and teachers. This can be achieved through regular training workshops, online educational resources and personalized guidance.

2. Establish a technical support center: Schools can set up specialized technical support centers to provide timely technical support to students and teachers. The center can resolve technical issues, provide training and guidance, and serve as an advisory body to facilitate technology integration.

3. Encourage teacher community interaction: Schools can create online platforms or social media groups to promote experience sharing and interaction among teachers. These communities

can serve as platforms for teachers to exchange information technology best practices, work together to solve problems, and inspire innovation.

4. Provide practical cases and resource libraries: Schools can establish practical cases and resource libraries to demonstrate the successful application of scientific experiments in teaching. These cases and resources can help educators better understand how to integrate technology and provide practical guidance and inspiration.

5. Regular evaluation and adjustment: The school regularly evaluates the application effects of scientific experiments and makes adjustments based on feedback and evaluation results. This helps identify problems in a timely manner and optimize integration strategies to ensure they meet the school's teaching goals and student needs.

Through these practical suggestions, schools can better promote the practical application of scientific experiments in education and provide more support and guidance for educators to improve the overall quality of education.

Suggestions for future research

1. In-depth study of the impact of scientific experiments on different disciplines: Further explore the application and impact of scientific experiments in different disciplines. Research could focus on discipline-specific teaching practices to understand how scientific experiments have differential impacts across disciplines.

2. Longitudinal studies of long-term effects: Conduct deeper, longer-term longitudinal studies to assess the long-term effects of science experiments on students' academic performance, skill development, and career readiness. Such research can shed light on the evolution and impact of scientific experiments throughout students' academic careers.

3. Cross-cultural comparative research: Carry out cross-cultural comparative research to explore the application and acceptance of scientific experiments in education under different cultural backgrounds. This helps to understand the impact of cultural differences on the integration of information technology and provides a broader reference for educational practices around the world.

6. Research on the professional development of educators: Research on the professional development of educators, with special attention to the impact of information technology training on educators. Understand the long-term impact of training on educators' teaching methods and attitudes to better support educators' professional development.

7. Explore the educational applications of emerging technologies: Research the potential applications of emerging technologies such as artificial intelligence, augmented reality, and virtual reality in education. It helps to grasp future technological development trends and provides forward-looking theoretical and practical guidance for educational innovation.

Due to limitations in the research cycle and audience scope, this scientific experiment safety study may not fully cover all potential safety issues. I hope future scholars can provide more concrete research to benefit the world. There are many ways to improve the safety of science experiments, but there is a gap between current practice and the standards required for a safe

educational environment. It is hoped that future research will go beyond the scope of this study and focus on a wider audience and longer research periods to fully cover all potential safety issues.

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