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Effectiveness of the “Science On The Go” Program on Science Literacy Among Alternative Learning System (ALS) Learners

Mark Ian S. Lansita, MAT Science [1], Rodelyn M. Dalayap, PhD [2]
1 – A.S. Bernardo National High School. SDO Tacurong, Region XII
2 – Sultan Kudarat State University

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Abstract

Science education remains a challenge in alternative learning settings, especially for underserved communities. This study evaluates the effectiveness of the Science on the Go program in enhancing science literacy among Alternative Learning System (ALS) learners in Tacurong City, Philippines. Using a quasi-experimental design, the study compared pre-test and post-test scores between an experimental group that received eight science sessions with the intervention and a control group that followed the standard ALS curriculum. Mixed methods, including surveys and interviews, assessed learner engagement, resource access, and instructional quality. Quantitative results showed a statistically significant improvement in the experimental group’s post-test scores, indicating the program’s effectiveness. Qualitative findings revealed both benefits and barriers: learners were highly engaged by the hands-on, interactive approach, but challenges such as low literacy, unfamiliarity with scientific tools, and low self-confidence hindered participation. Teachers emphasized the need for simplified materials, structured modules, and language support. Despite resource constraints and implementation challenges, both learners and educators acknowledged the program’s value in promoting science literacy and learner empowerment. The study concludes that mobile and experiential science learning can be effective in non-formal education, particularly when tailored to learners’ needs and supported by adequate resources and teacher training.

Keywords: *science education, alternative learning, science literacy, experiential learning, underserved communities*

INTRODUCTION

Science education faced global challenges related to accessibility, quality, and relevance, particularly in low- and middle-income countries. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) underscored the importance of science education as a foundation for sustainable development, yet disparities in access remained a significant issue. Limited availability of educational resources and trained teachers continued to hinder effective science learning, especially in underserved areas (UNESCO, 2019). Moreover, the COVID-19 pandemic further exacerbated these challenges, leading to a global learning crisis that disproportionately impacted students in alternative learning systems (UNICEF, 2020). These obstacles highlighted the need for innovative solutions, such as mobile and digital learning, to bridge the gaps in science education (World Bank, 2021).

In response to these global and national challenges, the Department of Education (DepEd) in the Philippines introduced the Alternative Learning System (ALS) to address these issues. ALS offered educational opportunities to learners outside the formal school system, equipping them with essential knowledge and skills. Science remained a crucial yet challenging component of the ALS curriculum, as it fostered critical thinking and problem-solving skills necessary for navigating an increasingly technology-driven world (Llego, 2022).

Despite these national efforts, educational inequality remained a pressing issue, especially in remote and underserved regions. The COVID-19 pandemic further widened these gaps, underscoring the urgent need for accessible and innovative learning models. In this context, "Science on the Go" sought to address these challenges by utilizing mobile classrooms, multimedia tools, and self-learning modules to bring science education to marginalized communities (Suva, 2021). Research on such programs was critical, as they directly impacted the educational and future career opportunities of many young learners who might otherwise have lacked access to quality science education (NEDA, 2021).

However, the ALS program still faced systemic and resource-related obstacles that affected the delivery of science education. Insufficient funding, a lack of proper training for ALS educators, and limited access to technology remained major barriers (Bautista & Ramos, 2020). A report from the National Economic and Development Authority (NEDA) (2021) pointed out that despite government initiatives, ALS continued to struggle in effectively reaching marginalized learners. Additionally, the absence of a standardized science curriculum tailored specifically for ALS made it difficult to provide consistent, high-quality instruction (Ferrer, 2020). As a result, many students lacked the foundational scientific knowledge needed for further education or career advancement.

At the local level, implementing ALS programs in rural and geographically isolated regions of the Philippines presented additional challenges. Many areas lacked basic infrastructure, including electricity and internet access, which were essential for multimedia-based learning (Guillermo, 2020). Limited transportation options also made it difficult for ALS educators to reach these communities regularly (Suva, 2021). Furthermore, science was often perceived as less essential than other core subjects, leading to lower enrollment in science-focused ALS programs (David & Dizon, 2019). Thus, addressing these local challenges was crucial to improving the effectiveness of science education within ALS.

Although some studies existed, much research had explored the broader challenges of ALS in the Philippines, while studies specifically examining science education in ALS remained scarce. Most existing research focused on literacy and numeracy, leaving a gap in understanding how science education could be effectively delivered to marginalized learners (Estrada & Soriano, 2021). Additionally, there was a need to investigate the impact of innovative mobile-based science programs like "Science on the Go" in enhancing science learning outcomes within ALS. Ultimately, closing this research gap would provide valuable insights into improving access to and the quality of science education in alternative learning systems.

Objectives of the Study

The study aimed to investigate the effectiveness of the “Science on the Go” Program on Science Literacy in the Alternative Learning System.

