

Enhancing Science Education in Ningo-Prampram, Ghana: Implementing Viable Hands-On Experiments and Science Fairs

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Abstract This paper explored practical solutions to address the challenges in science education from the perspective of Ghanaian students. A quantitative survey was conducted, focusing on students in grades 7 to 9 (JHS 1 to 3) within the Ningo-Prampram District of Ghana to understand the state of science education. A total of 46 schools (23 public schools and 23 private schools) were randomly chosen for the survey. The survey received responses from 48 science teachers and 899 students, providing valuable insights into the current landscape of science education. While science education is highly emphasized in schools (48% very high, 31% high) and 69% of students said they plan to pursue Science, Technology, Engineering, and Mathematics (STEM) as a career, only 10% of students said their school had a dedicated science lab. Science teachers cited 'lack of facilities' (81%) and 'lack of materials' (13%) as reasons why science is not effectively taught in their schools. Detailed information about the survey analysis is provided in the Methods section. This study demonstrated that various science experiments and activities could be conducted on a limited budget, even without a dedicated laboratory. For several months, the author conducted student-centered hands-on activities at a local school. Subsequently, a school science fair was organized, motivating students to develop their ideas into projects. This paper detailed how it was organized and conducted. Furthermore, to promote practical science engagement among students, the author is collaborating with the Ningo-Prampram District of the Ghana Education Service (GES) to arrange an inter-school science fair, extending invitations to 20 schools within the district.

Keywords: science education, Ghana, JHS, learner-centered education, viable hands-on experiments, small-scale science fair

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1. Introduction

Science education plays an important role in national development, especially in producing the human resources and skilled labor that Ghana needs. However, despite the importance of science education, challenges persist in teaching and learning methods [1]. Science education in Nigeria is experiencing the same situation [2].

Indeed, the prevalent 'lecture' approach in Ghanaian science education tends to be teacher-centered, emphasizing knowledge transfer through explanations, notes, and some question-and-answer techniques. This teacher-centered, knowledge-based pedagogy may limit student engagement [3] and deeper understanding [4].

It is essential to address these challenges in science education. Science teachers have been found to be limited in explaining science concepts in class because they rely on textbooks and wall charts in addition to lecture methods. Students find understanding science concepts

difficult and complicated as they have not seen or experienced them firsthand but are expected to memorize them from textbooks and even procedures for experimental activities [5].

The main reasons for little or no practical learning in the classroom are lack of or inadequate science labs, limited resources, and insufficient teaching and learning science materials [4,5,6].

Mr. Frank Kwesi Nartey, the District Science Technology Mathematics and Innovation Education (STMIE) Coordinator of the Ningo-Prampram District, highlights critical challenges in Ghana's science education. These include insufficient funding, inadequate infrastructure, and a shortage of trained personnel. He also agrees that practical aspects from textbooks are often conveyed through diagrams drawn by teachers on charts or boards, or via diagrams in lab books.

Hands-on learning is defined as "a method that includes the processes of observing, explaining, comprehending and thinking about an event or phenomenon with the help of tools that students create with simple materials they use

in daily life” [7]. Hands-on learning is not just a way for teachers to deliver information, but a way for students to actively participate in lessons and make meaningful sense of science concepts on their own through personal observation and experience [3,8,9], and to figure things out for themselves [4]. It also gives students the opportunity to manipulate objects and materials around them to apply concepts learned in class [8]. It has been observed that activities using simple equipment are not only more effective than traditional teaching methods in improving students' academic performance, but also contributed increased interest and positive attitudes [7]. Hands-on learning approach is learner-centered [8] as opposed to the teacher-centered approach, which is the predominant lecture approach used by science teachers in Ghana [3]. Learner-centered approaches help students engage in real-life issues and equip students with critical thinking and problem-solving skills, a useful skill in their future professional career. It leverages the learner's curiosity and develops it into a strong interest in the subject. When working with multiple people, it helps to foster a collaborative dynamic between people [10].

Research shows that when learning methods become more activity-based, the average learning retention rate increases significantly [8,9]. This is evidenced by the statistics that lecture-based learning has an average retention rate of 5%, while hands-on learning has an average retention rate of 75% [8]. Hands-on experiments also encourage students to think, engage, and act creatively. With hands-on experiments, students are not given direct answers, but are given the tools they need to figure it out for themselves creatively. Developing creativity in the classroom is necessary because it builds the foundation for students' adaptability and problem-solving skills [11].

The author chose a junior high school in the Ningo-Prampram District to help students learn science concepts through hands-on experiments over the course of a school year. In each class, the author first explained science concepts to the students and then had them participate in a prepared hands-on experiment. At the end of the school year, the author organized the first school science fair after seeing that students were interested in science experiments.

