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# Level of Technological Implementation in Science Instruction to Enhance National Achievement Test (NAT) Performance in Butuan City Division, Philippines

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## ABSTRACT

The study probed the integration of technology in Science instruction in relation to the students' performance in National Achievement Test (NAT) results. It utilized a researcher-made questionnaire to obtain the data. The respondents of the study were the upper and lower 30% performing schools in the National Achievement Test (NAT) for the aforementioned school years. Results of the study revealed that the available technological resources for use in Science instruction in Butuan City Division for the upper 30% were printer, desktop computer, and Internet connection while for the lower 30% were desktop computer, printer, and speaker; that the level of technological skills of both the 30% school-respondents were rated expert in creating a presentation, using social networks, and their knowledge to operate computer. For the level of implementation in Technology-Assisted Science instruction the respondents were rated occasionally. On the other hand, data revealed that the relationship between the level of technological skills of the teachers, school's implementation in Technology-Assisted Science instruction, and the performance in Science NAT between the upper and lower 30% school-respondents was significant. In conclusion, school-participants considered lack of computer sets as the major challenge they faced upon the implementation of Technology-Assisted Science instruction.

## INTRODUCTION

The last two decades have witnessed a worldwide proliferation of Information and Communication Technologies (ICT) into the field of education. The global adoption of ICT into education has often been premised on the potential of the new technological tools to revolutionize an outmoded educational system (Collins *et al.*, 2018), better prepare students for the information age, and accelerate national development efforts (Bordbar, 2010). With this, Philippine government has made an effort to provide the infrastructure that will make it possible to employ these technologies in school to include the launching of Computerization Program in DEpED schools (DepEd Press released, 2013). The ultimate goal is to enhance learning (Bull and Bell, 2010).
In the Philippines, the Filipino students' poor achievement level in Science has been noted for several years now (DepEd, 2014). It is evident in the National Achievement Test (NAT) which is administered annually to measure the academic performance in key subjects of elementary and secondary students in both DepEd and private schools (DepEd, 2014). In 1996, the national mean rating in Science test of the National Elementary Achievement Test was 41.5%. A recent National Achievement Test showed that in 2005, the mean rating in Science test was 54.1% for Grade Six students, and only 14.8% of Grade Six Science students attained mastery levels of Science curriculum goals (DepEd, 2014).
These low achievement levels are also documented in international assessments of Science education like the Trends in International Mathematics and Science Study (TIMSS) (Martin, Mullis, Gonzalez, and Chrostowki, 2004). The results showed that Filipino Grade Six students ranked third from last out of 25 countries in Science, with an average rating of 332. The average international rating was 489, and the highest rating by any country was 565. The average international rating was 474, and the highest rating by any country was 578.
Similarly, in the Division of Butuan City, the results of the National Achievement Test (NAT) for the past four years, from school year 2010-2014 among Grade Six students showed below average performance in terms of their Science MPS NAT result (DepEd database, 2012).
DepEd (2012) points out that Science continues to be the most difficult subject of study in basic education in the Philippines which according to Samuel (2017), can be attributed to lack of interest by the students, difficulty in Science curriculum as perceived by students, teacher factors such as strategies used to teach Science, teacher attitude towards Science teaching, teacher experience and qualifications, perception of the academic standard of the school, and students' study habits (Fisher and McGeveran, 2019; Gul and Bano, 2019).
Various researches to address the flagging and critical performance in the national Achievement Test (NAT) for Grade 6, especially in Science were conducted (DepEd, 2012), however, most of which only focused on the factors resulting within. With this, the researcher, being a Science teacher himself, was motivated to probe the use of technology in Science instruction to enhance Science learning and teaching, which in turn would yield enhanced National Achievement Test (NAT) results in Science.

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## MATERIAL AND METHODS

### Research Design

This study utilized descriptive-correlational research design. It was descriptive because it described the use of technology to assist science instruction among DepEd schools in Butuan City to enhance Science learning. Moreover, it was also correlational as it aimed to describe the level of relationship between the school's level of technological skills and performance in Science National Achievement Test (NAT); and the school's level of implementation and performance in the Science National Achievement Test.

### Research Locale and Sample

This study was conducted in Butuan City, Agusan del Norte. Butuan City is located in the Northern part of Agusan valley sprawling across the Agusan River.

Furthermore, Butuan City is considered as the oldest city and center for government agencies in CARAGA, Region XIII. As constituted, Butuan City has a total land area of 70, 800 hectares and with the population of 309,709 per latest census (NSO, 2010). Butuan City is politically divided into 27 urban and 59 rural barangays. The number of existing DepEd elementary schools is one hundred two (102) in which five (5) of these are central schools. There are also existing fifteen elementary private schools. In this study, the respondents were the upper and lower 30% DepEd performing schools in the National Achievement Test (NAT), based on the Mean Percentage Score (MPS), school year 2013-2014, four years after the implementation of the Computerization Program in DepEd schools.

In embracing the K+12 curriculum in the country, these schools had been implementing different programs of DepEd to make education more challenging and technologically advanced in the field of Science and Technology ranging from Special Education (SPED) to other special Sciences programs. Some of these schools had computer laboratory, access to internet, and other social networks as sources of knowledge or information.

### Sampling Design

The researcher utilized the non-probability using purposive sampling technique in the selection of the school-respondents since there were criteria that were followed in choosing the samples. On the other hand, the schools involved in this study were the upper and lower 30% performing schools in the National Achievement Test (NAT) based on their Mean Percentage Score (MPS) among DepEd elementary central and non-central schools of Butuan City Division. Private elementary schools were not included for consistency of exposure and academic standards.

