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Status of Technology Utilization in Science-Based Instruction in Selected Schools in Sarangani, Davao Occidental, Philippines

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ABSTRACT

This study reported the status of technology utilization in science-based instruction in the schools of Sarangani District, Davao Occidental. It was conducted during the academic school year of 2022-2023. A total of 48 elementary and junior high school teachers from 15 schools were interviewed using validated survey questionnaires. The results showed that laptops, desktop computers, printers, USB flash drives, and speakers were commonly used technological tools. Moreover, the science teachers were moderately skilled in utilizing technology in science-based instruction. Regarding the level of technological implementation, the science teachers have slightly applied technology integration in science instruction. At the same time, they practiced technology integration in the implementation of science instruction, and the training programs were provided. To improve technology utilization on Sarangani Island, the DepEd has to allocate more educational technology capability-building training for teachers. Moreover, DepEd has to establish active partnerships with local and provincial government units to improve its facilities and resources, namely electricity and internet connectivity.

Keywords: Collaboration, Davao Occidental, educational technology, remote learning, teaching

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INTRODUCTION

Technology plays a vital role in the field of education to facilitate in the fast-changing world. Utilizing educational technology can help students study effectively (Hanımoğlu, 2018). Technology in learning can help improve student participation (Azlim et al., 2015). The educators have been using technology to improve education. The use of computers, the internet, and mobile phones is steadily increasing to be more open to innovation for customers in developing countries expected to increase (Schindler et al., 2017). The Philippine government's implementation of the K-12 education program in 2013 (DepEdPH, 2024) necessitates using technology in teaching and learning. Educators have developed creative methods for successfully and efficiently delivering student lessons (Hero, 2019).

The emergence of technology integration provides new opportunities for teaching and learning (Schul, 2013). The utilization of technology to create student-centered learning environments in the science classroom is evident (Bang and Luft, 2013). Using modern technology in classrooms plays a crucial role in science education (Bang and Luft, 2013). Technology can aid the teacher in collaborative pedagogies (Gao, 2023). Science teachers trained in technology utilization were prepared to use technology more substantially and meaningfully (Windschitl and Sahl, 2002). However, there were still gaps in how teachers utilized technology as a teaching and learning tool, despite the efforts made by schools to provide the required technological resources (Sorensen et al., 2007). The teachers viewed integrating technology as helpful for their students' success. However, their performance and practices did not reflect this progress (Hero, 2019).

The ability of teachers to implement innovations in their classrooms depends on the technology's complexity level and their enthusiasm to learn the technology (Morales et al., 2021). Integrating science and technology is one of the most effective strategies for teaching science (Paje et al., 2021). This study assessed the status of technology utilization in science based instruction in the schools of Sarangani district in terms of the teachers' technological tools used, the level of technological skills of science teachers, and the level of the technological implementation of science teachers. The study's findings can provide an initial assessment of the technological utilization that must be strengthened toward mainstream adoption of technology-based instruction in science.

MATERIALS AND METHODS

The research was conducted at Sarangani Island (Figure 1), a coastal municipality in the province of Davao Occidental. The municipality consists of two major islands: Sarangani Island (50,24',44.244" North, 1250,25', 19.0164" East) and Balut Island (50,26',33.5508" North, 1250, 28', 32.7216" East), collectively called the Sarangani Islands. They are located south of Mindanao Island in the Celebes Sea.

