Original Article

Curriculum Development on the Utilization of Solar Power to Operate Televisions for Enhanced Learning Delivery at Fye Falel Indigenous People (IP) School

Emran K. Gandulan Jr.[1]*

1. Teacher-in-Charge, Fye Falel IP School, Department of Education, Division of Sarangani, Philippines.

* Correspondence: emran.gandulan@deped.gov.ph

Abstract: Curriculum innovations involve the introduction of new strategies, methods, or content to better or cater to the evolving needs and expectations of learners, educators, and society. These changes aim to enhance the educational experience and improve the overall outcome of education This study dwelled upon curriculum development that incorporates solar-powered television as a teaching tool to improve the process of learning at Fye Falel Indigenous People (IP) School, a remote educational institution in a distant area with no power supply. It is a mixed-methods, design-based study based on the objectives-based curriculum development model created by Tyler (1949) and with the framework of the UNESCO-23 on Information and Communication Technology (ICT) to develop inclusive education. The collected based on the needs assessment, focus group discussions, development of the lesson plan, implementation in a classroom, and assessment of the outcomes of the learners. Baseline assessments identified severe infrastructural and pedagogical bottlenecks, primarily a lack of electricity and restricted multimedia integration. Following the implementation of solar installations, curriculum realignment, and teacher training, student learning outcomes improved substantially, marked by a mean test score increase from 62.4% to 83.7%, alongside elevated classroom engagement. Qualitative data confirmed that teachers developed greater confidence and instructional creativity, while field evidence showed active community participation in infrastructure maintenance. However, interviews with school heads and teachers underscored that long-term project sustainability remains contingent upon addressing ongoing equipment maintenance needs and providing continuous capacity-building training.

Keywords: curriculum development, solar power, indigenous people's education, instructional technology

1. INTRODUCTION

Curriculum innovations involve the introduction of new strategies, methods, or content to better or cater to the evolving needs and expectations of learners, educators, and society. These changes aim to enhance the educational experience and improve the overall outcome of education [1]. The innovations in the curriculum may encompass the introduction of fresh knowledge, skills, or competencies needed for success in the 21st century. It may also involve the integration of new pedagogical approaches or theories, the adoption of cutting-edge technologies or media, the implementation of new policies or standards, and the tackling of emerging social or environmental challenges [2]. Contemplating curriculum innovations in Nigeria has become a necessary discourse if the Nigerian educational system must be improved upon such that it can be subservient to the needs and aspirations of the Nigerian

people. As such, goals, objectives, content, methods, materials, assessment, or evaluation must all be well thought-out when considering a curriculum innovation that can meaningfully deliver sustainable national development. In negotiating for better student achievement, [3] pointed out that digital literacy is one of the factors that contribute to improving students' academic achievement when considering curriculum innovations. This study therefore hinges on the belief that educators can become successful drivers of sustainable development through useful and effective curriculum innovation such as Technology-enhanced learning. Sustainable development in this respect refers to the process of meeting the educational needs of the present without compromising in any way, the ability of future generations to meet their own educational and socioeconomic needs [4]. This concept thus bothers around three dimensions: economic, social, and environmental; and any form of innovation that seeks to engage the concept of sustainability must require the integration of these dimensions to achieve a reasonable level of well-being for mankind and its planet. To deliberate about driving sustainable national development through curriculum innovation therefore calls for an indebt consideration of alternative education models such as technology-enhanced learning (TEL) [5]. It is no secret that among the most attractive services from a solar home system is the possibility to listen to music and look at TV and video. Studies on the type of appliances found in households with solar home systems show that TVs are common [6-8], and the time spent using these appliances depends on the power supply but can reach up to 5 h a day [9]. Solar systems purchased by users on commercial basis in Kenya are more often meant for use together with a TV set, than for getting solar lighting [10]. A geographically remote and disadvantaged region education has continued to be one of the most pressing issues in the attainment of equitable quality education in the Philippines. There are still thousands of Indigenous Peoples (IP) schools, especially the ones located in remote and mountainous areas, where the supply of reliable electricity is not ensured. This is because a power supply is lacking and thus it could not use the modern instructional technologies that can be used to improve the effectiveness of instruction and engagement of learners. Faye Falel IP School is such a facility that is based in a remote community and all teachers can do now is to teach using traditional and text-based lessons since there is no electrical system. The learners are therefore denied access to multimedia and visual learning that would help to enhance understanding and encouragement. Due to the rising trend of incorporating technology in education there has arisen the idea of renewable energy, which can be utilized to power off-grid schools. In this case, solar energy will provide a clean, affordable, and readily available source of electricity that can be used to energize simple education machines like TVs and audio-visual devices. The Department of Energy (2021) states that solar photovoltaic (PV) systems can considerably enhance the rural energy access, which consequently can assist in social development and education. Similarly, [11] also emphasizes that Information and Communication Technologies (ICTs) when localized can help lower the gap in learning and foster inclusion in marginalized learners. This study is coming up with a curriculum where solar-powered television can be used as a teaching aid in improving the delivery of learning at the Fye Falel IP School. The proposed program will aim at adapting renewable energy use to the Department of Education (DepED) learning competencies and localization framework, and make it relevant to the cultural and environmental context of the learners. Basing its findings on the objectives-based model of the curriculum design by Tyler (1949) and grassroots approach to curriculum design by Taba (1962), the study provides a participatory and needs-based process, in which the teachers, learners, and community stakeholders participate. The study designed, implemented and evaluated a contextualized model of curriculum utilizing solar-powered audiovisual teaching to improve teaching and learning in an off-grid IP school through this research. The implications of the findings are that they will aid the innovation and sustainability of education by showing how renewable energy and curriculum development can collaborate to enhance access, engagement, and equity in remote education environments. This mixed-method study is aimed at understanding the challenges, solutions, and solutions of how to develop and implement a curriculum