### Research Instrument

The researcher developed a questionnaire for the teacher-respondents. The questionnaire consisted of four (4) questions representing the information needed for the study. It was reviewed by research professors from two universities in the region for content validation and were revised based on their comments and suggestions.

The survey questionnaire was validated on the basis of the appropriateness of each item. In the same manner, the data collected on the pre-testing of the instrument underwent reliability testing using Coefficient Alpha yielding a reliability result of 0.84 which is highly reliable.

### Data Gathering Procedure

Before the conduct of the data gathering, the researcher sent a letter to the Schools Division Superintendent in Butuan City Division to ask permission to conduct the study on the use of Technology-Assisted Instruction in Science among DepEd schools. Following the approval of the Schools Division Superintendent, the researcher sent a letter to the school administrators of the said division asking permission to conduct the study in their respective schools.

The researcher then conducted the data gathering by asking the DepEd school-respondents to answer the questionnaires. In total, the researcher spent around one month working days in data gathering involving 56 teacher-respondents and 28 principal-respondents in the upper and lower 30% performing DepEd elementary schools in Butuan City Division.

### Data Analysis Procedure

The descriptive evaluation of findings to determine the technological skills of the school-respondents, level of implementation of schools in Technology-Assisted Science Instruction in terms of training program, and the practices of teachers in integrating the use of technology in Science Instruction among DepEd schools in the Division of Butuan City was based on the statistical parameters presented in Tables 1 and 2.

**Table 1:** Rating Scale for Technological Skills of the Teachers

| Scales | Intervals | Description |
|---|---|---|
| 4 | 3.51 – 4.00 | Expert (The teacher can do this very well) |
| 3 | 2.51 – 3.50 | Proficient (The teacher can do this with help from someone) |
| 2 | 1.51 – 2.50 | Novice (The teacher knows what this means but he cannot do it) |
| 1 | 1.00 – 1.50 | Unacceptable (The teacher doesn't know what this means) |

**Table 2:** Rating Scale for the Level of Technological Skills and Implementation of Technology-Assisted Science Instruction

| Scales | Intervals | Description |
|---|---|---|
| 5 | 4.2 - 5.0 | Regularly |
| 4 | 3.4 - 4.1 | Frequently |
| 3 | 2.6 - 3.3 | Occasionally |
| 2 | 1.8 - 2.5 | Rarely |
| 1 | 1.0 - 1.7 | Never |

**Ethical Consideration**

Informed letter of consent was handed to the school-respondents. Meanwhile, confidentiality was observed all throughout the conduct of the study.

**Statistical Treatment of Data**

To facilitate the analysis of the data, chi-square test of independence was used to test significant relationship between the categorical data on schools' technological skills and their performance in Science National Achievement Test. Coefficient alpha was used to test the validity and reliability of the questionnaire. Frequency and Percentage were used to determine the technological resources of the schools available for use in Science instruction as well as the skills of the teachers and their practices. Lastly, mean was used to compute the average NAT performance of the schools for the past 4 school years. Pearson Product Moment Correlation Coefficient was used to test the significant relationship between the level of school's technological practices and implementation to their performance in Science National Achievement Test (NAT) for the previous years.

## RESULTS AND DISCUSSION

**On the Availability of Technological Resources for Use in Science Instruction**

Based on results and analysis, Table 3 shows the percentage distribution of the technological resources available for use for Science Instruction as rated by the teachers and the principals when respondents were grouped as upper and lower 30% performing schools in the National Achievement Test (NAT).

**Table 3:** Percentage Distribution of the Technological Resources in Science Instruction

| Technological Tools/ Resources | Teachers Upper 30% | | Principals Upper 30% | | Total | | Teachers Lower 30% | | Principals Lower 30 & | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NO | YES | NO | YES | NO | YES | NO | YES | NO | YES | NO | YES |
| Desktop Computer | 3.8 | 96.2 | 8.3 | 91.7 | 6.1 | 94.0 | 10.7 | 89.3 | 7.1 | 92.9 | 8.9 | 91.1 |
| Laptop or notebook computer | 37.0 | 63.0 | 42.9 | 57.1 | 40.0 | 60.1 | 25.0 | 75.0 | 41.7 | 58.3 | 33.4 | 66.7 |
| Tablet Device | 82.1 | 17.9 | 84.6 | 15.4 | 83.4 | 16.7 | 88.0 | 12.0 | 100.0 | 0.0 | 94.0 | 6.0 |
| Overhead Projector | 21.4 | 78.6 | 7.1 | 92.9 | 14.3 | 85.8 | 65.4 | 34.6 | 21.4 | 78.6 | 43.4 | 56.6 |
| LCD/ multimedia projector | 11.1 | 88.9 | 14.3 | 85.7 | 12.7 | 87.3 | 24.0 | 76.0 | 8.3 | 91.7 | 16.2 | 83.9 |
| Television Set | 46.4 | 53.6 | 28.6 | 71.4 | 37.5 | 62.5 | 32.1 | 67.9 | 28.6 | 71.4 | 30.4 | 69.7 |
| Compact disc Player | 17.9 | 82.1 | 42.9 | 57.1 | 30.4 | 69.6 | 34.6 | 65.4 | 46.2 | 53.8 | 40.4 | 59.6 |
| DVD player | 25.0 | 75.0 | 23.1 | 76.9 | 24.1 | 76.0 | 28.6 | 71.4 | 44.4 | 55.6 | 36.5 | 63.5 |
| Speakers | 14.3 | 85.7 | 14.3 | 85.7 | 14.3 | 85.7 | 7.1 | 92.9 | 16.7 | 83.3 | 11.9 | 88.1 |
| Digital Camera | 38.5 | 61.5 | 30.8 | 69.2 | 34.7 | 65.4 | 32.1 | 67.9 | 28.6 | 71.4 | 30.4 | 69.7 |
| Video Recorder | 82.1 | 17.9 | 78.6 | 21.4 | 80.4 | 19.7 | 78.6 | 21.4 | 66.7 | 33.3 | 72.7 | 27.4 |
| Karaoke/ Videoke | 82.1 | 17.9 | 61.5 | 38.5 | 71.8 | 28.2 | 30.8 | 69.2 | 60.0 | 40.0 | 45.4 | 54.6 |
| Internet Connection | 10.7 | 89.3 | 7.1 | 92.9 | 8.9 | 91.1 | 17.9 | 82.1 | 23.1 | 76.9 | 20.5 | 79.5 |
| Printer | 7.1 | 92.9 | 0.0 | 100.0 | 3.6 | 96.5 | 7.1 | 92.9 | 14.3 | 85.7 | 10.7 | 89.3 |
| USB (memory) Stick | 18.5 | 81.5 | 14.3 | 85.7 | 16.4 | 83.6 | 10.7 | 89.3 | 27.3 | 72.7 | 19.0 | 81.0 |
| Computer Laboratory | 18.5 | 81.5 | 7.7 | 92.3 | 13.1 | 86.9 | 18.5 | 81.5 | 28.6 | 71.4 | 23.6 | 76.5 |