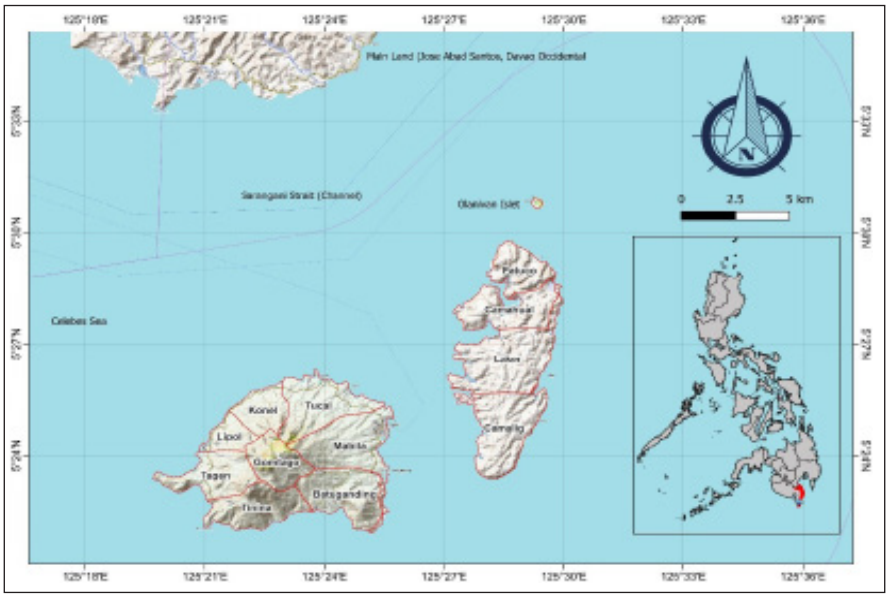

Figure 1. Map of Sarangani Island, Davao Occidental Philippines.

There were forty-two teachers from public elementary schools and six teacher respondents from junior high schools in the Municipality of Sarangani. The study occurred at the end of the third grading period of both elementary and secondary levels of the academic year 2022-2023. A ratio of one teacher respondent to one section was used to determine the student's academic performance since most schools in Sarangani District have a lone section. The study used an adapted and self-made survey questionnaire composed of three (III) parts. Part I was used to determine the technological resources in science-based instruction in terms of technological tools/ resources (13 items) and answerable using the Likert Scale (dichotomous scale) ranging from 1- "Yes" and 2- "No" adapted from the study of Berame, (2016). Part II was used to identify the level of technological skills of science teachers (6 items) using a three-point Likert Scale ranging from 1- "Novice" to 3- "Expert". The scale and descriptive rating used in part II was adapted from the study of Pimentel, (2019). Part III was used to assess the level of technological skills of science teachers in terms of their personal practices in integrating technology in science instruction (7 items), technological integration practices in science instruction (4 items), and training programs (6 items). This part was answerable by a four-point Likert Scale ranging from 1 – "never" to 4– "Always". The scale used in Part III was adapted from the study of Garcia et al. (2020).

Figure 2. Selected respondents answering the survey questionnaire on the utilization of technology in teaching (A, B, C, D).

Statistical tools

The gathered data were run in and analyzed using IBM SPSS statistical software to determine the central tendency of the respondent's response for each tested parameter.

RESULTS

Table one shows the technological resources used in science instruction among public elementary and secondary science teachers in Sarangani District, Davao Occidental. The results show that the commonly used technological tools in science-based instruction with more than 80% of the respondents were computers (93.75%), printers (97.92%), USB flash drives (97.92%), and speakers (83.33%). On the other hand, more than 80% of therespondents do not utilize desktop computers, overhead projectors, digital cameras, and computer laboratories in their mode of instruction. Moreover, it can also show that only a few respondents used LCD projectors, tablet devices, television sets, video recorders, and the internet.

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Table 1. Technological tools/resources used in science instruction among public elementary and secondary science teachers in Sarangani District, Davao Occidental.

Technological tools/resources	Yes		No	
	Frequency	%	Frequency	%
1. Desktop Computers	6	12.50	42	87.50
2. Laptop or notebook computer	45	93.75	3	6.25
3. Tablet Device	20	41.67	28	58.33
4. Overhead Projector	9	18.75	39	81.25
5. LCD/Multimedia Projector	11	22.92	37	77.08
6. Television Set	23	47.92	25	52.08
7. Speakers	40	83.33	8	16.67
8. Digital Camera	5	10.42	43	89.58
9. Video Recorder	15	31.25	33	68.75
10. Internet Connection	23	47.92	25	52.08
11. Printer	47	97.92	1	2.08
12. USB Flash drive	47	97.92	1	2.08
13. Computer Laboratory	1	2.08	47	97.92

Table 2 shows the technological skills of Science Teachers in Sarangani District, Davao Occidental. The respondents show proficiency and are moderately skilled in using different technological tools, particularly productivity tools such as Microsoft Office, with the highest mean (mean=2.23). Moreover, other tools in which the respondents show proficiency are daylight projectors and computers, Zoom, Google Meet, and Canva, access to educational sites or resources online, and social media such as Facebook and Telegram. On the other hand, respondents indicated that they are less skilled in using different multimedia tools such as Adobe Photoshop, Adobe Premier, Filmora, and other editing applications. Overall, the science teachers in Sarangani District, Davao Occidental, are moderately skilled in utilizing technology in science instruction, with an overall mean of 1.98.