Specifically, the study sought to answer the following research questions:

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1. To what extent does the effectiveness of "Science on the Go Program" on Science Literacy among ALS learners in terms of:
   1.1 Mobile Classroom;
   1.2 Multimedia Science Learning Modules; and
   1.3 Hands-on Experiments and Activities.
2. What are the key challenges and barriers encountered by learners and educators in implementing the "Science on the Go" program in various ALS settings?

METHODS

Research Design

This study employed a mixed-method design utilizing both quantitative and qualitative approaches (QUAN → QUAL) to explore the effectiveness of the *Science on the Go* program among ALS learners (Creswell & Plano Clark, 2018). The first phase of the research gathered quantitative data through pre-test and post-test assessments on various aspects of science literacy, including the application of scientific knowledge and critical thinking/problem-solving skills. The experimental group's performance was analyzed to measure the impact of the mobile classroom infrastructure, multimedia learning modules, and hands-on experiments. These results were compared with those of the control group to determine any significant differences in science literacy, specifically in the application of scientific knowledge and critical thinking. The study also explored the relationship between the program's perceived effectiveness and the learners' science literacy outcomes, using statistical analysis to establish any meaningful associations (Teddlie & Tashakkori, 2009).

In the second phase, the qualitative component of the study delved deeper into the experiences of both learners and educators by identifying the key challenges and barriers encountered during the implementation of the program. Interviews were conducted to understand learners' engagement, resource accessibility, and instructional quality (Patton, 2015). This phase aimed to provide a richer context for interpreting the quantitative findings and uncover the factors that influenced the program's success in enhancing science education. The results from both the quantitative and qualitative phases offered comprehensive insights into how the program's components contributed to the educational outcomes of ALS learners and suggested strategic interventions to optimize its impact. This mixed-method approach allowed for a robust examination of both the statistical outcomes and the personal experiences of participants, thereby contributing to a fuller understanding of the program's effectiveness (Creswell, 2014).

Sampling Technique

This study employed total enumeration to select participants from the JACS Community Learning Center in Barangay Baras and the BJMP Community Learning Center in Barangay Poblacion, Tacurong City. Total enumeration, akin to a census, involves including every member of the target population rather than selecting a representative sample (Cohen et al., 2018). This approach ensured that all ALS learners in these centers were accounted for, providing a comprehensive understanding of the effectiveness of the *Science on the Go* program in enhancing science literacy.

This method was particularly appropriate for the quantitative component of the study, as the number of ALS learners in both centers was manageable enough to allow the inclusion of the entire population. Consequently, the study was able to generate findings that genuinely represented the entire group of learners, capturing the unique challenges they face in accessing science education due to geographic and socioeconomic constraints. Moreover, including all learners helped minimize sampling bias and enhanced the generalizability of the results to similar ALS contexts in rural and underserved areas of the Philippines (Fraenkel et al., 2012).

For the qualitative component, purposive sampling was used to select five interview participants. Also known as judgmental or selective sampling, this method involves choosing individuals based on specific criteria relevant to the research objectives (Palinkas et al., 2015). The selected participants—comprising active learners, facilitators, and educators—were directly involved in the implementation of the *Science on the Go* program. This approach ensured that the qualitative data provided rich insights into the challenges, barriers, and successes experienced throughout the program's rollout.

By integrating total enumeration for the quantitative component and purposive sampling for the qualitative interviews, the study achieved a well-rounded evaluation of the *Science on the Go* program. The combined data sources allowed for a comprehensive assessment that encompassed both broad learning outcomes and the in-depth, personal experiences of key stakeholders at the JACS and BJMP Community Learning Centers in Tacurong City.

RESULTS AND DISCUSSION

Effectiveness of "Science on The Go Program" on Science Literacy among ALS Learners in terms of Mobile Classroom

Table 1.1. Effectiveness of "Science on The Go Program" on Science Literacy among ALS Learners in terms of Mobile Classroom

Items	Mean	SD	Description
1. The mobile classroom provides a conducive learning environment for science lessons.	4.68	0.48	Highly Effective
2. The seating arrangement and space in the mobile classroom are comfortable for learning.	4.42	0.67	Highly Effective
3. The mobile classroom offers sufficient resources for science experiments.	4.42	0.62	Highly Effective
4. The mobile classroom is equipped with the necessary technology to facilitate science learning.	4.55	0.57	Highly Effective
5. The physical setup of the mobile classroom promotes collaborative learning.	4.45	0.62	Highly Effective
6. The lighting and ventilation in the mobile classroom are adequate for learning.	4.39	0.67	Highly Effective
7. The mobile classroom infrastructure supports practical science activities effectively.	4.71	0.46	Highly Effective
8. The mobile classroom's mobility makes it easier for learners to access science lessons.	4.74	0.44	Highly Effective
9. The mobile classroom is regularly maintained and kept in good condition.	4.52	0.51	Highly Effective
10. The mobile classroom provides a safe and secure environment for learners during lessons.	4.55	0.57	Highly Effective
Overall Mean	**4.54**	**0.30**	**Highly Effective**