As indicated in Table 3, there were three (3) technological resources that were being used by more than 90% of the teachers and principals for the upper 30% performing schools in the National Achievement Test. These were printers (96.5%), desktop computers (94.0%), and Internet connection (91.1%).

Based on the responses by the majority of the respondents to the survey questionnaire, they used printers for Science instructional materials, summative and periodic tests, lesson plans, activities, reports, processing output, visual aids, and worksheets (Fischer *et al*., 2020). Meanwhile, desktop computers and Internet connection were used by teacher-respondents for making reports, PowerPoint presentations, hands-on application, data searching on the Internet, supplemental lessons, research about Science teaching, downloading educational videos, encoding, typing for the lessons to collect data from the Internet and surfing Science materials for the lessons (Ertmer and Park, 2008).

The table also indicated that 85% of these schools had Liquid Crystal Display (LCD)/multimedia projectors, computer laboratories, overhead projectors, and speakers. These implies that majority of the upper 30% performing schools in the National Achievement Test (NAT) had the basic technological resources that could be used by their teachers in their Technology-Assisted medium of instruction.

It could be noted however that less than 20% of these schools had video recorder (19.7%), tablet device (16.7%), lowest) and karaoke/videoke (28.2%) available for their teachers' use. But this did not imply that the teachers did not have access to these things because tablet devices could be a personal property of the teacher and yet could still be used as their instructional media. According to the respondents, tablet device was usually used for Science documentation and personal use only (Collins and Halverson, 2018). Similarly, video and camera recorder were almost present and available even to students because of the technological advancement of smart phones used in school documentations like Science activities or programs, Science feature writing, photo journalism and "Palit-Awit" or parody contest.

Rowcliffe (2016) emphasize the usability of the tablet and mobile devices to increase learning. Being roughly the same size as a book, the tablet device is thought to encourage students to engage with it the same way they would with a physical storybook. The authors further put forward that the mobile devices encourage collaboration as their size stimulated face-to-face interaction (Chong and Reinders, 2020; Haslip and Gullo, 2017).

On one hand, video recording techniques have been used in educational setting for a number of years. They have included viewing videotaped lessons in Science, using whole videos or clips of tapes as a quick for discussion, viewing video recordings to observe role models for practice, and being video recorded in order to receive feedback on performance from peers and tutors. Although this last application has been used since the 1960s, it has only been evaluated as a teaching method with health care professionals in the past 10 years and mostly in the areas of medical and counselor education (Duzenli, 2018; Hasni *et al*., 2016). Moreover, karaoke/videoke in school is an interactive media which opens new avenues for learning integrated in the lessons (Fornas, 2018; Hill and Uribe-Florez, 2020).

Charp (2020) and Jeffrey *et al*, (2019) states that the integration of technology to Science education is based on the identified six contributions that technology can make to the learning process such as enhancing interest and motivation; providing access to information; allowing active, manipulative presentations; structuring the process with tactical and strategic support; diagnosing and correcting errors; and managing complexity and aiding production (Carman and Judge, 2017; Poore, 2015).

In contrast, unlike the upper 30% performing schools in National Achievement Test (NAT), the lower 30% performing schools in the National Achievement Test had only one (1) technological resource present to more than 90% of the lower 30% performing schools in National Achievement Test (NAT) and these were desktop computers with 91.1%. A little less than 90% of them have printers (89.3%) and speakers (88.1%). Other technological items that were present to at least 80% of these schools were Liquid Crystal Display (LCD)/ multimedia projector and Universal Serial Bus (USB) stick with 83.85% and 81.0%, respectively. A similar case was depicted for tablet device, which was present to only 6% of the schools.

In sum, both upper and lower 30% performing schools in NAT had both desktop computer and printers as common technological resources available for use in Science teaching and learning.