Table 2. Level of technological skills of science teachers in Sarangani District, Davao Occidental.

Level of technological skills	Mean	Description
1. I know how to use technological devices such as Daylight Projector and computers	2.21	Proficient
2. I know how to use productivity tools such as Microsoft Office	2.23	Proficient
3. I know how to use educational tools online, such as Zoom, Google Meet, and Canva	1.83	Proficient
4. I know how to use multimedia tools such as Adobe Photoshop, Premier, Filmora, and other editing applications.	1.52	Novice
5. I know how to access educational sites/resources online	1.90	Proficient
6. I use social media platforms like Facebook and Telegram for science-related communication.	2.17	Proficient
Overall mean	**1.98**	**Proficient**

Level of the technological implementation of science teachers

The personal practices of science teachers in integrating technology into science instruction results are presented in Table 3 . Using audio/ speaker/lapel devices to discuss science lessons in the classroom shows the highest mean with a value of 2.88. Other technological tools that were often applied or moderately usedby the teachers were the use of e-mail or social media/messaging applications to communicate with other teachers (mean=2.65) and the use of interactive presentations to explain science concepts (mean =2.75). Moreover, the results showed that the teachers seldomly applied the use of computer in calculating data related to science experiments (mean=2.17), use computer simulation software in science experiments (mean= 1.83), introduce online educational sites for remedial/supplemental

science activities (mean=2.06), and demonstrate the use of online resources such as digital libraries for science lessons (mean=1.94). The overall mean implied that the science teachers seldom applied the integration of technology in science instruction in their personal practices.

Table 3. The level of the technological implementation of science teachers in terms of personal practices in integrating technology in science instruction.

Personal practices in integrating technology in science instruction	Mean	Description
1. I use e-mail or social media/messaging applications to communicate with other science teachers	2.65	Moderate
2. I use an interactive presentation to explain science concepts	2.75	Moderate
3. I demonstrate the use of computer in calculating data related to science experiments	2.17	Low
4. I demonstrate the use of computer simulation software in science experiments	1.83	Low
5. I use audio/speaker/lapel devices to discuss science lessons in the classroom.	2.88	Moderate
6. I introduce online educational sites for remedial/supplemental science activities.	2.06	Low
7. I demonstrate using online resources such as digital libraries for science lessons.	1.94	Low
Overall mean	**2.32**	**Low**

Technology integration practices of science teachers

Table 4 shows the level of technological implementation of science teachers in terms of technological integration practices in science instruction. Results show that the introduction of online educational sites as remedial for science lessons got the highest mean of 2.06, and other technologies were seldom practiced, with an average rating of 1.90.

Table 4. Level of the technological implementation of science teachers in terms of technological integration practices in science instruction.

Technology integration practices in science instruction	Mean	Description
1. Computer simulation software is used to demonstrate science experiments	1.90	Low
2. Software applications are used to control/monitor laboratory experiments/activities	1.90	Low
3. Online educational sites are introduced as remedial/supplemental for science lessons	2.06	Low
4. The use of online resources such as digital libraries for science lessons is demonstrated	1.92	Low
Overall mean	**1.94**	**Low**

Training programs

Table 5 shows that training programs are rarely experienced by science teachers, with an overall mean of 1.61. Moreover, training and workshops on presentation and multimedia provided by the school have the highest mean of 1.81, considered low. It can also be observed that enrollment in online short courses related to technology integration in integrating science subjects shows the lowest mean (mean=1.21). Teachers mostly rated "never" the other listed training programs for technological implementation in science instruction. In this study, it can be perceived that there could be limited opportunities for ICT training and workshops for the teachers provided by the schools within the Sarangani District.

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Table 5. Level of the technological implementation of science teachers in terms of technological integration practices in science instruction.

