# Information And Communication Technology In Teaching Physics

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ABSTRACT

Information and communication technologies (ICT) have developed in great quantity because of the advancement of science and technology, and many of these ICT are suitable for use in the teaching and learning process. This study utilized a descriptive research design to assess the use of ICT in teaching Physics. The study involved 60 Physics teachers from. The study indicates that Physics teachers use computers as their primary hardware but have limited internet access. Meanwhile, teachers commonly own digital educational applications. Spreadsheets and Word processing applications are common office tools used by teachers. Physics teachers lack confidence in using ICT in general and in educational use. Moreover, the teachers do not make the most out of ICT in teaching physics. ICT is only used to an average extent despite its benefits in the teaching-learning process. It is frequently incorporated in preparing instructional materials, motivating students, assessing their learning progress, and summarizing lessons. The most common ICT tools used were Electronic Spreadsheets, Word Processing applications, Video/LCD Projector, CD/ROM, and DVD-VCD. Limited access to digital resources, inadequate ICT pedagogy expertise, and time constraints make ICT challenging to use in teaching Physics. Furthermore, the most effective predictors of ICT usage include confidence in its general use and having accounts on social networking sites.

Keywords**:** ICT, confidence, utilization, obstacles.

## 1. Introduction

Information and communication technology (ICT) is playing a bigger role in people's daily lives and in the educational system. The use of ICT in the classroom to impart to pupils the knowledge

and skills they need for the digital age is becoming more and more demanded from educational institutions. The adoption and integration of ICT into the teaching and learning environment opens more options for instructors and students to collaborate more effectively in the globalized digital age. (Japhet & Usman, 2018)

Studies worldwide have demonstrated that ICT can enhance teaching strategies and student learning. UNESCO emphasized using ICT in national education initiatives in 2008. ICT serves as a goal for education and enhances pedagogical effectiveness by providing access to technology to teachers and students, thereby improving learning and teaching experiences. Effective ICT use broadens learning and knowledge at the local, national, and international levels (Chen et al., 2015). ICT use allows students to learn and use the necessary 21$^{st}$ century skills (Ratheeswari, 2018). Curriculum integration involving increased exposure to educational ICT significantly enhances student achievement in subjects like mathematics, science, and social studies, particularly in knowledge comprehension, practical skills, and presentation skills (Elmo Co., 2012).

"ICT includes skills, software, applications, and systems" (Chen et al., 2015). ICTs involve the use of computers, devices, hardware and software, networks, and internet to convert information into digital formats, including text, images, sounds, and motion (Lever-Duffy et al., 2003).

ICT in education is a supplement that increases the value of education in modern knowledge (Chen et al., 2015). It improves instruction and learning, strengthening the position of teachers as creators of pedagogical environments. At all levels of educational programs, it enables teachers to effectively communicate their lessons and make learning accessible to students (Ratheswari, 2018). The integration of ICT tools for education was further emphasized by Elmo Co. (2012) as follows: ICT enables teachers to use images in teaching, improve student memory, explain complex instructions, and create engaging, interactive lessons, thereby increasing attention and participation in learning, thus enhancing the overall student learning experience.

In the field of Science, Physics in particular, most of the concepts taught to students are abstract in nature. This makes it very difficult for the teacher to explain the concepts, thus the need to laboratorize to concretize for easier understanding of the students. Most of the time, physics equipment and supplies are

not readily available. However, with the advent of computers, the problem on the dearth of physics equipment and supplies can be solved. Physics experiments, which need sophisticated equipment and supplies, can now be substituted with simulations wherein the students can perform experiments using computer software. Physics teachers can also use ICT in other aspects of teaching, like assessment, communication, and personal development.

The Department of Education (DepEd) Division of Ilocos Sur, Philippines conducted various trainings on computer use. However, only a few teachers can attend trainings on ICT use in teaching-learning processes, focusing on general computer usage instead of specific ICT use areas. It is essential to conduct research on the use of ICT in teaching science, particularly physics, considering the development of technology on a local and international scale. The result of the study may help school administrators plan for further professional development programs for their teachers, particularly in improving their knowledge, attitudes, and skills in utilizing ICT in teaching. Furthermore, the results can be an input for the University of Northern Philippines in coming up with an ICT Training Program for science teachers in Ilocos Sur, Philippines through the University' Adopt-a-School Program.

**Objectives of the Study**
This study is primarily envisioned to determine the level of ICT use in teaching Physics. It specifically aimed to investigate the adequacy of ICY resources used in teaching Physics, the teachers' level of confidence in using ICT, and the level of ICT use by the Physics teachers. Moreover, the challenges and obstacles teachers encounter when using ICT to teach Physics were determined in the study.