**On the Level of Technological Skills of the Respondents**

The level of technological skills of the teachers in the upper 30% and lower 30% performing schools in the National Achievement Test (NAT) from 2010 to 2014 is presented in Table 4. The participants from the upper 30% performing schools in National Achievement

**Table 4:** Level of Technological Skills among Teachers and principals of the Upper and Lower 30% Performing Schools in NAT

| Level of Technological Skills | Teachers Upper 30% | | Principals Upper 30% | | Total | | Teachers Lower 30% | | Principals Lower 30 & | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | VD | Mean | VD | Mean | VD | Mean | VD | Mean | VD | Mean | VD |
| Edit digital photographs | 3.2 | P | 3.1 | P | 3.2 | P | 2.9 | P | 3.1 | P | 3.0 | P |
| Create a database | 2.9 | P | 2.6 | P | 2.8 | P | 2.7 | P | 2.3 | N | 2.5 | N |
| Use a spreadsheet to plot a graph | 3.4 | P | 2.8 | P | 3.1 | P | 3.0 | P | 2.9 | P | 3.0 | P |
| Create a presentation | 3.8 | E | 3.6 | E | 3.7 | E | 3.4 | P | 3.4 | P | 3.4 | P |
| Create a multimedia presentation | 3.5 | P | 3.2 | P | 3.4 | P | 3.2 | P | 3.3 | P | 3.3 | P |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Knowledge of how computers operate | 3.8 | E | 3.5 | E | 3.7 | E | 3.6 | E | 3.5 | P | 3.6 | E |
| Ability to design own programs | 2.7 | P | 2.9 | P | 2.8 | P | 2.5 | N | 2.9 | P | 2.7 | P |
| Ability to evaluate educational Software | 2.7 | P | 2.4 | N | 2.6 | P | 2.5 | N | 2.7 | P | 2.6 | P |
| Knowledge of educational Computer applications | 3.3 | P | 2.8 | P | 3.1 | P | 3.0 | P | 3.0 | P | 3.0 | P |
| Create a document using word processing program | 3.7 | E | 3.5 | P | 3.6 | E | 3.4 | P | 3.2 | P | 3.3 | P |
| Use spreadsheet / excel program | 3.5 | P | 3.6 | E | 3.6 | E | 3.1 | P | 3.4 | P | 3.3 | P |
| Use a presentation program | 3.8 | E | 3.7 | E | 3.8 | E | 3.2 | P | 3.3 | P | 3.3 | P |
| Use a database program | 2.7 | P | 2.6 | P | 2.7 | P | 2.6 | P | 2.8 | P | 2.7 | P |
| Use a publication program | 3.2 | P | 3.0 | P | 3.1 | P | 2.8 | P | 2.7 | P | 2.8 | P |
| Create /edit multimedia presentation | 3.5 | P | 3.2 | P | 3.4 | P | 3.0 | P | 2.8 | P | 2.9 | P |
| Use programming software | 2.8 | P | 2.9 | P | 2.9 | P | 2.5 | N | 2.4 | N | 2.5 | N |
| Use authoring program | 2.3 | N | 2.1 | N | 2.2 | N | 2.0 | N | 2.2 | N | 2.1 | N |
| Use social media programs like FB and skype | 3.8 | E | 3.6 | E | 3.7 | E | 3.7 | E | 3.6 | E | 3.7 | E |
| Can troubleshoot hardware problems | 2.5 | N | 2.4 | N | 2.5 | N | 2.0 | N | 2.3 | N | 2.2 | N |
| Can troubleshoot software problems | 2.6 | P | 3.4 | P | 3.0 | P | 2.4 | N | 2.1 | N | 2.3 | N |
| Can create a website | 2.5 | N | 2.4 | N | 2.5 | N | 2.3 | N | 2.1 | N | 2.2 | N |
| Can create web-based learning materials | 2.5 | N | 2.4 | N | 2.5 | N | 2.3 | N | 2.1 | N | 2.2 | N |
| (W) Can access blogs and e-journals | 2.9 | P | 2.8 | P | 2.9 | P | 2.9 | P | 2.7 | P | 2.8 | P |
| **Over-all Mean** | **3.1** | **P** | **3.0** | **P** | **3.1** | **P** | **2.8** | **P** | **2.8** | **P** | **2.8** | **P** |

Test (NAT) indicated that they were expert in using a presentation program which received the highest mean ratings from the teachers (3.8) and principals (3.7) and highest grouped mean of 3.8. This result showed that the teachers could very well use presentation program by themselves and without the help from someone (Bull, 2016; Raja *et al.*, 2018). Other items which the teachers considered themselves expert were creating a presentation and use of social media programs like Facebook (FB) and Skype, both with 3.7, and knowledge on how to operate computers (3.7).

Presentation program is widely used by Science educators, trainers, and students. Presentation program/PowerPoint has become the world's most widely used presentation program to Science lectures and instructions (Shelton, 2019; Rasheed and Kamsin, 2020). As Sivin-Kachala *et al.*, (2017) examined the effects of classroom technology use in Science, including PowerPoint, they found out that teachers who augmented their face-to-face presentations with technology were generally perceived as being more reliable than those who did not employ technology in the school.

Furthermore, Bahodir-Qizi (2021) and Reeves (2020) revealed that students learned better if the course material was presented through some visual tools. They also reported that teachers believed that PowerPoint presentations made the content more appealing; therefore, they helped them to take students' attention. The results of Regian (2018) study also showed that students who were exposed to PowerPoint presentations preferred them over the textbook presentations and that students were learning better when their attention was captured via highlighting, color, different fonts, and visual effects (Buckingham, 2019; Robinson, 2018).