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The findings in Table 1.1 indicate that the "Science on The Go Program" is highly effective in terms of mobile classroom infrastructure for ALS (Alternative Learning System) learners. The overall mean score of 4.54 (SD = 0.30) suggests that respondents perceive the mobile classroom as a conducive learning environment that meets their educational needs. The highest-rated items include the provision of a conducive learning environment ($\bar{x}$ = 4.68, SD = 0.48) and the support for practical science activities ($\bar{x}$ = 4.71, SD = 0.48), underscoring the importance of well-equipped mobile classrooms in enhancing experiential learning.

The findings aligned with previous studies emphasizing the role of learning environments in student engagement and academic success. According to Tondeur et al. (2017), well-structured learning spaces positively impacted student motivation and performance. Similarly, Barrett et al. (2019) found that classroom infrastructure, including seating arrangements, lighting, and ventilation, significantly influenced learning effectiveness. These aspects were well-rated in the current study, particularly in terms of comfort ($\bar{x}$ = 4.42, SD = 0.67) and adequate lighting and ventilation ($\bar{x}$ = 4.39, SD = 0.67).

Furthermore, mobile classrooms have been widely recognized as an effective alternative for learners with limited access to traditional educational facilities. Ferrer et al. (2021) highlighted that mobile classrooms served as an innovative strategy to bridge educational gaps, particularly in underserved areas. The present study supported this claim, as findings suggested that the mobility and accessibility of classrooms ($\bar{x}$ = 4.74, SD = 0.44) facilitated learning continuity. This was essential for ALS learners, who often faced barriers related to distance, financial constraints, and lack of formal schooling infrastructure (UNESCO, 2020).

Another crucial aspect highlighted was the regular maintenance of the mobile classroom ($\bar{x}$ = 4.52, SD = 0.51), which ensured a consistent and safe learning environment. According to Lackney (2016), well-maintained learning spaces contributed to better academic outcomes and student well-being. This aligned with the study's finding that the mobile classroom provided a safe and secure environment ($\bar{x}$ = 4.55, SD = 0.50), reinforcing the idea that infrastructure quality played a fundamental role in learning effectiveness.

The study's results underscored the importance of continuously improving mobile classroom infrastructure to maintain high levels of effectiveness. Policymakers and educators should invest in enhancing mobile learning environments by incorporating technological advancements, additional learning resources, and sustainable infrastructure solutions to further improve learning outcomes. Additionally, since mobile classrooms promoted collaborative and experiential learning ($\bar{x}$ = 4.45, SD = 0.62), integrating hands-on science experiments and interactive activities should be prioritized.

Overall, the *Science on the Go* program demonstrated high effectiveness in providing quality education to ALS learners. Future research may explore the long-term impact of mobile classrooms on student performance and employability outcomes.

Effectiveness of "Science on The Go Program" on Science Literacy among ALS Learners in terms of ScieGo Learning Module

Table 1.2. Effectiveness of "Science on The Go Program" on Science Literacy among ALS Learners in terms of ScieGo Learning Module

Items	Mean	SD	Description
1. The Scie Go Learning Module help me understand scientific concepts better.	4.55	0.68	Highly Effective
2. I find the Scie Go Learning Module engaging and informative.	4.48	0.68	Highly Effective

3. The Scie Go Learning Module clarifies difficult scientific topics.	4.52	0.63	Highly Effective
4. The Scie Go Learning Module makes learning science more interesting and enjoyable.	4.35	0.61	Highly Effective
5. The Scie Go Learning Module is easy to follow and understandable.	4.65	0.55	Highly Effective
6. I am able to retain more information through the lessons presented in the Scie Go Module.	4.52	0.63	Highly Effective
7. The Scie Go Learning Module provide real-world examples of scientific principles.	4.61	0.56	Highly Effective
8. The lessons in Scie Go Learning Module allow me to learn at my own pace.	4.58	0.62	Highly Effective
9. The Scie Go Learning Module enhances the application of scientific concepts in the real world.	4.65	0.55	Highly Effective
10. The Scie Go Learning Module develops the development of critical thinking and problem-solving skills by encouraging learners to analyze, evaluate, and apply scientific concepts effectively.	4.68	0.54	Highly Effective
Overall Mean	**4.56**	**0.29**	**Highly Effective**

The findings in Table 1.2 indicate that the *Science on The Go Program* is highly effective in delivering its learning module to ALS learners. The overall mean score of 4.56 (SD = 0.29) suggests that the module successfully facilitates science learning. Among the highest-rated features are the development of critical thinking and problem-solving skills ($\bar{x}$ = 4.88, SD = 0.54), as well as the application of scientific concepts to real-world situations ($\bar{x}$ = 4.65, SD = 0.55), highlighting the module's practical effectiveness in making science education relevant and engaging.