Training programs	Mean	Description
1. Schools train science teachers on technology use in science education.	1.73	Very low
2. The school provides video presentation and multimedia technology training and workshops.	1.81	Low
3. School provides training on the effective use of multimedia technology.	1.69	Very low
4. The school provides training and workshops on the integration of technology for Science Instruction.	1.58	Very low
5. The school provides training on the use of Internet sources in curriculum or lesson planning evaluation.	1.63	Very low
6. I enrolled in online short courses related to technology integration in integrating science subjects.	1.21	Very low
Overall mean	**1.61**	**Very low**

DISCUSSION

The availability of tools and resources determined the utilization and integration of technology in science-based instructions, alongside the teachers' skills in using technology (Daling, 2018). Teachers only utilize whatever technology is available at school (Tomaru, 2018). Few teachers use overhead projectors, desktop computers, digital cameras, and video recorders since some devices and tools are already outdated. Teachers use smartphones to replace digital cameras, video recorders, and smart televisions to substitute projectors (Josol et al., 2023). The lower percentage of teachers who use tablet devices is due to their cost and inability to accommodate the entire class. Furthermore, the lack of facilities, infrastructure, and budget for procuring computer sets to build computer laboratories affects the utilization (Dotong, 2016; Tomaru, 2018). The presence of infrastructure is pivotal in implementing effective technology-driven instruction (Gente et al., 2024; Figueroa et al., 2016). The schools' geographic location and demographic profile under study incurred challenges in delivering ICT equipment and materials to build infrastructures and facilities (Daling, 2018). The selection of teaching modality incorporating technology is also challenging for the teacher without limited exposure (Nuevo et al., 2024). The results implied the need for other ICT equipment, facilities, infrastructures, and electricity and Internet access. It does need further support from the national government, particularly from the Department of Education (DepEd), the Department of Information and Communications Technology (DICT), and other stakeholders, including the local government unit (LGU).

The high-frequency values in the level of technological skills of science teachers on the utilization of devices, productivity tools, access to educational resources online, and use of social media platforms for science-related communication, resulted from an adaptation to the demands of digital technologies. Teachers use Microsoft Office primarily for administrative purposes such as reports and other submissions, lesson planning and preparation, teacher-directed instructional delivery, students' homework and assessments, and interactive multimedia presentations (Boholano, 2021; Carstens et al., 2021; Navarro-Martinez et al., 2022; Mastul et al., 2023; Galope, 2013). Social media and networking sites have been utilized to deliver instructions and disseminate class announcements; they promote teacher-student interactions and even upload learning materials for easy sharing with the class (Kim and Lee, 2020). The emergent use of conferencing software or applications was also observed during the COVID-19 pandemic as the primary mode of synchronous virtual classes and for remote and online meetings (Paje et al., 2021; Cahapay, 2021; Karaferye, 2022).

Moreover, the results showed that teachers considered themselves novices in the operation of multimedia tools such as Adobe Photoshop, Adobe Premier, filmora, and other editing applications, as these tools require additional training and effort to acquire the specific sets of skills to use these tools

(Boholano et al.,2021; Akram et al., 2022). Moreover, some teachers consider themselves novices in other technological skills, such as troubleshooting software and hardware problems, creating websites, and web-based learning material. Hence, additional training and workshops are also needed to improve the technological proficiency of the teachers (Aldunate and Nussbaum, 2013). Students must be exposed earlier to different technological tools, such as smartphones, tablets, laptops, desktops, and the Internet (Kim and Lee, 2020). It is challenging to fully utilize the advantage to improve and enrich the student's learning experience and academic performance (Boholano et al., 2021). The students' technological skills significantly correlate with age, access to gadgets, and income status. It can positively affect the academic performance of students (Abojon et al., 2023). The teachers' computer proficiency and technological skills are the determining factors in the personal practices in integrating technology into science instruction (Bang, and Luft,2013; Aldunate and Nussbaum, 2013; Navarro-Martinez et al., 2022). Technology integration in science experiments and activities is seldom applied in their practices. This may be due to the unavailability of resources for the whole class and the internet connectivity and electricity in the school areas (Paje et al., 2021). This can imply that investing in equipping the teachers through workshops and seminars and on different equipment, such as computer sets, smart classrooms, and laboratories, can help to improve and motivate the teachers to implement technology in their practices (Aldunate and Nussbaum, 2013). This was highlighted during the event of a pandemic, where the shift to pure online and virtual modes of instruction added additional stress and frustrations to the teachers, as they were not trained or knowledgeable, and the school itself was not ready and equipped to teach, manage, and conduct the class virtually or remotely (Billonid et al., 2023; Robosa et al., 2021). Most of the teachers are challenged by the lack of resources, facilities, and infrastructures, the size of the class, and the additional workloads (Agarao-Fernandez and Guzman, 2005; Robosa et al., 2021); thus, learning and equipping themselves under this particular challenge and situation, can cause additional burden and difficulty on their part. Hence, by reforming and restructuring the appropriate workloads of the teachers, they can divert their focus to learning and adapt the utilization of technology in their practices. Technology should greatly help and aid in uplifting science teaching. Moreover, teachers' awareness of basic ICT skills is insufficient; they also need to develop mastery and other 21st-century skills for effective teachers (Paje et al., 2021; Boholano et al., 2021).