On the other hand, as perceived by teachers, creating/

PowerPoint presentation works well in the classroom in a number of ways like teachers can create graphically enhanced information and instructions for the learning centers, create tutorials, reviews, or quizzes for individual students, display student work and curriculum materials or accompany teacher presentations, and provide a slide show of classroom activities in Science or other subjects (Bonagua (2015).

However as seen in Table 5, teacher and principal-respondents considered themselves novice in the use of authoring program with the least mean rating of 2.2. Other technological skills that the participants felt they were still novice were on troubleshooting hardware problems, creating a website, and creating web-based learning materials, all rated 2.5 by the group.

On authoring program, this technological skill received the least percentage rating because it is rarely used in the school since the skill is not widely used for classroom related activity of the teacher and student. Such applications tend to target professional educational content creators only and do not cater to end-users with limited computer proficiency (Baran *et al*., 2015; Steele and Drew, 2018).

Troubleshooting software was also rare in school. However, many teachers may automatically contact their computer teacher in the school for simple troubleshooting procedures while they encountered computer-problem during classroom lectures and to easily access into Computer Troubleshooting for Teachers and Students websites (Chen *et al*., 2018). Anderson (2016) notes that most schools will never be able to afford enough technical support for all of the problems that arise in one school day.

As to level of technological skills of the lower 30% performing schools in National Achievement Test (NAT) for the last four (4) school years, the teacher and principal-respondents rated themselves expert on the use of social media programs like Facebook and Skype with 3.7 mean. This was the only item given an expert rating by the principal while teachers also rated themselves as expert and knowledgeable on how to operate computers. For the knowledge on how to operate computer, it has a lot of applications in various fields involved in order to manipulate well the technology for the teachers and students to use in the classroom (Bond *et al*., 2018; Sousa and Rocha, 2019).

Therefore, computer literacy is much needed for teachers as well as learners. The computers have created a revolution in the content of education and in the nature of learning process (Tsai, 2020). Teachers should be in terms with the physical reality of the computers, and learn how to take actual advantage of the machines' educational potential (Blanchard *et al*., 2016).

With this, computer knowledge is essential for teachers. As research revealed, favorable attitude towards computer plays a very important role in making one interested in it. Unless the teachers possess a favorable expertise towards computer which in turn will affect their knowledge of computer and also, they will find teaching with help of computer difficult, which in turn will affect students learning in the classroom (Bersin, 2018; Thomson, 2017). Therefore, if the teachers have favorable knowledge towards computer, then there may be a chance for them to be motivated in acquiring knowledge of computer, as it is clear that the computer knowledge is very much needed for teachers in many aspects inside the classroom (Smith, Tsai, and Rajasekar, 2019).

On the other hand, teacher-respondents also considered their skill on the use of authoring program and troubleshooting hardware problems as novice with the least mean rating of 2.0. The principal-respondents also rated lowest their skills on troubleshooting software problems, creating a website, and creating web-based learning materials with 2.1.

Taken as a group, the lower 30% performing schools were expert on the use of social media programs like Facebook and Skype (3.7) and knowledge on how computers operate (3.6) but novice in terms of the use of authoring program (2.1) and troubleshooting hardware problems (2.2). The over-all mean rating of the teachers and principals of the lower 30% performing schools indicates that they were all proficient in their technological skills with 2.8.

**On the Level of Implementation of the Upper and lower 30% Performing Schools in Technology-Assisted Science Instruction**

Table 5 shows the level of implementation of both upper and lower 30% performing schools in their Technology-Assisted Science instruction in terms of practices in integrating technology in Science instruction and training programs is presented in this section.

The personal practices in integrating technology in Science instruction in terms of using technology by myself received the highest mean of 3.0 (frequently) from the teachers from the upper 30% performing schools. In contrast, teachers from the lower 30% rated the item 2.4 often. On the other hand, using computer for lesson planning received the highest rating from the teachers of the lower 30% performing schools with 2.9, frequently, but rated only often by the other group (2.5). These items both received the mean rating of 2.70 when teachers were considered as a single group.

As to their least rated items, the upper 30% teachers said that they often used computer database to keep an inventory of Science audio-visual materials with 1.9 while the teachers from the other group gave the same rating to the use of audio/speaker/lapel devices to discuss the lessons in the classroom (Berame and Baring, 2022). The use of computer database to keep an inventory of Science audio-visual materials received the least mean rating of 1.95 when teachers were grouped (Benitt *et al*., 2019).