These findings supported constructivist learning theories, which emphasized active engagement and the application of knowledge in meaningful contexts. As Bruner (1960) posited, students learned more effectively when they could relate new information to prior experiences. This was reflected in the study's results, with learners rating the module as informative ($\bar{x}$ = 4.48, SD = 0.68) and easy to understand ($\bar{x}$ = 4.65, SD = 0.55), indicating that it was well-structured and learner-centered.

Moreover, the module's capacity to enhance knowledge retention ($\bar{x}$ = 4.52, SD = 0.63) was particularly valuable for ALS learners, who often encountered barriers to consistent formal education. Mayer's (2014) research on multimedia learning corroborated this, asserting that well-designed instructional materials significantly improved retention and understanding, especially when they incorporated interactive and engaging elements.

Another noteworthy aspect was the module's ability to increase learners' interest and enjoyment in science ($\bar{x}$ = 4.35, SD = 0.61). This finding aligned with Self-Determination Theory (Ryan & Deci, 2000), which underscored the role of intrinsic motivation in effective learning. When learners perceived educational content as enjoyable, they were more likely to remain engaged and motivated, resulting in improved outcomes.

Furthermore, the module's flexibility in enabling self-paced learning ($\bar{x}$ = 4.58, SD = 0.62) was especially advantageous for ALS learners with varying schedules and learning styles. Moore et al. (2011) emphasized that self-directed learning environments contributed to greater autonomy and knowledge acquisition—key factors for success in alternative education settings.

Overall, the findings underscored the need to continually refine and expand mobile science learning modules to meet diverse learner needs. Educators and policymakers were encouraged to integrate interactive digital elements such as simulations, videos, and hands-on activities to deepen student engagement and understanding. Given the module's effectiveness in fostering critical thinking and problem-solving skills, it should also be supplemented with experiential learning opportunities, such as community-based science projects.

In conclusion, the *Science on the Go* learning module showed strong potential in enhancing science education for ALS learners. Future studies could investigate its long-term impact on learners' academic development and career trajectories.

Effectiveness of "Science on The Go Program" on Science Literacy among ALS Learners in terms of Hands-On Activities and Experiments

Table 1.3. Effectiveness of "Science on The Go Program" on Science Literacy Among ALS Learners in terms of Hands- On Experiments and Activities

Items	Mean	SD	Description
1. The hands-on experiments help me better understand science concepts.	4.45	0.72	Highly Effective
2. I enjoy participating in hands-on science activities.	4.42	0.67	Highly Effective
3. I feel more confident about science after completing hands-on experiments.	4.74	0.51	Highly Effective
4. The hands-on activities help me apply scientific principles to real-world situations.	4.42	0.85	Highly Effective
5. I learn more effectively through the hands-on experiments than through lectures alone.	4.42	0.67	Highly Effective
6. The materials for the hands-on activities are adequate and easy to use.	4.55	0.57	Highly Effective
7. The hands-on experiments make science learning more exciting.	4.39	0.67	Highly Effective
8. The experiments help me develop critical thinking and problem-solving skills.	4.39	0.76	Highly Effective
9. The hands-on activities allow me to collaborate with my peers.	4.55	0.77	Highly Effective
10. I look forward to more hands-on experiments in future science lessons.	4.68	0.54	Highly Effective
Overall Mean	**4.50**	**0.40**	**Highly Effective**

The findings in Table 1.3 indicate that the hands-on experiments and activities component of the *Science on The Go Program* is highly effective among ALS learners, with an overall mean of 4.50 (SD =

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0.40). The highest-rated aspect is students' anticipation for future hands-on experiments (x̄ = 4.88, SD = 0.54), suggesting that experiential learning fosters enthusiasm and engagement in science education. In addition, students reported feeling more confident in their understanding of science after completing experiments (x̄ = 4.74, SD = 0.51), reinforcing the idea that active participation enhances learners' self-efficacy.

These findings were aligned with Experiential Learning Theory, which asserted that learning was most effective when it involved direct experience, reflection, and application (Kolb, 1984). The results also indicated that learners perceived hands-on experiments as more effective than traditional lecture-based instruction (x̄ = 4.42, SD = 0.87), a finding supported by Freeman et al. (2014), whose research demonstrated that active learning significantly improved conceptual understanding and retention in STEM education.

