Laboratory Practical Work in Conceptualizing of Secondary Science Education: Empowering Girl Students in West Bengal

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Abstract: Science education is crucial for empowering girls and women, enabling them to participate fully in the workforce and contribute to societal development. In West Bengal, India, where gender disparities persist, it is essential to examine how practical work in science education can foster empowerment among girl students at the secondary level. This paper explores the multifaceted role of practical work in conceptualizing science education and its implications for women empowerment. Drawing upon existing literature and empirical evidence, it highlights the significance of hands-on learning experiences, building confidence, challenging stereotypes, developing critical thinking skills, promoting collaboration, empowering decision-making, and influencing career choices. Through a comprehensive analysis, this paper demonstrates how practical work serves as a catalyst for women empowerment in the context of science education in West Bengal.

Keywords: practical work, science education, girl students, secondary level, women empowerment, West Bengal

Introduction: In West Bengal, like many other regions globally, gender disparities persist in education, particularly in STEM (Science, Technology, Engineering, and Mathematics) fields. Empowering girls and women through education is critical for addressing these disparities and promoting gender equality. Science education plays a pivotal role in this process, offering opportunities for girls to develop essential skills, challenge stereotypes, and pursue diverse career paths. At the secondary level, practical work in science education emerges as a powerful tool for conceptualizing scientific concepts and fostering women empowerment. This paper aims to explore the role of practical work in science education among girl students at the secondary level in West Bengal, with a focus on its implications for women empowerment.

Rationale of the Study: The rationale for this study stems from the persistent gender disparities in STEM education and workforce participation in West Bengal, India. Recognizing the pivotal role of science education in empowering girls and women, this research aims to investigate how practical work in secondary science education can contribute to women's empowerment. By addressing these disparities and exploring the multifaceted impacts of practical work, the study seeks to inform policies and interventions aimed at fostering gender equality in science education and beyond.

Objectives:

- ❖ To explore the role of practical work in conceptualizing science education among girl students at the secondary level in West Bengal.
- ❖ To examine how practical work contributes to women empowerment in the field of science education.
- ❖ To identify challenges and barriers faced by girl students in engaging with practical work in science education.
- ❖ To propose recommendations for enhancing the role of practical work in promoting women empowerment in science education.

Hypotheses:

HP-1: There is a significant relationship between practical work and achievements of girl students thereby empowering them to pursue STEM education and careers.

HP-2: Laboratory Practical work in science education significantly contributes to women empowerment among girl students at the secondary level in West Bengal.

Methodology:

Method: The study employs a mixed-methods approach, combining qualitative and quantitative research methods. Data will be collected through surveys, interviews, and classroom observations conducted with girl students, teachers, and educational administrators in secondary schools across West Bengal. The qualitative data will be analyzed thematically to identify key themes and patterns related to the role of practical work in science education and women empowerment. The quantitative data will be analyzed using statistical techniques, such as descriptive statistics and inferential statistics, to examine the relationship between practical work and women empowerment in science education.

Research Design: This study utilizes a descriptive survey design to evaluate the impact of practical science education on girl students' achievement and perceptions. Two girls' schools are selected, each with control and experimental groups. Experimental group students participate in practical experiments during a 40-minute class, followed by a 20-mark questionnaire. Control group students attend traditional 40-minute science classes, completing the same questionnaire. Standardized and validated questionnaires assess student perceptions.

Besides the achievement test of girl students, Interviews with science teachers and educational administrators provide additional insights. Teacher interviews cover integration, benefits, challenges, collaboration, and success stories. Administrator interviews focus on initiatives, monitoring, strategies for participation, professional development, and empowerment through practical work.

Sample of the Study: 120 girl students from two different schools of class ix of South 24 Parganas district of West Bengal are sample of the study. Total 120 girl students are chosen randomly to conduct the research from the Government sponsored Secondary School of West Bengal. Convenience sampling techniques will be used to select the schools and random sampling techniques will be used to select samples. Besides 120 girl students, science teachers and educational administrators of these schools are also chosen for the sample.