Wanting to introduce more students to the joy of learning science through hands-on experiments, the author conducted a survey of 46 junior high schools in the Ningo-Prampram District to understand the state of science education in Ghana. Responses were collected from a total of 48 teachers and 899 students. The author explores ways to conduct practical science experiments in classrooms with limited budgets, even when a dedicated science lab is not available. This paper provides insights into enhancing science education by emphasizing a learner-centered, experiment-driven approach.

Despite the challenges in science education, Ghanaian students hope to see a shift toward a learner-centered teaching approach from their teachers, who play pivotal roles in the education process [12].

class was organized and conducted, how the class evolved and led to the first science fair, and how a survey was conducted among schools in the Ningo-Prampram District of Ghana to understand the state of science education. Prior permissions were obtained from the school principal to conduct the hands-on class once a week for an academic year and from the Director of the Ningo-Prampram District for the survey. Names of schools, teachers, and students are kept anonymous, but some photos are shown with permission to enhance the depiction of the activities.

2.1. Hands-on Experiments Class

A private school in Ningo-Prampram District, Ghana was selected. A total of 40 students, selected from grades 6 and 7, were divided into 9 groups, with 4-5 students in each group participating in the practical activities. Experiments using inexpensive and readily available materials were prioritized, so that students can repeat the experiments at home. Wherever possible, the materials used were environmentally conscious including recycled plastic bottles, rubber bands, straws, paper, wooden sticks, and aluminum foil, etc.

Usually, the author dedicated the initial 15 to 20 minutes of class time to introducing new science concepts before conducting a planned experiment. Once the students grasped the demonstrated science concepts, each group received a Ziploc bag containing the necessary materials for the hands-on experiment, along with standard supplies like scissors, tape, glue, rulers, and markers. Students collaborated with their peers to conduct hands-on experiments, experiencing a sense of accomplishment and enjoyment while gaining firsthand knowledge of science.

To maintain an engaging class environment, surprise competitions were organized. Students vied for small prizes—like snacks—by creating their own projects. Despite the small rewards, this approach motivated students to demonstrate creativity, teamwork, and communication skills.

For example, while studying the concepts of air resistance and surface area, students had to use the science concepts they learned to create a stable parachute. Each group was given the same materials: paper, plastic bags, and various lengths of string. The challenge was to use the materials to design and build a unique parachute that could stay in the air for an extended period of time.



Figure 1. Students are making their parachute

2. Methods

This section describes how a hands-on experiments

Students initially designed and tested prototypes. The challenge encouraged students to think creatively and use the provided materials to design and test their parachutes. Over a short period of time, students made modifications with different sizes of paper, lengths of string, and other provided materials to optimize the performance of their parachutes. The process sparked lively discussions among team members. The activity not only fostered teamwork and critical thinking, but also emphasized science, creativity, and application. Each group's parachute was released with the same mass attached, and a small prize was awarded to the winning team whose parachute stayed in the air the longest and touched the ground last.



Figure 2. Students are competing with their paper parachute

Another example involved creating a simple rubber-band car. It demonstrates how potential energy is converted into kinetic energy. Consisting of a few materials—a plastic bottle, wooden sticks, rubber bands, and cardboard—this project fascinated students. The basic principle at work here is that the elastic potential energy stored in a stretched rubber band is released as the rubber band unwinds, propelling the car forward. Students used a plastic bottle as the car's body and drilled holes in the bottle to insert wooden axles made from kebab sticks. Then, they wrapped rubber bands around these axles while pulling to create tension. Finally, they attached a piece of cardboard cutout in the shape of a circular wheel to the axle. Students observed that the rubber band quickly unwound, converting the stored potential energy into kinetic energy, and propelling their car forward.



Figure 3. Students are assembling a rubber-band car

The competition had a straightforward rule: Design a non-motorized car that could travel the farthest distance. Achieving this goal demanded creative design skills and precision in cutting and assembling the car parts. The students enjoyed the experience of building and experimenting with their miniature cars.



Figure 4. Students are competing in the rubber-band car race

Even with affordable and readily available materials, students gained firsthand experience and understanding of science concepts. Following that class, students shared that the rubber-band car experiment was their favorite. The author believes that the experiment's appeal lies in its dynamic nature—where assembled parts come to life, turning students into little engineers.

2.2. The School's First Science Fair

After several months of classes and hands-on activities, the author observed a diverse array of creative projects crafted by students using simple materials. To encourage students to apply their scientific knowledge and practical skills, an intra-school science fair was organized. This time, students were tasked with generating their own ideas and showcasing their unique projects.

The students had been preparing for the science fair for about a month. During the first two weeks, each group generated their project ideas through discussion and brainstorming. Subsequently, they presented their ideas to the author, who provided necessary suggestions. Finally, the group members worked together to complete their projects. The students received detailed guidelines for the science fair, including:

- Items on the project display board: title, hypothesis/abstract, materials, methods, data, results, and conclusions, along with photos or illustrations.
- Public speaking and communication skills: how to demonstrate and present their project to an audience.

Additionally, the scoring criteria and scale for evaluating projects were announced as shown in [Table 1](#).