Another noteworthy finding was the promotion of collaborative learning through hands-on activities (x̄ = 4.55, SD = 0.77). This aligned with the Social Constructivist Theory of Vygotsky (1978), which emphasized the fundamental role of social interaction in the development of cognition. When students collaborated on experiments, they not only enhanced their problem-solving abilities but also benefited from peer interaction and the sharing of diverse perspectives, leading to deeper learning outcomes.

Furthermore, the study highlighted the value of applying scientific concepts to real-life contexts. The ability to connect science lessons with everyday situations (x̄ = 4.42, SD = 0.85) was essential for fostering scientific literacy. This was supported by the National Research Council (2012), which emphasized that engaging in real-world, hands-on activities helped learners develop curiosity, critical thinking, and problem-solving skills essential for STEM education.

Despite these positive findings, the study also identified areas for improvement. Although students found the materials used in the experiments to be adequate and easy to use (x̄ = 4.55, SD = 0.57), maintaining a consistent supply of high-quality experimental tools and resources was essential to sustaining learner engagement and instructional effectiveness.

Overall, the findings suggested that integrating more hands-on experiments into ALS science programs could significantly enhance student learning outcomes, self-confidence, and motivation. To support this, policymakers and educators should prioritize the provision of laboratory materials, facilitator training in experiential teaching methods, and the inclusion of real-world applications in science curricula. Additionally, because collaborative problem-solving emerged as a key benefit of these activities, science programs should incorporate more group-based, inquiry-driven experiments.

Key Challenges and Barriers Encountered by Learners and Educators in Implementation of the "Science on the Go" program

Table 7. Thematic Analysis on Key Challenges and Barriers Encountered by Learners' and Teachers' Experiences in the "Science on the Go" Program

Initial Codes and Significant Statements	Emerging Themes	Essential Themes
STUDENT CODES 1. **Hands-on learning improves engagement** • "These activities have brought us closer to	**STUDENT THEMES** **1. Hands-on Learning as a Motivator**	**STUDENT THEMES** **1. Hands-on Learning as a Motivator** • Students found Science more exciting due to interactive experiments.

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Science and have inspired us to continue learning." (P1) 2. **Shift from passive to active learning** • "Before, we only relied on modules, but now, we get to experience learning like real students." (P2) 3. **Challenges in literacy and prior education** • "I found the Science on the Go program quite challenging because I am not very good at reading and writing." (P3) • **TEACHER CODES** 1**. Structured modules improve comprehension** • "The module is well-structured and easy to follow, making it helpful for both teachers and students." (P4) 2. **Teacher adaptability supports learning** • "I also noticed that you adjust to the learners by simplifying your explanations so they can understand better." (P4) 3. **Collaboration enhances understanding** • "Instead of merely listening to lectures, learners collaborate in small groups, discuss scientific concepts, and	• Students valued experiential learning over passive reading. • Engaging activities sparked interest in Science. 2. **Overcoming Learning Challenges** • Some students struggled due to literacy and education gaps. • The program provided an opportunity for continued learning 3. **Transition from Passive to Active Learning** • Moving from modules to experiments made learning feel more authentic. • Students enjoyed being treated like regular students • **TEACHER THEMES** 1**. The Role of Structured Modules in Learning** • The modules were clear and well-structured, making it easier for students to follow along. • Even with limited resources, modules bridged learning gaps.	• Learning through experience deepened understanding. • "These activities have brought us closer to Science and have inspired us to continue learning." (P1) **2. Overcoming Learning Challenges** • Some students struggled with literacy, making it harder to grasp concepts. • Despite this, the program provided an opportunity for growth. • “I found the Science on the Go program quite challenging because I am not very good at reading and writing.” (P3) **3. Transition from Passive to Active Learning** • Students felt like "real students" rather than just module learners. • The shift from reading to doing improved knowledge retention. • "Before, we only relied on modules, but now, we get to experience learning like real students." (P2) **TEACHER THEMES** **1. The Role of Structured Modules in Learning** • The modules provided a solid foundation for both teachers and students. • Even without complete materials, the modules helped sustain learning. • “The module is well-structured and easy to follow, making it helpful for both teachers and students.” (P4) **2. Teaching Adaptability and Instructional Strategies** • Teachers adjusted explanations to match student abilities.

actively engage in experiments." (P5) 4. **Resource limitations require creativity** • "May mga pagkakataon na kulang ang kagamitan, kaya bilang guro, kailangan naming maging resourceful." (P4)	2. **Teaching Adaptability and Instructional Strategies** • Teachers simplified explanations and adjusted teaching styles to help struggling students. • Demonstrations helped make Science more understandable. 3. **The Power of Collaborative Learning** • Group activities allowed students to learn from each other and gain confidence. • Collaboration helped mitigate resource constraints. 4. **Resource Limitations and Workarounds** • Lack of materials was a challenge, but teachers found ways to be resourceful. • Creativity and adaptability ensured continued learning.	• Demonstrations and step-by-step teaching made science more relatable. • "Before you teach them, you demonstrate first so they can see how the process works." (P4) **3. The Power of Collaborative Learning** • Encouraged teamwork and student engagement. • Collaboration helped overcome individual weaknesses. • “Learners collaborate in small groups, discuss scientific concepts, and actively engage in experiments.” (P5) **3. Resource Limitations and Workarounds** • Limited materials posed challenges, requiring creativity. • Teachers improvised to ensure effective learning. • "May mga pagkakataon na kulang ang kagamitan, kaya bilang guro, kailangan naming maging resourceful." (P4)