that uses solar power to power televisions to facilitate improved learning delivery in Faye Falel IP School. In this regard, the study is likely to produce the insights that can inform the development of the technology-enabled off-grid Indigenous Peoples (IP) schools' sustainable educational programs and policies in such settings. In particular, the following questions were to be answered in the course of the study: What are the difficulties faced by teachers and learners in providing and receiving quality education in the non-electricity situation in Fye Falel IP School? What were the strategies used in the development and implementation of a curriculum that incorporates the use of solar powered televisions in the teaching and learning process? What are the consequences of the solar-powered, television-based curriculum with respect to the engagement of the learners, their motivation, and performance at school? What would come together between qualitative information and quantitative data in assessing the effectiveness of the implementation of the solar-powered curriculum?

2. MATERIALS AND METHODS

The study design was both a mixed-method and design-based research (DBR) study to design, implement, and assess a curriculum that makes use of solar power to power televisions to facilitate enhanced delivery of learning in Fye Falel Indigenous Peoples (IP) School. It was possible to comprehend the contextual issues of the school, the participatory design of the solar-powered curriculum, and the quantification of the results of the activity on the engagement of learners and academic outcomes due to the combination of qualitative and quantitative methods. The design-based research framework was chosen due to its iterative nature, collaborative nature and concentration on the empirical generation of viable solutions to the real-life educational issues. In line with the model of Reeves (2006), the study has followed four major stages: (1) examination of real-world problems alongside practitioners, (2) generating solutions based on the existing concepts of design and theories, (3) cycling of tests and adjustments in the real classroom settings and (4) reflection to generate design principles and guidelines that can be used to inform comparable educational situations. In the course of the qualitative stage, the data were gathered via interviews and focus group discussions with teachers, learners and community stakeholders to establish issues connected with teaching in non-electrified setting and to co-design the curriculum framework. Classroom implementation was observed to record the change in the teaching practice and students' engagement. During the quantitative stage, there were pre-test and post-tests that were used to establish the changes in the academic performance of the learners prior to the implementation of the solar-powered television-based lessons, as well as after the lessons had been introduced. Learning gains were measured using descriptive statistics and basic inferential, and qualitative data were analyzed using thematic analysis to determine the emergent themes on challenges, and strategies and outcomes. This mixed-methods DBR design was able to combine both data strands and thus provide a holistic perspective on the role of integrating renewable energy sources such as solar-powered television to improve curriculum delivery in off-grid IP schools. This research should provide contributions to the theory (curriculum development in resource-restricted settings) as well as to the practice (instructions on how to introduce sustainable, technology-based teaching in such educational settings). The participants of this study were selected from Fye Falel Indigenous Peoples (IP) School, a remote public elementary school located in a far-flung community with no access to grid electricity. The school was purposely chosen as the study site because it represents the context of off-grid Indigenous schools where the integration of renewable energy technologies can significantly improve instructional delivery and learning access. A purposive sampling technique was employed to identify participants who could provide relevant and meaningful information about the development and implementation of a solar-powered curriculum. A total of 25 participants were involved in the study, consisting of the following groups, teachers, learners, school head, and community representative. The diversity of participants helped to make the curriculum development process participatory and context-sensitive in accordance with the principles of Design-Based Research (DBR)