Table 1. Scoring criteria and scale

Creativity	Design	Working model	Presentation
5 points (25%)	5 points (25%)	5 points (25%)	5 points (25%)

During the additional two weeks, students completed their projects and display boards. Meanwhile, the host school adorned its premises with posters and banners, inviting parents and students from nearby schools to the event. The author designed and prepared medals, awards, and certificates for it. The author raised the prize money and necessary costs through personal fundraising efforts.

In the end, six groups that completed their work on time submitted projects. On the science fair day, tables were arranged in a circle in the school lobby. Parents and guests freely explored the exhibits while judges evaluated the entries. Students proudly showcased the science concepts they had learned through their projects.



Figure 5. Participants are displaying their projects

After the judging process, the top three teams—winner, runner-up, and third place—received medals, certificates, and cash prizes during the award ceremony where parents and guests were present. Additionally, every student who participated in the science fair received a certificate of participation.



Figure 6. School's first science fair award ceremony

From a simple concept aimed at sharing the author's love for science with fellow students, the effort has now developed into an event that inspires people's passion for science.

2.3. Survey on JHS Science Education

The students who participated in the science fair showed that organizing such an event on a limited budget was feasible. To spread the joy of science to more students, the author sought to assess the state of science education in other schools within the Ningo-Prampram District. Separate survey questions were prepared—one for science teachers and another for students.

Teachers were queried in three categories: science lab preparedness, science experiments, and science fairs.

Survey Questions for the Science Teachers

Science teachers were surveyed across three categories: science lab preparedness, science experiments, and science fairs. The survey questions were designed to find out how much they value hands-on experiments in science education, what factors prevent them from implementing hands-on experiments in their science classes, and what they think are the most pressing priorities to address this issue.

1. Does your school have dedicated science labs? [Yes, No]
2. How much emphasis is placed on science education in your school? [None, Some, High, Very high]

3. How effective do you think hands-on experiments are for understanding science concepts? [None, Some, High, Very high]
4. How important is the impact of resource availability on science education in your school? [None, Some, Important, Very important]
5. Identify the primary reason you believe science is not taught effectively at your school. [Materials, Facilities, Student's interest, Trained teachers]
6. How much do you think the lack of hands-on experiments affects students' interest in science? [None, Some, High, Very high]
7. What should be the top priority for the government or educational authorities to improve science education in local schools? [Investment in infrastructure, Teacher training, Dedicated period for lab/practical sessions]
8. If science fairs have not been held at your school, select an appropriate reason. [Lack of interest, Lack of budget, Lack of infrastructure, Lack of trained teachers]
9. If there are inter-school science fairs in your school district, will you encourage your students to participate? [No, Maybe, Sure, Absolutely]

Survey Questions for the Students

Students were also queried in three categories as their teachers: science lab preparedness, science experiments, and science fairs. But the questions were different from their teachers. The survey questions were designed to find out whether they were interested in STEM majors/careers, whether their school had a science lab, their experience with experiments in class, and their willingness to participate in local science fairs.

1. Do you plan to study Science, Technology, Engineering, and Mathematics (STEM) as your career? [Yes, No, Maybe]
2. Does your school have a dedicated science laboratory? [Yes, No]
3. How much emphasis is placed on science education in your school? [None, Some, High, Very high]
4. How much of your science learning is based on hands-on experiments? [0%, 25%, 50%, 75%]
5. How much do you think the lack of hands-on experiments affects your interest in science? [None, Some, High, Very high]
6. If there is a Science Fair in your school district, will you participate? [No, Maybe, Sure, Absolutely]

3. Results

This section describes findings from the survey, results of the intra-school science fair, and discussion on small-scale inter-school science fairs.

3.1. Findings from the Survey

A total of 48 science teachers and 899 students participated in the survey across 46 schools (23 public and 23 private). Only notable differences were noted between responses from public and private schools.

Responses from the Science Teachers

Table 2 provides an overview of the responses from 48 science teachers, divided evenly between public and private schools.

Table 2. Survey results from the science teachers

1. Does your school have dedicated science labs?	Yes 6 (13%)		No 42 (88%)	
2. How much emphasis is placed on science education in your school?	None 6 (13%)	Some 4 (8%)	High 15 (31%)	Very high 23 (48%)
3. How effective do you think hands-on experiments are for understanding science concepts?	None 2 (4%)	Some 3 (6%)	High 6 (13%)	Very high 36 (77%)
4. How important is the impact of resource availability on science education in your school?	None 8 (17%)	Some 5 (11%)	Important 13 (28%)	Very important 21 (45%)
5. Identify the primary reason you believe science is not taught effectively at your school.	Materials 6 (13%)	Facilities 38 (81%)	Student's interest 3 (6%)	Trained teachers 0 (0%)
6. How much do you think the lack of hands-on experiments affects students' interest in science?	None 0 (0%)	Some 5 (11%)	High 9 (19%)	Very high 33 (70%)
7. What should be the top priority for the government or educational authorities to improve science education in local schools?	Investment in infrastructure 36 (75%)		Teacher training 4 (8%)	Dedicated period for practicals 8 (17%)
8. If science fairs have not been held at your school, select an appropriate reason.	Lack of interest 6 (13%)	Lack of budget 15 (33%)	Insufficient infrastructure 24 (52%)	Lack of trained teachers 1 (2%)
9. If there are inter-school science fairs in your school district, will you encourage your students to participate?	No 0 (0%)	Maybe 0 (0%)	Sure 4 (9%)	Absolutely 43 (91%)