Both groups gave an over-all mean rating of occasionally on their personal practices in integrating technology in Science instruction with 2.47 (upper 30%), 2.30 (lower 30%), and 2.38 (grouped mean). The result pointed out that the teachers either from the upper 30% performing schools or otherwise, only personally integrated

**Table 5:** Level of Implementation of the Teachers in Technology-Assisted Science Instruction among the upper and the Lower 30% Performing Schools in NAT in Terms of Personal Practices

| Personal Practices in Integrating Technology in Science Instruction | Upper 30% | | Lower 30% | | Total | |
|---|---|---|---|---|---|---|
| | Mean | VD | Mean | VD | Mean | VD |
| I use computer for lesson planning | 2.5 | O | 2.9 | F | 2.7 | F |
| I use e-mail or network to communicate with other science teachers. | 2.4 | O | 1.9 | O | 2.2 | O |
| I use a computer database to keep an inventory of Science audio-visual materials | 1.9 | O | 2.0 | O | 2.0 | O |
| I use spreadsheet to maintain student achievement/attendance records | 2.8 | F | 2.5 | O | 2.7 | F |
| I demonstrate the use of computer to record data/calculations related to experiments | 2.6 | F | 2.6 | F | 2.6 | F |
| I use my personal computer programs to teach lesson | 3.0 | F | 2.4 | O | 2.7 | F |
| I use web-based learning materials | 2.6 | F | 2.6 | F | 2.6 | F |
| I use audio/speaker/lapel devices to discuss the lessons in the classroom. | 2.3 | O | 1.8 | O | 2.1 | O |
| **Over-all Mean** | **2.51** | **O** | **2.34** | **O** | **2.45** | **O** |

technology in Science instruction 40% of the time.

The principals from both groups were also asked to rate their level of implementation in the practice of integrating technology in Science instruction as presented in Table 6. The principals of the upper 30% rated highest the item on demonstrating the use of computer to record data/ carry out calculations related to experiments or problems while those from the lower 30% rated highest the items on the use of computer for lesson planning and use of spreadsheets (excel) to maintain student achievement/ attendance records with 2.8, which is frequently or about 70% of the time.

According to Armour-Thomas (2017), computer in record keeping can be defined as one of the most useful modern means of collecting, updating, controlling, recording, and storing of information for future usage by any resourceful organization. Computers are widely used in the field of Science in education (Valenduc, 2018). When used as flexible tools in the hands of students for the collection, analysis, and graphical display of data, can accelerate the rate at which student can acquire data, abstract, and generalize from real experience with natural phenomena. The digital computer is an important tool for an inquiry-based option in Science because it has become the most universal tool of inquiry in scientific research (Bell and Dourish, 2016; Wang, 2019).

On one hand, the principals of the upper and lower 30% performing schools rated lowest respectively the items on the use of email or network to communicate with other Science teachers, with 2.3 and 1.8, and the use of a computer database to keep an inventory of Science equipment, supplies, references, audiovisual materials, with 2.3 and

**Table 6:** Level of Implementation of the School Principals in Technology-Assisted Science Instruction among the Upper and the Lower 30% Performing Schools in NAT in terms of Personal Practices

| Personal Practices in Integrating Technology in Science Instruction | Upper 30% | | Lower 30% | | Total | |
|---|---|---|---|---|---|---|
| | Mean | VD | Mean | VD | Mean | VD |
| Computer for lesson planning | 2.6 | F | 2.8 | F | 2.70 | F |
| E-mail or network to communicate with other Science teachers | 2.3 | O | 1.8 | O | 2.05 | O |
| A computer data base to keep an inventory of Science audio-visual materials | 2.3 | O | 1.9 | O | 2.10 | O |
| Spreadsheet (excel) to maintain student/achievement attendance records | 2.7 | F | 2.8 | F | 2.75 | F |
| Demonstrate use of computer to record data / calculations related to experiments | 2.8 | F | 2.4 | O | 2.60 | F |
| Personal computer programs for my own | 2.7 | F | 2.1 | O | 2.40 | O |
| Web-based learning materials | 2.5 | O | 2.1 | O | 2.30 | O |
| Use audio/speaker/lapel Devices to discuss the lessons in the classroom | 2.4 | O | 2.3 | O | 2.35 | O |
| **Over-all Mean** | **2.54** | **F** | **2.28** | **O** | **2.41** | **O** |

1.9. The result presented that these things were practiced occasionally by the principals or at most 40% of the time (Attawell, 2009; Woodward and Beschorner, 2019).

Moreover, the principals from the upper 30% frequently integrated technology in Science instruction at least 70% of the time as indicated by their over-all mean rating of 2.55. In comparison, the principals from the lower 30% performing schools practiced integration of technology in Science instruction often or 40% of the time with the mean rating of 2.26. As a group (Antonenko, 2018; Winslow *et al*., 2021; Zyad, 2016), the principals rated their practices as often with a group mean of 2.41. Compared to their teacher counterparts, it could be seen that both teacher and principal participants from the upper 30% and lower 30% performing schools in the National Achievement Test (NAT) for the last four (4) years practiced personally the integration of technology in Science instruction less than half (40%) of the time.

## CONCLUSION

Based on the findings of the study, it was concluded that the use and integration of technology-equipment in Science classroom instruction significantly impact students' performance relative to their National Achievement Test (NAT) result. The available technological resources for use in Science instruction in Butuan City Division for the upper 30% school-respondents were printer, desktop computer, and internet connection while for the lower 30% school-respondents were desktop computer, printer, and speaker to assist Science learning. The level of technological skills of both the upper and lower 30% school-respondents were rated expert in creating a presentation (PowerPoint), using social networks programs like Facebook and Skype, and their knowledge on how to operate computer. The level of implementation of school-respondents in Technology-Assisted Science instruction between the upper and the lower 30% performing schools in the National Achievement Test (NAT) in terms of personal practices, technology integration practices and training programs were rated often.