This section presents an in-depth discussion of the themes identified in the Science on the Go program using Braun and Clarke’s (2006) thematic analysis framework. The discussion incorporates significant participant statements, theoretical insights, and supporting literature to interpret the findings.

Student Themes

Theme 1: Hands-on Learning as a Motivator

Students expressed enthusiasm for hands-on learning, emphasizing how experiential activities made Science more engaging and enjoyable. Participant 1 (Happy) described how the program inspired continued learning:

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"These activities have brought us closer to Science and have inspired us to continue learning and further increase our interest in studying." (Happy)

This finding aligned with Kolb's (1984) Experiential Learning Theory, which suggested that students learned best when they actively engaged in experiences rather than passively receiving information. Hands-on learning also promoted higher student motivation and retention of scientific concepts (Freeman et al., 2014).

Additionally, Constructivist Learning Theory (Piaget, 1950) highlighted that students developed a deeper understanding when they interacted directly with their environment. By conducting experiments and engaging in group discussions, students felt more connected to the subject matter.

The findings suggested that ALS programs should integrate more hands-on experiments to sustain student interest and engagement in science. Hands-on activities allowed learners to actively participate in the learning process, making abstract concepts more concrete and easier to understand. This approach not only enhanced knowledge retention but also fostered curiosity and enthusiasm for learning. Furthermore, teachers should incorporate real-world applications to further deepen students' understanding and motivation. Connecting scientific concepts to everyday life helped learners see the relevance of what they were studying, making the learning experience more meaningful. By implementing these strategies, ALS programs could create a more interactive, engaging, and effective science education experience for students, particularly those with limited prior exposure to formal schooling.

Theme 2. Overcoming Learning Challenges

Some students faced significant learning difficulties, particularly in literacy, making it harder for them to grasp scientific concepts. Despite these challenges, they valued the opportunity to learn. Participant 3 (Workaholic) expressed this struggle:

"I found the Science on the Go program quite challenging because I am not very good at reading and writing." (Workaholic)

The Zone of Proximal Development (Vygotsky, 1978) suggested that students learned best when provided with guided support. This aligned with the program's approach of incorporating teacher assistance and hands-on activities to help learners bridge literacy gaps.

Furthermore, research indicated that multimodal teaching strategies—such as visual aids, peer discussions, and hands-on activities were effective in supporting students with literacy difficulties (Gee, 2008).

To enhance the effectiveness of science education in ALS programs, it was essential to integrate literacy support mechanisms that catered to students with varying levels of reading and comprehension skills. This could be achieved by incorporating simplified texts and visual aids, which made complex scientific concepts more accessible and easier to grasp. Visual representations such as diagrams, charts, and instructional videos served as powerful tools to support learning, especially for students who struggled with reading.

Additionally, teachers should have implemented scaffolding techniques to guide and support struggling learners throughout the learning process. By breaking down information into manageable steps, providing guided instruction, and gradually encouraging independent learning, teachers could help students build confidence and improve their comprehension.

These strategies ensured that students, regardless of their literacy levels, could actively engage in science learning and achieve meaningful progress in their education.

Theme 3. Transition from Passive to Active Learning

Students noted that the transition from module-based learning to interactive experiments made them feel like "real students." Participant 2 (Enthusiast) highlighted this transformation:

"Before, we only relied on modules, but now, we get to experience learning like real students." (Enthusiast)

This finding supported active learning theories (Prince, 2004), which emphasized that students learned better when they engaged with content actively rather than passively absorbing information. Studies showed that interactive learning led to improved comprehension and retention of scientific knowledge (Michael, 2006).

The shift from text-based to experiential learning aligned with Bruner's (1961) Constructivist Learning Theory, which suggested that students retained knowledge better when they discovered concepts on their own rather than just memorizing information.

To enhance student engagement and comprehension in science, ALS programs should have minimized reliance on traditional text-based learning and incorporated more active learning strategies that encouraged hands-on participation and critical thinking. While modules provided foundational knowledge, they should have been complemented with interactive activities such as experiments, group discussions, and problem-solving exercises to make learning more dynamic and effective.

Additionally, science teaching should have integrated inquiry-based approaches, where students actively explored scientific concepts through questioning, investigation, and experimentation. This method fostered deeper engagement and understanding, as learners developed their own conclusions rather than passively receiving information.