Questions about science lab preparedness: When asked if their school has a dedicated science lab, only 6 out of 48 science teachers (13%) answered 'yes.' Since two of the teachers are from the same school, this means that five schools have science labs. If one school, where no student answered 'yes,' is excluded, only four private schools have science labs.

Questions about science experiments: Most teachers (79%) answered science education is highly emphasized in their school (48% very high, 31% high).

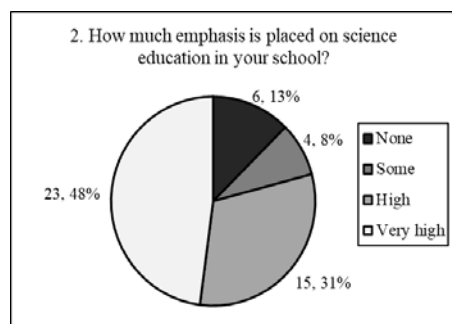


Figure 7. Emphasis on science education in schools

Concurrently, the majority (90%) believe that hands-on experiments can effectively enhance students' grasp of science concepts (77% very high, 13% high).

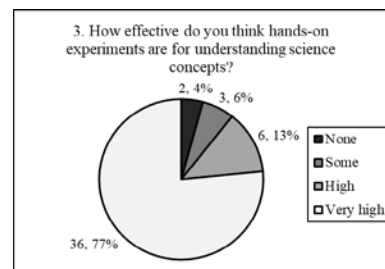


Figure 8. Effectiveness of hands-on experiments on science education

Most of them (73%) believe the impact of resource availability is crucial in science education (45% very important, 28% important).

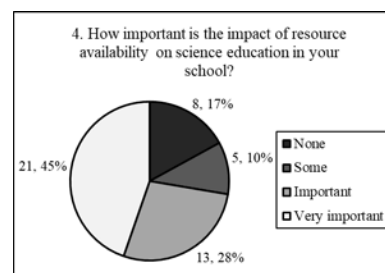


Figure 9. Importance of resource availability on science education

When asked how lack of hands-on experiments affect students' interest in science, majority of them (89%) thought it significant (70% very high, 19% high).

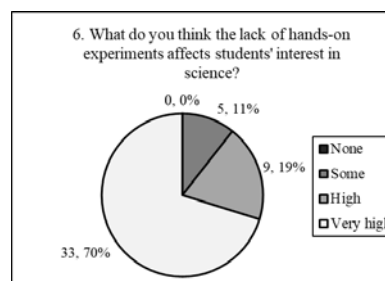


Figure 10. How hands-on experiments affect students' interest in science

Although teachers recognize the importance of hands-on experiments in science education, when asked why science is not taught effectively in their schools, teachers cited 'lack of facilities' as the main reason (81%), followed by 'lack of materials' (13%) and 'lack of student's interest' (6%), while none thought 'lack of trained teachers.'

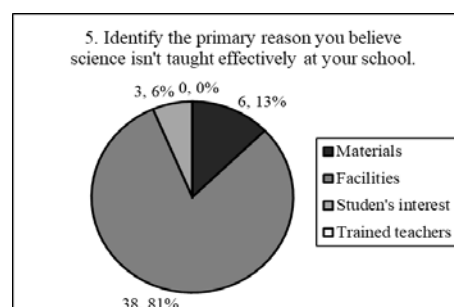


Figure 11. Primary reasons why science is not taught effectively

When asked what the government or education authorities should prioritize to improve science education in schools, most teachers cited ‘investment in infrastructure’ (75%). Teachers’ high demand for ‘investment in infrastructure’ may be related to the fact that 88% of teachers said their schools do not have science labs. Other opinions included ‘dedicated period for practicals’ (17%) and ‘teacher training’ (8%).

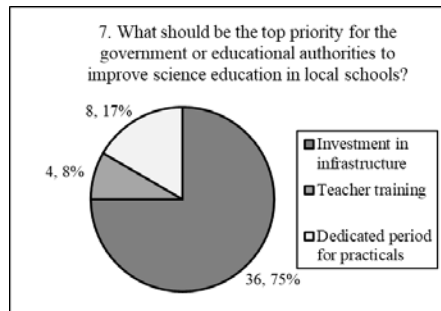


Figure 12. The government’s top priorities for improving science education

When students were asked about what is needed for effective science education, they responded with open-ended answers. Among these, 67% (598 students) mentioned the need for science labs, while 33% (301 students) emphasized the importance of science experiments or practical sessions.