**2. Methodology**
The descriptive research design was used in the study. Specifically, the survey and correlational methods were employed. The respondents were the 60 teachers teaching Physics in Ilocos Sur, Philippines. The use of questionnaire and personal interview were used in gathering the data necessary for the study. The questionnaire was composed of five parts, some of which were constructed by the researchers, and some were adapted (i.e., with modification) from varied sources. The questionnaire on the teachers' level of confidence in using ICT and on ICT utilization for

instructional processes were adapted from Ainley et al. (2010) and Gelacio (2012), respectively. Data were analyzed using descriptive statistics and regression analysis to determine how the teachers' personal and professional profiles, confidence in using ICT, and the adequacy of ICT resources influence the teachers' level of use of ICT in teaching Physics.

## 3. Results and Discussions

### 3.1 The Physics Teachers

The Physics teachers in the study are female dominated, married, and middle-aged. The group is composed of young and old inter of years of teaching and have 20-30 hours per week teaching load. Meanwhile, only a few of them had attended computer-related trainings at the local level. Only very few were given opportunities to attend trainings at the district to national levels. In terms of ICT equipment that the teachers use in teaching Physics, many of them possessed personal computers, some had a cellphone with an internet connection, and more than one-third of the group had access to the internet. It is noteworthy that almost all the respondents use a computer everyday. Most of the group spends 1-3 hours daily on their computer. In addition, majority had been using ICT in teaching for one to three years already. It is also worth noting that the Physics teachers had social networking accounts. Their most common social networking account is Facebook, followed by email. Only a few of them had Twitter and YouTube accounts.

### 3.2 ICT Resources Available in Teaching Physics

Regarding computer hardware, around three-fourths of the group have computers available for use in teaching Physics. Majority of those with computers had access to an internet connection, and some even had computers with multimedia, Majority of the teachers also had smartphones connected to the internet. Other IT equipment and hands-on materials owned by the teachers and available for use in teaching Physics include CD writers, video cameras, electronic calculators, and recording devices. Only a few owned overhead and slide projectors and none possessed electronic laboratory equipment. For teachers who do not have ICT tools, there are available tools owned by the school and readily available for use in teaching Physics. However, the number of IT

tools present in the school may not be adequate for use by all the Physics teachers.

Meanwhile, digital educational applications like digital dictionaries and encyclopedias are the most common ICT software used by physics teachers. This is followed by communication software like email and chat, and general office suits like word processing, spreadsheets, presentation software, and databases. Findings also show that only a few teachers had multimedia production tools, data logging tools, and simulation/modeling softwares.

To prepare pupils for a position, adequate tools and equipment are essential. Inadequate teaching resources are a problem that has been well-documented throughout the entire educational system, and these deficiencies may prevent pupils from reaching proficiency. (McCubbins, et al., 2016)

### 3.3 Confidence in the Use of ICT in Teaching Physics

The teachers' confidence in using ICT was measured in general and pedagogical uses. Generally, the teachers exhibited an average level of confidence in the use of ICT. Their confidence in the general and pedagogical applications of ICT was average.

On the general use of ICT, respondents claimed that they are much more confident in producing a letter using a word-processing application, emailing a file to a colleague, taking photos and showing them on the computer, and filing electronic documents in folders and sub-folders on the computer, and producing presentation with animation, They were, however, honest in stating that they have a little confidence in using the internet for online purchases and payments.

**Table 1. Level of Confidence of the Physics Teachers in Using ICT in Teaching**

| ICT Confidence Indicators | Mean | Descriptive Level |
|---|---|---|
| General Use | 3.37 | Average |
| Pedagogical Use | 3.33 | Average |
| **Overall Mean** | **3.35** | **Average** |

As regards the pedagogical use of ICT, the respondents asserted that they are much more confident when planning lessons that require ICT use by students, searching the internet for useful curriculum resources, using ICT to deliver

powerful presentations, and choosing appropriate websites to support student learning. They also professed to know which teaching/learning situations suit ICT use. However, they accepted that they are not confident in using ICT for collaboration with others and installing educational software on the computer. Greener and Wakefield (2015) claimed that there are still issues surrounding digital confidence and the pedagogical reasoning for integrating such technologies.

### 3.4 The Level of ICT Utilization of the Physics Teachers

Generally, the respondents had an average use of ICT in teaching Physics. They displayed an average level of use of ICT in the following instructional processes: lesson preparation, motivation, evaluation of learning outcomes, and synthesis. However, ICT use was low in teaching and learning regarding presentation, discussion, enrichment, and communication processes.

In preparing lessons and teaching materials, the respondents sometimes searched the internet for additional references and preparation of visual aids. They also sometimes used word processors to prepare and update their lesson plans, list the steps to be performed in an activity, outline topics to be discussed, and list key questions as guides in discussing concepts. Meanwhile, the respondents also sometimes used spreadsheets in the preparation of tabular and graphical presentations of data as part of an experiment or activity. Moreover, CD/ROM was sometimes used by the respondents in searching for pictures or videos as visual aids. The slide presentation through Video/LCD Projector was likewise sometimes used to prepare the flow of discussion or lesson.

In the motivation process of instruction, the teachers sometimes used a Video/LCD Projector to introduce the objectives of the lesson, showing video clips or episodes from Knowledge Channel. Playing music using a CD Player was seldom used.