The technological integration practices of science teachers are determined mainly by their technological skills, computer proficiency, digital literacy, and the availability of resources (Boholano et al., 2021). These practices mainly involve internet connectivity, electricity, and enough devices to integrate effectively and have meaningful learning experiences (Boholano et al., 2021). This can imply that improving the teachers' practice by motivating and inspiring them can also directly or indirectly affect their technology-based teaching practices (Paje et al., 2021). However, most computer or online simulations and software applications are costly, as they may consume more significant amounts of data or bandwidth or require certain specific devices' software and hardware specifications, which school teachers and students cannot easily acquire without financial assistance from the school (Kim and Lee, 2020).

Previous studies have emphasized the importance of training, workshops, and capacity-building programs for teachers to fill out the gap between the necessary technological skills of the teachers and the efficient and successful utilization and implementation of technology in education (Dotong et al., 2016; Carstens et al., 2021). Attendance to training programs on the teachers' skills, beliefs, and attitudes toward using technology in their teaching significantly boosts their technology-based Instruction Knowledge. The importance of training, seminar workshops, and coaching and mentoring programs for teachers on ICT integration is highly pivotal totechnological and digital literacy (Hero, 2019).

The role of teachers as facilitators of learning is more demanding and challenging with the integration of technology in teaching and learning. However, it is still poSQssible to achieve successful ICT-friendly and technology-integrated teaching and learning with the strong logistical and collaborative efforts of the government, school administration, teachers, students, and other non-government organizations (Dotong et al., 2016;

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Boholano et al., 2021). Teachers should continuously seek professional and self-development as key players and implementors of ICT-integrated education. Ultimately, it is important to emphasize the important role of the national government and school administration in the continuing professional development of teachers.

CONCLUSION

The study used adapted survey questionnaires to collect data from the responses of 42 elementary teachers and six junior high school students in Sarangani. Based on the survey, the resources that are most utilized are laptops, speakers, printers, and USB flash drives, while the computer laboratory, digital camera, desktop computer, and tablet have the lowest frequency of utilization. Regarding technological skills, the teachers rated their skills as proficient (2 of 3, where 3 is considered an expert). Furthermore, they rated very low regarding technological implementation, integration, and training programs. The study's findings can be used as a basis for crafting capability-building training for teachers in incorporating technology in science instruction. Moreover, the findings can be used as a basis for procuring additional technological tools and allocating budget for building infrastructure for remote schools in the municipality of Sarangani, Davao Occidental.

RECOMMENDATIONS

- The Department of Education (DepEd) must intensify capability-building training for teachers on utilizing emerging learning platforms, both online and offline.
- An additional budget should be allocated for procuring educational learning equipment such as Televisions and LCD Projectors and building a school computer laboratory.
- The Department of Education must establish consistent dialogue and seek collaborations with politicians from the Municipal and Provincial government units to address the lack of electricity in the selected areas of Sarangani Island.
- School heads must encourage the active involvement of faculty in research to seek external funding for upgrading school technological facilities.
- At the school level, accurate reporting on the situation must be disseminated to the proper authority to implement appropriate action. There should be a proper channel and constant feedback system on DepED's proposed reforms to the national government units.

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AUTHOR CONTRIBUTIONS

Conceptualization, ACR and LPL; methodology, ACR and LPL; Data gathering, ACR; Data analysis, ACR and LPL; Manuscript drafting, ACR; Reviewing and Editing, LPL; Preparation of the research article, LPL. Editing of the research article, LPL. All authors have read and agreed to the publication of this manuscript.

CONFLICT OF INTEREST

The authors have no conflict of interest in the result of the study.

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