Tools of the Study:

a) Each school consisted of 60 students, divided into control (30 students) and experimental (30 students) groups.

b) A 40-minute class was conducted for both groups by the investigator. Experimental group students engaged in experiments, while control group students attended a traditional science class.

c) A standardized 20-mark questionnaire was administered to both groups.

d) From Achievement test scores, Z-scores were computed to analyze girl students' achievement in each group and test hypotheses.

e) Interviews with science teachers and educational administrators were conducted to provide additional insights into the study outcomes.

Data Analysis of Achievement Test:Table-1: On the basis of Achievement Test among girl students Mean and Standard Deviation value were calculated from their scores against both the control group and experimental group. Finally Z-score was determined.

Mallikpur Girls' High School (HS),P.S-Baruipur,Dist-South 24 Parganas,West Bengal.			
Control Group-30 Students		Experimental Group-30 Students	
Mean	S.D	Mean	S.D
7.1	2.5777	12.4666	2.4457
Z-Score: 8.273			

Z-Score=8.273>Critical Value at 1% significance level=2.58 & 5% sig. level=1.96 ; So there is a significant difference between two groups. Since the mean of the experimental group is more than the control group, teaching by practical work is more effective than the traditional method. Achievements of experimental group is more effective than the control group.

Data Analysis of Achievement Test :Table-2: On the basis of Achievement Test among girl students Mean and Standard Deviation value were calculated from their scores against both the control group and experimental group.Finally Z-score was determined.

Laskarpur Rabindra Vidyapith For Girls(H.S),P.S-Sonarpur,Dist-South 24 Parganas,West Bengal			
Control Group-30 Students		Experimental Group-30 Students	
Mean	S.D	Mean	S.D
7.3	2.5209	13.0	2.7543
Z-Score:8.36			

Z-Score=8.36>Critical Value at 1% significance level=2.58 & 5% sig. level=1.96; So there is a significant difference between two groups. Since the mean of the experimental group is more than the control group, teaching by laboratory practical work is more effective than the traditional method. Achievements of experimental group is more effective than the control group.

Besides the above Achievement Test among Students, Interviews were conducted with both science teachers and educational administrators to gather additional insights.

Interview questions for science teachers focused on:

1. Integration of practical work into science lessons.
2. Benefits of practical work in enhancing student understanding.
3. Challenges faced in delivering practical science education.
4. Promotion of collaboration and teamwork among girl students.
5. Success stories or examples of positive impacts on academic and personal development.

Interview questions for educational administrators focused on:

1. School initiatives supporting practical science education for girls.
2. Monitoring and evaluation of practical work effectiveness.
3. Strategies for promoting girls' participation and achievement in STEM.
4. Support and professional development opportunities for teachers.
5. Envisioned contributions of practical work to girl students' empowerment and steps being taken to realize this vision.

Conclusions: The findings underscore the indispensable role of laboratory practical work in shaping science education among secondary-level girl students in West Bengal. Through hands-on experiences, it fosters not only comprehension but also confidence, challenging ingrained stereotypes while nurturing critical thinking and collaborative skills. These aspects collectively contribute to the empowerment of girls in the realm of science education, paving the way for their active participation and success. Thus, practical work emerges as a potent catalyst for women's empowerment in the context of secondary science education, holding promise for fostering inclusive and equitable learning environments.

Recommendations: Based on the findings of the study, the following recommendations are proposed:

- ❖ Increase investment in laboratory facilities and resources to enhance practical work opportunities in secondary schools.
- ❖ Implement policies and programs to promote gender equality in STEM education and encourage more girls to pursue careers in science and technology.

❖ Provide professional development opportunities for teachers to improve their pedagogical skills in delivering practical science education.
❖ Foster partnerships between schools, universities, and industry to provide girl students with exposure to real-world STEM applications and role models.

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