By shifting towards active and inquiry-based learning, ALS programs could have created a more immersive and stimulating educational experience that empowered students to think critically, collaborate, and apply scientific knowledge in real-life situations.

Teacher Themes

Theme 1. The Role of Structured Modules in Learning

Teachers found the structured modules essential in guiding student learning, especially for ALS learners with limited access to formal education. Participant 4 (Model) explained how the modules helped sustain learning:

"The module is well-structured and easy to follow, making it helpful for both teachers and students." (Model)

This aligned with Instructional Design Theory (Merrill, 2002), which emphasized that well-structured materials provided a clear learning pathway for students. However, research suggested that modules alone were not sufficient; they should have been complemented with interactive strategies to maximize effectiveness (Adams, 2015).

To maximize the effectiveness of science education in ALS programs, modules should have been paired with hands-on and collaborative activities to create a more engaging and interactive learning experience. While structured materials provided essential guidance, complementing them with experiments, group discussions, and collaborative problem-solving enhanced comprehension and retention. Engaging students in active participation fostered deeper understanding and helped bridge learning gaps, particularly for those with limited prior exposure to formal education.

Additionally, teacher training should have focused on integrating structured materials with active learning methods, equipping educators with the skills to balance traditional instructional content with experiential approaches. By adopting these strategies, ALS programs could have created a more dynamic and student-centered learning environment, ensuring that science education was both accessible and impactful for all learners.

Theme 2. Teaching Adaptability and Instructional Strategies

Teachers adjusted their instructional strategies to make Science more accessible for ALS learners. Participant 4 (Model) described how demonstrations and simplified explanations helped:

"*Before you teach them, you demonstrate first so they can see how the process works." (Model)*

This finding supported Differentiated Instruction Theory (Tomlinson, 2001), which suggested that teachers should have modified their instruction based on students' abilities. Additionally, Dual Coding Theory (Paivio, 1986) highlighted that combining verbal explanations with visual demonstrations enhanced student understanding.

To improve science education in ALS programs, teacher training should have emphasized differentiated instruction and visual learning strategies to accommodate the diverse learning needs of students. Given that ALS learners came from various educational backgrounds and literacy levels, it was crucial for teachers to adapt their instructional methods to ensure that all students could effectively grasp scientific concepts. Using visual aids such as diagrams, videos, and models helped simplify complex topics and made learning more engaging.

Additionally, demonstration-based learning should have been prioritized in science instruction, as it allowed students to observe and experience scientific principles in action rather than relying solely on theoretical explanations. By incorporating hands-on demonstrations and visual learning techniques, teachers could have created a more inclusive and effective learning environment, ensuring that all students, regardless of their prior education or literacy skills, could actively participate and develop a deeper understanding of science.

Theme 3. The Power of Collaborative Learning

Teachers observed that students learned better through collaboration, as they supported and learned from each other. Participant 5 (Appreciative) emphasized this:

"Learners collaborate in small groups, discuss scientific concepts, and actively engage in experiments." (Appreciative)

This aligned with Social Learning Theory (Bandura, 1986), which stated that students learned effectively when they interacted with peers. Additionally, research by Johnson and Johnson (1999) showed that collaborative learning enhanced critical thinking skills and knowledge retention.

To enhance student engagement and learning outcomes in ALS programs, peer-led and collaborative learning activities should have been incorporated into science instruction. Collaborative learning allowed students to exchange ideas, work together on experiments, and reinforce their understanding through discussion and teamwork. This approach was particularly beneficial for ALS learners, as it fostered a supportive learning environment where students could learn from one another, build confidence, and develop critical thinking skills.

Additionally, teachers should have facilitated structured group discussions to encourage participation and deeper engagement with scientific concepts. By guiding discussions and ensuring that all students had the opportunity to contribute, teachers could have promoted active learning and enhanced comprehension. Implementing these strategies would have helped create a more interactive, student-centered learning experience that encouraged both independent thinking and cooperative problem-solving in science education.

Theme 4. Resource Limitations and Workarounds

A lack of resources posed challenges for both teachers and students, requiring creativity and adaptation. Participant 4 (Model) acknowledged this issue:

"There are times when resources are lacking, so as teachers, we need to be resourceful." (Model)

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Educational research highlighted that limited resources disproportionately impacted marginalized learners (OECD, 2018). Despite these challenges, adaptive teaching strategies (Tobin, 2006) helped teachers mitigate the impact of resource shortages by using alternative teaching materials.

To improve the effectiveness of science education in ALS programs, it was essential to address resource shortages through partnerships and government support. Limited access to laboratory materials and equipment could hinder students' ability to engage in hands-on learning (UNESCO, 2015), making it necessary for ALS programs to collaborate with local organizations, educational institutions, and government agencies to secure funding and resources (Burnett & Felsman, 2012). Establishing partnerships could help provide essential teaching materials and ensure that ALS learners received a well-rounded science education (Moore et al., 2019).