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## REFERENCES

Anderson, P. (2016). Web 2.0 and Beyond: Principles and technologies. CRC Press, Taylor and Francis Group. https://www.crcpress.com/authors/i50-paul-anderson/bio/

Antonenko, P. (2018). The instrumental value of conceptual frameworks in educational technology research. *Education Tech Research Development, 6*(9), 1-19. https://doi.org/10.1007/s11423-014-9363-4

Armour-Thomas, (2017). The Motivational Effects of Types of Computer Feedback on Children's Learning and Retention of Relational Concepts. http://files.eric.ed.gov/fulltext /ED28 7446.pdf

Attawell, J. (2009). Appropriating Technologies for Contextual Knowledge: Mobile Personal Learning Environments. Springer. https://doi.org/10.1007/978-3-642-04757-2_2

Bahodir Qizi, U.S. (2021). Digitization of Education at the Present Stage of Modern Development of Information Society. *The American Journal of Social Science and Education Innovations, 3*(5), 95-103. https://doi.org/10.37547/tajssei/Volume03Issue05-17

Baran, E., Correia, A., Thompson, A. (2015). Transforming online teaching practice: critical analysis of the literature on the roles and competencies of online teachers. *Distance Education, 32*(3), 421-439 https://doi.org/10.1080/01587919.2011.610293

Bell, G., Dourish, P. (2016). Divining a Digital Future: Mess and Mythology in Ubiquitous Computing. The MIT Press, Cambridge Massachusetts, London, England. https://mitpress.mit.edu/books/divining-digital-future

Benitt, N., Schmidt, T., Legutke, M. (2019). Teacher Learning and Technology-Enhanced Teacher Education. Second Handbook of English Language Teaching, 1171-1193. https://doi.org/10.1007/978-3-030-02899-2_58

Berame, J., Baring, J. (2022). Supporting Conceptual Comprehension of Newton's Laws of Motion of Grade 8 Students through Kotobee Interactive E-Module. *Indonesian Journal on Learning and Advanced Education, 4*(3), 209-232. https://doi.org/10.23917/ijolae.v4i3.18790

Bersin, J. (2018). The Blended Learning Book: Best Practices, Proven Methodologies, and Lessons Learned Pfeiffer John Wiley & Sons, Inc.

Blanchard, M., LePrevost, C., Gutierrez, K. (2016). InvestigatingTechnology-EnhancedTeacher Professional Development in Rural, High-Poverty Middle Schools. *American Educational Research, 45*(3), 46-63. https://doi.org/10.3102/0013189X16644602

Bonagua, R. (2015). Who's who in Technology Today. Technology Recognition Corporation, Pittsburgh, Pa.

Bond, M., Zawacki-Richter, O., Nichols, M. (2018). Revisiting five decades of educational technology research: A content and authorship analysis. *British Journal of Educational Technology, 50*(1), 12-63. https://doi.org/10.1111/bjet.12730

Buckingham, D. (2019). Beyond Technology: Children's Learning in the Age of Digital Culture. British *Journal of Educational Studies, 56*(1). https://doi.org/10.1111/j.1467-8527.2008.00397_1.x

Bull, C. (2016). Field Guide to Appropriate Technology Academic Press London. https://books.google.com.ph/books?id

Charp, A. (2020). Computer Education for Teachers: Integrating Technology into Classroom Teaching. *John Wiley & Sons, 8*(11), 405-432.

Chen, M., Mao, S., Zhang, Y., Leung, V. (2018). Big Data: Related Technologies, Challenges and Future Prospects. Springer Cham Heidelberg New York Dordrecht, London. Springer Cham Heidelberg New York Dordrecht London

Chong, S., Reinders, H. (2020). Technology-mediated task-based language teaching: a qualitative research synthesis. *Language Learning and Technology, 24*(3), 70-86. https://doi.org/10125/44739

Collins, A., Halverson, R. (2018). The second educational revolution: rethinking education in the age of technology. *Journal of Computer Assisted Learning, 4,* 18-27. https://doi.org/10.1111/j.1365-2729.2009.00339.x

Dep Ed Press Released, (2013). Computerization Program. https://www.deped. gov.ph/2013/01/18/january-18-2013-dm-12-s-2013-implementation-and-orientation-briefing-on-the-deped-computerization-program-dcp-for-batch-14-e-classroom-packages-for-public-elementary-schools-and-batch-15-lapto/

Duzenlı, H. (2018). Teaching in A Digital Age: Guidelines for Designing Teaching and Learning for A Digital Age. *Turkish Online Journal of Distance Education, 19*(2), 218-219. https://dergipark.org.tr/en/pub/tojde/issue/36573/415840

Ertmer, P., Park, S. (2008). Examining barriers in technology-enhanced problem-based learning: Using a performance support systems approach. *British Journal of Educational Technology, 9*(4), 631-643. https://doi.org/10.1111/j.1467-8535.2008.00858.x

Fischer, B., Peine, A., Östlund, B. (2020). The Importance of User Involvement: A Systematic Review of Involving Older Users in Technology Design. *The Gerontologist, 60*(7), 513–523. https://doi.org/10.1093/geront/gnz163

Fisher III, W.W., Mc. Geveran, W. (2019). The Digital Learning Challenge: Obstacles to Educational Uses of Copyrighted Material in the Digital Age. Cambridge: Berkman Center for Internet and Society. http://cyber.law.harvard.edu/media/files/copyrightandeducation.html

Fornäs, J., Klein, K., Ladendorf, J., Sundén, J., Svennigsson, M. (2018). Into digital borderlands. Digital Borderlands: Cultural Studies of Identity and Interactivity on the Internet, New York: Peter Lang, 1-47.