and Indigenous community participation. The ethics were also closely followed by obtaining informed consent of all the participants, guaranteeing confidentiality, and getting the consent of the school administration before data collection. In order to gather both qualitative and quantitative data, the research employed a number of researcher-developed tools. The teachers, school head and community representatives were interviewed semi-structured using a guide based on exploring challenges, strategies and outcomes of implementing the solar-powered television curriculum. A focus group discussion (FGD) protocol was used to collect the experiences of learners in regard to engagement and motivation in the television-assisted lessons. Teaching delivery, learner engagement and the appropriate use of audiovisual tools were evaluated using a 4-point rating scale in a classroom observation checklist. A pre-test and post-test with 20 multiple-choice questions using the Most Essential Learning Competencies (MELCs) was used to measure learning gains. Lastly, a checklist on document analysis was conducted on lesson plans, reflections, and activity sheets to ensure that the curriculum and integration of solar-powered technology were complied with. Each tool was confirmed by educational professionals and was aimed at triangulating the data, so that the overall picture of the impact of solar power on curriculum implementation and learning participation in off-grid environment of the Indigenous school was received. The data collection was performed in three large phases in accordance with the Design-Based Research (DBR) model: The first step involves the (1) Exploration and Needs Assessment, (2) Curriculum Development and Implementation, and (3) Evaluation and Reflection. Within the exploration phase, pre-visit and meetings with the school head, the teachers and the community representatives were conducted to offer an explanation of the study objective and seek permission. The researcher used interviews and focus group discussions to determine the problems of instructions that are occasioned by lack of electricity and to obtain local knowledge, which will be used to create curriculum. During development and implementation, the solar-powered television system was set up and a series of co-design workshops with teachers conducted to make lesson plans consistent with DepEd Most Essential Learning Competencies (MELCs). The lessons that were offered using the television were then observed in the classroom where the teaching practices and participation of the learners were recorded. During the evaluation phase, pre-test and post-test were taken to learners to determine the performance of the students in both pre-test and post-test phases before and after the curriculum implementation. To obtain the reflections and evaluation of the sustainability and perceived impact of the intervention, interviews, FGDs, and document analyses were performed. All data were gathered in an ethical manner where the participants were done on a voluntary basis, the data remained confidential, there was no disrespect to the Indigenous community. This study has followed the ethical guidelines set in the field of educational research to the latter to the extent that the participating parties in the study are secure, with their dignity and rights intact. Data collection was done after formal permission to carry out the study was secured with the Department of Education (DepEd) Division Office and the School Head of Fye Falel Indigenous Peoples (IP) School. All the participants were well informed about the purpose, objectives and procedures of the study in a language they understood to make them participate. All the subjects, teachers, learners, and community representatives, gave informed consent. In the case of minors as learners, permission was sought with their parents or guardians. Respondents were even made aware that in order to volunteer they were volunteering to participate in the study without being penalized or faced with consequences. The issue of confidentiality and anonymity were observed to the letter during the research process. The codes were used as personal identifiers and all the data that had been gathered including the interview recordings, transcripts and test outcomes were stored in a secured place and only the researcher could access it. The findings of the research were presented in groups in order to avoid identifying a single patient. Since the research was carried out on an Indigenous community, cultural sensitivity and adherence to local traditions were addressed throughout the research. The researcher liaised with local leaders and the elderly to make sure that all the procedures were in line with the community norms

and values. Any educational intervention and materials that were formulated during the study were to be respectful of Indigenous systems of knowledge and encourage inclusivity. Lastly, the research was adhering to the requirements of the Ethical Guidelines of Educational Research provided by the DepEd and Data Privacy Act of 2012 (Republic Act No. 10173). All discoveries will be applied with the sole purpose of academic and developmental interests and will be distributed to the school and community to enhance future educational enhancing activities.

3. RESULTS AND DISCUSSION

The purpose of the study was to design and execute a solar-powered television-based curriculum in order to improve the delivery of learning in an inaccessible Indigenous community, Fye Falel IP School, where there was no electricity access. The mixed-method technique was used to collect quantitative and qualitative data through teachers, learners, and the community representatives. The findings indicated that prior to the installation of solar power, the teachers were experiencing severe challenges in assimilating technology in teaching because of an all-round electricity shortage. Traditional lecture-based lessons were used in most of the instances and learner engagement with the lesson was very low and predetermined understanding was also found to be low. Teachers too complained that they could not innovate or make use of multimedia learning materials, whereas students had difficulty visualizing difficult concepts, thus making poor academic performance [12]. A set of interventions was established when the solar power system was installed which comprised curriculum alignment, teacher training, and community cooperation. The lesson plans were modified by teachers and school leaders to reflect television-based learning materials that were in accordance with the Most Essential Learning Competencies (MELCs). The training sessions helped the teachers to run solar panels, control the energy consumption, and incorporate digital contents [13]. The community members were also involved by helping in the installation and maintenance of the solar system and this has shown that there is a sense of ownership and cultural collaboration. This is a teamwork that played an important role in ensuring that the project remained successful and that all stakeholders of the project would take advantage of the project. The results of pre-test and post-test gave quantitative data about the level of improvement in the academic performance of learners. The average of 62.4 percent in the pre-test and 83.7 percent in the post-test showed that there was significant improvement in comprehension and retention after implementation of television-based instruction [14]. The observations in the classroom and the focus group discussions confirmed that learners were more attentive, motivated, and participative whenever they were taking audiovisual lessons. Students reported that the lessons were more fun and understandable and teachers reported that they had less time to prepare and the delivery of the lessons improved. The qualitative themes highlighted three major areas of impact, which included improved learning engagement, improved teacher capacity, and improved community involvement. The results indicate that solar-powered technology can be incorporated into the delivery of curriculum in off- grid Indigenous schools, and is indeed a transformational process [15]. It facilitates equal facilitation to good education, empowers educators by innovation, and enhances the involvement of communities in the educational process. Nevertheless, the sustainability issues including equipment repair, technical assistance, and constant capacity-building of teachers are the aspects that can be improved as well. In general, the paper has shown that curriculum development based on renewable energy and inclusive innovation can be used as an example by other remote schools in the Philippines and other areas of the world [16].