Therefore, finding ways to incorporate hands-on activities in class is essential for effective science education, while waiting for the government or educational institutions to allocate necessary budgets to build science labs in schools.

Questions about science fairs: Most science teachers (79%) said they had never organized a science fair in their school and when asked why, they cited ‘lack of facilities’ (52%) and ‘lack of budget’ (33%), with a small number citing ‘lack of (their) interest’ (13%) and ‘lack of trained teachers’ (2%).

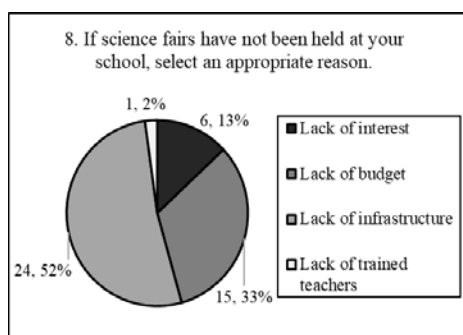


Figure 13. Reasons why science fairs have not been held

If the reason why science fairs were not organized by science teachers was ‘lack of interest,’ it may be due to ‘lack of facilities’ or ‘lack of funding.’ That is why it is even more important to find ways to conduct hands-on activities in the classroom with a limited budget.

Most teachers (93%) believe it would be beneficial for their students if science fairs are organized in their school (91% very beneficial, 2% beneficial), and all of them said that they would encourage their students to participate in the science fair if such an opportunity was available in their area (91% absolutely, 9% sure).

Teachers provided additional feedback regarding science fairs and some common responses were:

- “It will help boost the interest of students learning science.”
- “It can act as a medium for students to interact and share their intellectual knowledge in science or exhibit their talents and inspire others.”
- “It can help develop critical thinking and problem-solving skills.”
- “It can motivate students to pursue their interest in the fields of science.”
- “The students will be able to practice what is taught in class rather than studying only the theory. It will increase the understanding of science, making it easier in exams.”

One teacher wrote, “inter-school science fairs can help teachers become more knowledgeable themselves and teach science more effectively.” Another teacher wrote, “This exciting exercise (survey) has really motivated me to learn science more and do more practical experiments.” Additionally, the notion that “inter-school science fairs will help students who do not have labs at school to get educated, learn more, and develop an interest in the subject,” stood out.

Responses from the Students

Table 3 provides an overview of the responses from 899 students (445 at public school, 453 at private school).

Table 3. Survey results from the students

1. Do you plan to study Science, Technology, Engineering, and Mathematics (STEM) as your career?	Yes 613 (69%)	No 85 (9%)	Maybe 196 (22%)
2. Does your school have dedicated science labs?	Yes 86 (10%)	No 810 (90%)	
3. How much emphasis is placed on science education in your school?	None 125 (14%)	Some 106 (12%)	High 232 (26%) Very high 432 (48%)
4. How much do you think the lack of hands-on experiments affects your interest in science?	None 79 (9%)	Some 237 (26%)	High 344 (38%) Very high 235 (26%)
5. If there is a science fair in your school district, will you participate?	No 56 (6%)	Maybe 49 (5%)	Sure 86 (10%) Absolutely 708 (79%)

Overall, when asked if they were considering Science, Technology, Engineering, and Mathematics (STEM) as a career, a significant majority of students answered ‘yes’ (69%), surpassing ‘maybe’ (22%) or ‘no’ (9%).

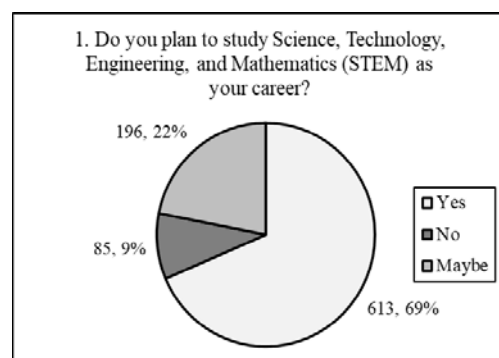


Figure 14. Students' choice for STEM as career

The survey findings could be connected to the Ghanaian government's focus on science education within the newly released 2022 curriculum [13]. The teaching philosophy advocates for a learner-centered approach that actively engages students both physically and cognitively, fostering knowledge acquisition within a rich and rigorous inquiry-driven environment. Such an innovative teaching approach has the potential to enhance the capabilities of students pursuing STEM careers.

Questions about science lab preparedness: Only four private schools (17%) answered having a dedicated science lab at their school, and none of the public schools answered having a science lab.

Questions about science experiments: A correlation was observed between the emphasis on science education in school and students' choice rate of STEM as a career. The greater the emphasis on science education in schools, the higher the percentage of students choosing STEM as a career. (49% very high, 25% high, 13% some, 13% none).