Additionally, teacher training should have included strategies for conducting low-cost science experiments using locally available materials (Hodson, 2014). By equipping teachers with innovative and resourceful approaches, they could create engaging and practical learning experiences even in resource-limited settings (UNESCO, 2016). These strategies would have helped make science education more accessible, interactive, and impactful for ALS learners, regardless of financial or material constraints (Abrahams & Millar, 2008).

The findings highlighted that the *Science on the Go* program significantly improved student engagement and learning, especially through hands-on activities, interactive learning, and collaborative approaches (Freeman et al., 2014; Prince, 2004). However, challenges such as literacy difficulties and resource limitations persisted, requiring adaptability from teachers and further support from ALS programs (UNESCO, 2015; Darling-Hammond et al., 2017).

By integrating structured modules with hands-on and collaborative learning, enhancing teacher adaptability, and addressing resource constraints, the program could become even more effective in making science education accessible for ALS learners (Bransford, Brown, & Cocking, 2000; Vygotsky, 1978; OECD, 2019).

Conclusion and Recommendation

Based on the findings, the *Science on The Go Program* is a highly effective and innovative approach to delivering science education to Alternative Learning System (ALS) learners. Its mobile, hands-on, and learner-centered structure significantly improved students’ mastery of scientific concepts, critical thinking, and problem-solving skills. Quantitative data showed meaningful gains in both the application of scientific knowledge and cognitive abilities, with the experimental group consistently outperforming the control group. The structured modules, interactive experiments, and collaborative learning environment contributed to high levels of student engagement, motivation, and self-confidence factors essential for learners who typically face barriers to formal education.

However, the study also revealed key challenges that must be addressed to optimize the program’s impact. These include learners’ low literacy levels, lack of familiarity with scientific tools, and limited access to educational resources. Teachers reported the need for more instructional support, simplified materials, and culturally responsive strategies to accommodate diverse learner needs. Despite these barriers, the program's experiential approach proved to be empowering, especially when paired with strong teacher guidance and motivational support. To further enhance its effectiveness, strategic interventions such as improved resource allocation, language support, and teamwork-based activities should be prioritized. Overall, the *Science on The Go Program* represents a valuable model for science education in alternative learning contexts, especially for underserved and marginalized learners

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Recommendations

Based on the study's findings, the following recommendations are proposed to further enhance the effectiveness of the "Science on the Go Program" in ALS settings:

1. Strengthening mobile classroom infrastructure is essential. This can be achieved by increasing the number of mobile classrooms to reach more ALS learners in remote areas, improving classroom facilities with advanced scientific tools and resources to support hands-on experiments, and ensuring regular maintenance of mobile classrooms to provide a conducive and safe learning environment.
2. Enhancing multimedia science learning modules will significantly improve learner engagement. This includes developing additional interactive digital content such as virtual simulations and animated science lessons, integrating a self-paced learning approach to accommodate different learning speeds, and providing learners with offline access to multimedia learning materials to address connectivity issues in remote areas.
3. Expanding hands-on experiments and activities is crucial in making science education more practical and engaging. To achieve this, funding and partnerships with local organizations should be increased to provide adequate laboratory materials and resources. ALS educators should be trained in innovative, low-cost experimental techniques that allow students to conduct practical science activities using locally available materials.
4. Community-based learning initiatives should be encouraged, enabling ALS learners to conduct experiments in collaboration with local science professionals and educators.
5. Improving learner engagement and accessibility is vital in ensuring consistent participation. Flexible learning schedules should be implemented to accommodate ALS learners who may have other responsibilities, such as work or family duties. Providing transportation support or mobile learning kits will assist students facing challenges in attending physical sessions.
6. Strengthening partnerships with local government units (LGUs) and private institutions will enhance ALS learners' access to educational technology and learning spaces.
7. Capacity building for ALS educators is necessary to ensure effective program implementation. This can be done by conducting regular training programs and workshops for ALS teachers on modern instructional strategies and technology integration in science education.
8. Establishing a peer mentoring system will allow experienced ALS educators to guide new facilitators in implementing innovative teaching techniques. Additionally, teacher resource kits containing lesson plans, experiment guides, and assessment tools tailored for ALS science education should be developed.
9. Long-term program evaluation and sustainability must be prioritized. Implementing a monitoring and evaluation framework will help continuously assess the program's effectiveness in various ALS settings.
10. Follow-up studies should be conducted to track long-term improvements in science literacy among ALS learners who participated in the program.
11. Advocating for government and private sector funding is necessary to sustain and expand the program, ensuring continuous improvement and a wider reach.

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