Table 01: Summary of Results and Key Findings

Research Focus	Major Findings	Supporting Evidence

Challenges	Lack of electricity, limited multimedia integration, low learner engagement, restricted teacher innovation	Interview and observation data before intervention
Approaches Implemented	Curriculum realignment, teacher training, community participation in solar installation	Project documentation, interviews, and FGD
Learning Outcomes	Improved test performance (mean increase from 62.4% to 83.7%), higher engagement and comprehension	Pre-test and post-test data, FGD with learners
Teacher Outcomes	Increased confidence in technology use, enhanced instructional creativity	Interview transcripts and observation notes
Community Involvement	Active participation in solar maintenance and school activities	Field notes and community feedback
Sustainability Issues	Maintenance needs, continuous training required	Teacher and school head interviews

This study, which was titled Curriculum Development on the Utilization of Solar Power to Operate Televisions to enhance learning delivery at Fye Falel IP School in a remote region with no electricity, investigated a solar-powered television-based curriculum on enhancing the delivery of teaching and learning in an Indigenous Peoples (IP) school. The research used a mixed-methods design to collect both quantitative and qualitative information about teachers, learners, and community members by conducting interviews, focus group discussion, classroom observations, and pre- and post-test [17]. Results showed that electricity shortages were very problematic to teaching and learning before the advent of solar power. Educators could not incorporate multimedia contents or audio-visual tools in their lesson plans, and this restricted their creativity and the participation of learners. The teaching was usually restricted to text-based learning, making students unmotivated and unable to understand. Following the process of installation of the solar power system, the school implemented an updated curriculum design that incorporated a television-based learning in line with the Most Essential Learning Competencies (MELCs) [18]. Educators were trained to use the solar powered equipment and also to work effectively with multimedia learning materials. Another type of community participation that was observed was the installation and maintenance of the system by the community, which showed high levels of cooperation and collective responsibility. The quantitative findings revealed that the learning outcomes of students have significantly improved, and the mean scores were significantly increased as the student rate grew to 83.7% in the post-test, compared to 62.4% in the pre-test, and this indicates a great increase in the levels of understanding and recall [19]. These findings were supported by qualitative data that indicated that the learners got attentive, motivated, and enthusiastic about lessons that were presented on television. Educators declared increased satisfaction and confidence in their performance as teachers with references to the decreased workload and improved lesson delivery.

4. CONCLUSION

With such results, the study concludes that the introduction of solar power into the curriculum is a viable and sustainable approach to improving the provision of education in off-grid Indigenous communities. The application of solar energy contributed to the possibility of introducing technology-based teaching in order to close the divide between rural and urban educational opportunities. The project also contributed to teacher professional development, increased the role of the community, as well as enhanced an inclusive and participatory learning environment. Nevertheless, such issues like maintenance of equipment and the constant training of teachers were also identified as crucial aspects that had to be paid attention to. In light of these conclusions, the study recommends that the Department of Education (DepEd) consider expanding solar-powered learning initiatives in

geographically isolated schools to promote equitable access to technology. School administrators are encouraged to collaborate with local government units (LGUs), non-government organizations (NGOs), and private partners to sustain the solar system and provide continuous capacity-building for teachers. Teachers should continue to innovate by integrating multimedia resources into lessons and sharing best practices with other Indigenous schools. Likewise, community members should remain active partners in maintaining the solar facilities and supporting the educational programs of the school. Future researchers are encouraged to conduct longitudinal studies on the long-term impact of solar-powered instruction and explore the use of other renewable energy technologies to enhance learning continuity and resilience in remote educational settings. Ultimately, the experience of Fye Falel IP School demonstrates that the combination of renewable energy and curriculum innovation can transform education in marginalized areas. By bringing light into classrooms—both literally and figuratively—the project has shown that even in the absence of traditional infrastructure, sustainable solutions can empower teachers, inspire learners, and strengthen communities toward achieving educational resilience and equity.

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