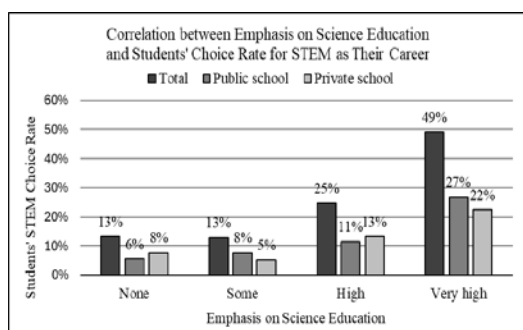


Figure 15. More students tend to choose STEM careers when there is greater emphasis on science education

When students were asked about the impact of the lack of hands-on experiments on their interest in science, the majority (64%) indicated that it had a significant effect (26% very high, 38% high). This could be interpreted as a message that students wanted to acquire science concepts through student-centered learning methods.

The survey shows that there is a gap in views between science teachers and their students: while most teachers (90%) viewed the effectiveness of science experiments highly (77% very high, 13% high), students felt that their involvement in hands-on experiments was insufficient (6% very high, 28% high). This highlights the need to bridge this gap and ensure that students have more chances for practical learning experiences.

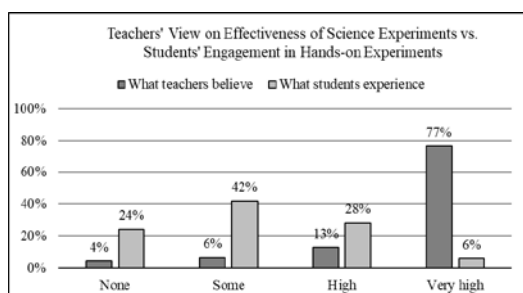


Figure 16. Teacher's emphasis on science experiments versus student's desire for more hands-on activities

Questions about science fairs: When surveyed about their interest in science fairs, 91% of students aiming for STEM careers responded positively (82% absolutely, 9%

sure), while 83% of students pursuing other career paths expressed interest (71% absolutely, 12% sure). All students had grand expectations for science fairs.

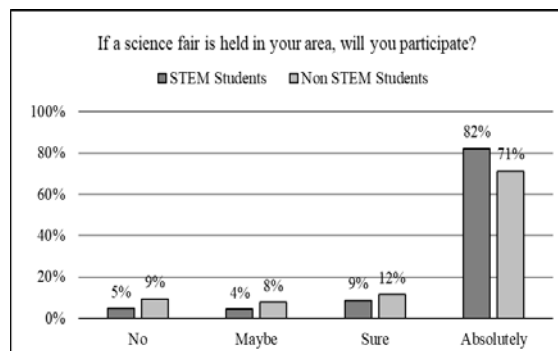


Figure 17. Students' interest in science fairs

3.2. Results of the Intra-School Science Fair

To assess the impact and effects of the science fair on students, the author administered a separate survey after the science fair.

Survey Questions for the Students participated in the fair

1. Do you plan to study Science, Technology, Engineering, and Mathematics (STEM) as your career? [Yes, No, Maybe]
2. How well did the science fair help you understand science concepts? [None, Some, Useful, Very useful]
3. How do you think this event helped you practice and improve your teamwork skills? [None, Some, Useful, Very useful]
4. How do you think this event helped you improve your communication/public speaking skills? [None, Some, Much, Very much]
5. What challenges did you face in preparing for or during the science fair? [Coming up ideas, Getting materials, Turning ideas into works, Speaking in public]
6. What was your favorite part about participating in the science fair? [Acquired science concepts, Practiced teamwork skills, Turned ideas into works, Practiced public speaking]
7. If there is another science fair in your school district, will you participate? [No, Maybe, Sure, Absolutely]

Responses from the Students participated in the fair

Table 4 provides an overview of the responses of 29 students who participated in a school science fair.

Of the students who participated in the science fair, 72% showed interest in pursuing STEM fields, slightly surpassing the 69% reported by students from other schools. However, it is not clear whether these differences are related to their hands-on experiments class.

Effectiveness of science fair. When students were asked about the effectiveness of the science fair in enhancing their understanding of science concepts, the majority (86%) reported that it was helpful (55% very useful, 31% useful).

The author believes that organizing a science fair for students, even a small-scale, after hands-on experiments class can enhance their ability to grasp science concepts through practical activities. The students' growing

confidence in their projects during the hands-on activities was evident, and they eagerly participated in the intra-school science fair.