Gul, S., Bano, S. (2019). Smart libraries: an emerging and innovative technological habitat of 21st century, *The Electronic Library, 37*(5), 764-783. https://doi.org/10.1108/EL-02-2019-0052

Haslip, M., Gullo, D. (2017). The Changing Landscape of Early Childhood Education: Implications for Policy and Practice. *Early Childhood Education Journal, 46,* 249-264

Hasni, A., Bousadra, F., Belletête, V. (2016). Trends in research on project-based science and technology teaching and learning at K–12 levels: A systematic review. *Studies in Science Education, 52*(2), 199-231. https://doi.org/10.1080/03057267.2016.1226573

Hill, J. E., Uribe-Florez, L. (2020). Understanding secondary school teachers' TPACK and technology implementation in mathematics classrooms. *International Journal of Technology in Education, 3*(1), 1-13.

Judge, T. K., & Neustaedter, C. (2015). Studying and Designing Technology for Domestic Life: Lessons from Home. https://dl.acm.org/doi/abs/10.5555/2769771

Jeffrey, L. M., Milne, J., Suddaby. G., Higgins, A. (2019). Blended learning: How teachers balance the blend of online and classroom components. *Journal of Information Technology Education: Research, 13,* 121-140

Poore, M. (2015). Using Social Media in the Classroom: A Best Practice Guide. *International Journal of Disability, Development and Education, 62*(2). https://doi.org/10.1080/1034912X.2015.998446

Raja, R., Nagasubramani, P. (2018). Impact of modern technology in education. *Journal of Applied and Advanced Research, 3,* 33-41. https://dx.doi.org/10.21839/jaar.2018. v3S1.165

Rasheed, R., Amirrudin Kamsin, A. (2020). Challenges in the online component of blended learning: A systematic review, *Computers and Education, 144.* https://doi.org/10.1016/j.compedu.2019.103701

Reeves, T. (2020). Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. Educational design research. New York: Routledge.

Regian, D. (2018). Teaching with Educational Technology in the 21st Century: The Case of the Asia-Pacific Region. *Turkish Online Journal of Distance Education, 7*(2), 179 - 180

Robinson, L. (2018). Diffusion of Educational Technology and Education Reform: Examining Perceptual Barriers to Technology Integration. IGI Global Publisher. https://doi.org/10.4018/978-1-59904-949-6.ch155

Rowcliffe, S. (2016). Using PowerPoint Effectively in Science Education. *Cogent Education, 3*(1). https://doi.org/10.1080/2331186X.2015.1127745

Ruberg, J. (2020). Using Computer Technology to Foster Learning for Understanding. *Journal of Science Education, 1*(1). https://doi.org/10.1128/me.1.1.7-13.2000

Samuel, L. (2017). Technology for Classroom and Online Learning. *Distance Education Journal, 23*(2). https://doi.org/10.1080/0158791022000009169

Shelton, E. (2019). Design and Development of Virtual Reality: Analysis of Challenges Faced by Educators. *Educational Technology and Society, 11*(1), 118-131. https://www.jstor.org/stable/jeductechsoci.11.1.118

Sivin-Kachala, J., Bialo, E.R., & Langford, J. (2017). The effectiveness of technology in schools. Report. Washington, D. C.: Software Publishers Association. (ERIC Document Reproduction Service No. ED-413- 875.

Smith, R. (2019). Cross-disciplinary perspectives on meta-learning for algorithm selection. *ACM Computing Surveys, 41*(1), 1-25. https://doi.

org/10.1145/1456650.1456656

Steele, G., Drew, S. (2018). The literature landscape of blended learning in higher education: the need for better understanding of academic blended practice. *International Journal for Academic Development, 18*(4), 371-383. https://doi.org/10.1080/1360144X.2013.786720.

Sousa, M., Rocha, A. (2019). Digital learning: Developing skills for digital transformation of organizations. *Future Generation Computer Systems, 91,* 327-334. https://doi.org/10.1016/j.future.2018.08.048

Sousa, M., Martins, M., Zagalo, N. (2016). Transmedia Storytelling: The Roles and Stakes of the Different Participants in the Process of a Convergent Story, in Divergent Media and Artefacts. *Media Convergence Handbook, 2,* 117-135. https://doi.org/10.1007/978-3-642-54487-3_7

Tsai, R. (2020). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Pre-service Teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Thompson, C. (2017). The digital natives as learners: Technology use patterns and approaches to learning. *Computers & Education, 65,* 12-33. https://doi.org/10.1016/j.com pedu.2012.12.022

Valenduc, G. (2018). Technological Revolutions and Societal Transitions. ETUI Research Paper Foresight Brief. http://dx.doi.org/10.2139/ssrn.3180000

Wang, Y. (2019). On Abstract Intelligence: Toward a Unifying Theory of Natural, Artificial, Machinable, and Computational Intelligence. *International Journal of Software Science and Computational Intelligence, 1*(1), 1-17. https://doi.org/10.4018/jssci.2009010101

Winslow, J., Fegely, A., Lee, C., Setari, A. (2021). Continued Rasch Development and Validation of a Standards-Based Instrument to Measure Teacher Educational Technology Competencies. Proceedings of EdMedia Innovate Learning, 339-345. https://www.learntechlib.org/primary/p/219677/.

Woodward, J., Beschorner, B. (2019). Long-Term Planning for Technology in Literacy Instruction. *The Reading Teacher, 73*(3), 325-337. https://doi.org/10.1002/trtr.1828

Zyad, H. (2016). Integrating Computers in the Classroom: Barriers and Teachers' Attitudes. *International Journal of Instruction, 9*(1), 65-78.