Table 4. Survey results from students who have participated in the intra-school science fair

1. Do you plan to study Science, Technology, Engineering, and Mathematics (STEM) as your career?	Yes 21 (72%)	No 4 (14%)	Maybe 4 (14%)
2. How well did the science fair help you understand science concepts ?	None 0 (0%)	Some 4 (14%)	Useful 9 (31%) Very useful 16 (55%)
3. How do you think the event helped you practice and improve your teamwork skills ?	None 2 (7%)	Some 0 (0%)	Useful 3 (10%) Very useful 24 (83%)
4. How do you think this event helped you improve your communication/public speaking skills ?	None 2 (7%)	Some 3 (10%)	Much 7 (24%) Very much 17 (59%)
5. What challenges did you face in preparing for or during the science fair?	Coming up ideas 5 (17%)	Getting materials 12 (42%)	Turning ideas into works 5 (17%) Speaking in public 7 (24%)
6. What was your favorite part about participating in the science fair?	Acquired science concepts 6 (21%)	Practiced teamwork skills 10 (34%)	Turned ideas into works 9 (31%) Practiced public speaking 4 (14%)
7. If there is another science fair in your school district, will you participate?	No 1 (3%)	Maybe 1 (3%)	Sure 2 (7%) Absolutely 25 (86%)

Teamwork skills enhancement. It seems clear that the science fair played a significant role in enhancing students' teamwork skills. Almost all students (93%) reported that the event greatly helped them in this regard (83% very useful, 10% useful).

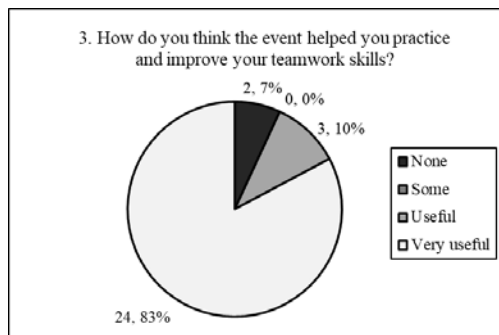


Figure 18. The science fair empowered students to enhance their teamwork skills

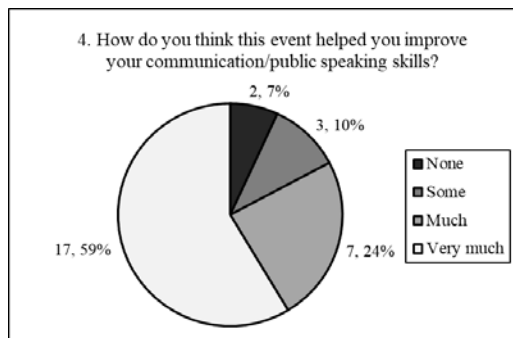


Figure 19. The science fair empowered students to enhance their public speaking skills

Communication and public speaking skills. According to students' responses, the science fair significantly improved their public speaking skills. The majority (83%) found the event helpful (59% very much, 24% much). Encouraging students to present their projects and engage with an audience during science fairs appears to be an effective strategy for nurturing these essential skills.

Challenges, yet greater joy. Students shared the challenges they encountered while participating in the science fair. Getting materials (42%) and public speaking (24%) were the most common hurdles. Others faced difficulties in coming up with ideas (17%) and turning ideas into projects (17%). On the positive side, they recalled that practicing teamwork skills (34%), turning ideas into work (31%), acquiring science concepts (21%), and developing public speaking skills (14%) were enjoyable.

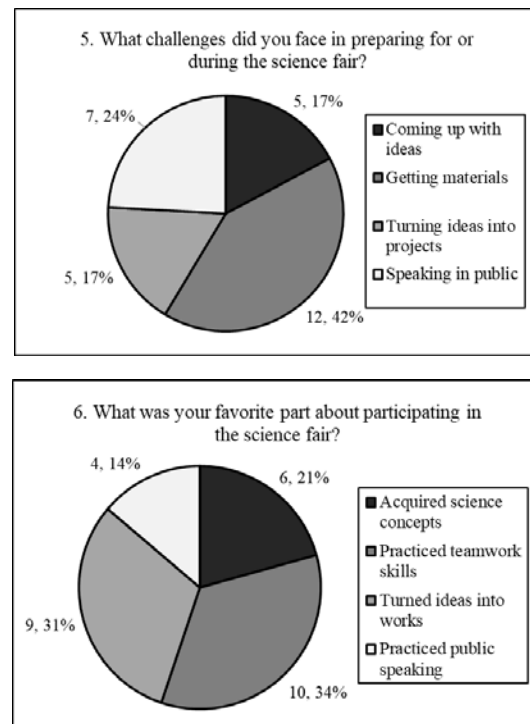


Figure 20. Challenges and favorites of the science fair

Positive attitude toward science fairs. When asked whether they would participate in a science fair, almost all students (93%) answered 'yes.' This positive attitude was stronger among students who had participated in hands-on activities and exhibited their projects at the intra-school science fair (86% absolutely, 7% sure), compared to that from students who had not participated (79% absolutely, 10% sure).

3.3. Small-Scale Inter-School Science Fairs

Based on the positive results observed during the first intra-school science fair and the enthusiastic response from students, the author has decided to collaborate with Ghana Education Service (GES) Ningo-Prampram District to organize a small-scale inter-school science fair. The event will be held in September after the start of the new school year and will involve 20 schools (10 public and 10 private). Before the vacation period, each school will inform students about the science fair. During the break,

students will collaborate in pairs, working on their projects and submitting them to their respective schools. The science teacher will assess the submitted projects and choose a team for the school. The selected team will then undergo training and participate in the inter-school science fair.

An approval for the inter-school science fair was obtained from the Director of the Ningo-Prampram District. The author will prepare certificates of participation and prizes. Other necessary expenses will be covered through fundraising.

4. Conclusion

This ambitious initiative demonstrates that science concepts can be explored through diverse hands-on activities in the classroom, even without a dedicated lab or expensive equipment. To take it one step further, science teachers in collaboration with educational authorities should consider organizing small-scale science fairs in the area on a limited budget to ignite students' curiosity for science.

Drawing from the insights gained during this endeavor, the author aims to share the passion for science with more students. This involves creating a science experiment book that simplifies scientific concepts through viable experiments and activities. The list of experiments will utilize affordable and readily available materials, accompanied by practical advice and cautions based on the author's personal experience.

The author believes that science should be enjoyable, and that joy can be found through hands-on activities that reinforce fundamental science concepts. The author's aspiration is to inspire more students to pursue their dreams of becoming scientists or engineers as they prepare for small-scale science fairs.

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References

- [1] Azure, J. A., "Senior High School Students' Views on the Teaching of Integrated Science in Ghana," *Journal of Science Education and Research (JOSER)*, 1(2), 49-61, 2015. Available: <https://uew.edu.gh/static/news/files/852-1647-1-SM.pdf>.
- [2] Kola, Aina Jacob, "Importance of Science Education to National Development and Problems Militating Against Its Development," *American Journal of Educational Research*, 1(7), 225-229.
- [3] Naah, A. M., Owusu, M., Osei-Himah, V., Ansah, F. Owusu, Mensah, T. K., Amuda, T.Y., Yaw, R. Osei, Samari, J. A., Agyemang, A. Y. K., Acheampong, L. Opoku, and Kwaah, O. K., "Developing A Conceptual Framework for Science Teaching at Colleges of Education in Ghana," *European Journal of Education and Pedagogy*, 2(6), 13-18, Nov. 2021.
- [4] Marcourt, Samuel Richard, Aboagye, Emmanuel, Armoh, Ebenezer Kingsley, Doughlor, Vivian Vinette, and Ossei-Anto, Theophilus Aquinas, "Teaching Method as a Critical Issue in Science Education in Ghana," *Social Education Research*, 4(1), 82-90, Dec. 2022.
- [5] Quansah, Rebecca Esi, Sakyi-Hagan, Nelly Adjoa, and Essiam, Charles, "Challenges Affecting the Teaching and Learning of Integrated Science in Rural Junior High Schools in Ghana," *Science Education International*, 30(4), 329-333, Nov. 2019.
- [6] Humphrey-Darkeh, Assem, Owusu-Sekyere, Kofi, and Mensah, Samuel Agyei, "Investigating the Challenges Facing the Teaching and Learning of Science and Technology in Selected Schools in the Ashanti Region of Ghana," *Journal of Science Learning*, 5(3), 431-438, Nov. 2022. Available: <https://files.eric.ed.gov/fulltext/EJ1368499.pdf>.
- [7] Kırılmazkaya, Gamze, and Dal, Sena Nur, "Effect of Hands-On Science Activities on Students' Academic Achievement and Scientific Attitude," *International Journal of Education & Literacy Studies*, 10(4), 56-61.
- [8] Ekwueme, Cecilia O., Ekon, Esther E., and Ezenwa-Nebife, Dorothy C., "The Impact of Hands-On-Approach on Student Academic Performance in Basic Science and Mathematics," *Higher Education Studies*, 5(6), 47-51, Nov. 2015.
- [9] Dhanapal, Saroja, and Shan, Evelyn Wan Zi, "A Study on the Effectiveness of Hands-on Experiments in Learning Science Among Year 4 Students," *International Online Journal of Primary Education*, 3(1), 29-40, June 2014. Available: <https://www.iojpe.org/index.php/iojpe/article/view/111>.
- [10] Tzenios, Nikolaos, "Learner-Centered Teaching," *International Research Journal of Modernization in Engineering Technology and Science*, 4(12), 916-919, Dec. 2022.
- [11] Trnava, Eva, "Brightening our Future," in *The Hands-on Science Network*, ISBN 978-989-8798-01-5, Funchal, Madeira, Portugal, 103-109, 2015. Available: <https://hdl.handle.net/1822/43987>.
- [12] Kahveci, Hakkı, "The positive and negative effects of teacher attitudes and behaviors on student progress," *Journal of Pedagogical Research*, 7(1), 290-306, Mar. 2023.
- [13] National Council for Curriculum and Assessment (Ministry of Education), Science Common Core Programme (CCP), Curriculum for JHS1 (B7) - JHS3 (B9). Sep. 2020. Available: SCIENCE.pdf (nacca.gov.gh).