During the discussion process, the teachers seldom used Video/LCD Projector. This tool was used to present keywords or Physics concepts and to demonstrate abstract concepts. Slide Presentation or simulation was also seldom used to reinforce students' learning. In addition,

spreadsheet was likewise seldom used to present tabular or graphical data. However, DVD-VCD and TV were sometimes utilized for film showing or playing episodes from the Knowledge Channel. These justify the low level of use of the teachers in discussion of Physics concepts.

The Electronic spreadsheet was the most commonly used. This was, however, only sometimes used by the teachers in logging experiment reports and getting statistical findings, entry or recording of gathered students' activities, computation of grades, and graphic grades. This was likewise seldom used by the teachers in creating templates for Q and A type review sheet with automatic scoring/recording of test scores. Aside from Electronic Spreadsheet, the teachers also used the Word Processor. This was sometimes utilized in the preparation of diagnostic tests and periodical examinations.

Along the enrichment process of instructions, the teachers sometimes used the internet to look for additional activities given to students. They also require their students to surf the internet to answer Physics problems/questions given to them.

To summarize what had been presented or discussed in the Physics classes, the Physics teachers used slide presentations and video clips and seldom used Electronic Spreadsheets.

Communication with the students after classes is necessary for monitoring students' work/activities and students' progress and for advisory purposes. It must be recalled that only a minimal use of ICT exists in this process. The telephone or cellphone was the most common ICT tool used; this was followed by Facebook or instant messaging applications. The Mail Merge Tool was also seldom used to produce just one letter template for individualized copies sent to students' parents.

The above findings imply that the Physics teachers had not yet fully integrated ICT into the teaching-learning process. They may not have the sufficient competence towards the technology – basic and educational competence. The study of van Laar et al. (2017) determined 7 core digital skills in the 21$^{st}$ century as "technical, information management, communication, collaboration, creativity, critical thinking and problem solving." In line with instruction, the

information management core skill is the most useful. This skill enables the efficient use of Information and Communication Technology (ICT) to efficiently search, select, and organize data for specific tasks.

The presence of ICT infrastructure, technical support, and teacher computer proficiency were the three main determinants of the degree of ICT integration in schools for teaching and learning, according to Gikundi (2016). ICT aids teachers in their pre-lesson planning. Different approaches and strategies are used to integrate ICT into pre-service teacher education. The use of many tools, including word processing, databases, spreadsheets, etc. Several technology-based strategies are employed by the teachers to support their practice teaching. (Bhattacharjee & Deb, 2016)

### 3.5 Barriers to the Use of ICT in Teaching Physics by Physics Teachers

Table 2 presents the perceived barriers to the use of ICT in teaching Physics. The primary barrier to utilizing ICT in Physics teaching is the absence of digital resources. These findings justify earlier findings that the schools do not have adequate ICT resources to teach Physics. During an interview, teachers admitted that most school computers are used for office work rather than classroom instruction. Moreover, most schools covered in the study do not have internet access. This is in consonance with the findings of Bingimlas (2009), who found that the lack of access to resources is one of the major barriers to successfully integrating ICT in teaching and learning.

The third most frequent barrier to ICT adoption was time. The respondents openly admitted that they did not have enough time to include ICT into their physics lessons. They find it time-consuming to prepare the setting up of the ICT equipment.

**Table 2. Barriers to the Use of ICT in Teaching Physics**

| Barriers | f | % |
|---|---|---|
| Lack of access to digital resources | 21 | 46.7 |
| ICT pedagogy skills | 17 | 37.8 |
| Time | 16 | 35.6 |

| | | |
|---|---|---|
| Student ICT skill | 15 | 33.3 |
| Student ICT Tool Access | 15 | 33.3 |
| ICT general skills | 14 | 31.1 |
| Infrastructure | 13 | 28.9 |
| Out-of-school access | 12 | 26.7 |
| Self-confidence | 11 | 24.4 |
| Lack of flexibility | 10 | 22.2 |
| Basis for ICT choices | 7 | 15.6 |
| Utility | 5 | 11.1 |

### 3.6 Regression of ICT Use in Teaching Physics

The level of ICT integration in Physics teaching was regressed to the respondents' profile, adequacy of ICT resources, and confidence in using ICT.

The results of the regression analysis reveal that 52.0% of the variation in the respondents' use of ICT in teaching physics is explained by their respondents' confidence in ICT and social networking. Singly, confidence in the general use of ICT can explain 48.3 percent of the variance, while a number of social networking accounts can explain 3.70 percent.

The standardized regression coefficients for the group of predictors shown in the preceding table are shown in Table 3. The confidence in the general use of ICT has a beta weight of.695, but when combined with the number of social networking accounts, it increases to .727. This translates to teachers who are very comfortable using ICT and who are also exposed to a variety of social networking sites being much more likely to use ICT in teaching physics.

**Table 3 Best Set of Predictors of Level of ICT Use in Teaching Physics from Stepwise Multiple Linear Regression Analysis**

| Step | R | $R^2$ | Adjusted R | Change Statistics | | |
|---|---|---|---|---|---|---|
| | | | | R Square | F Change | Sig F |
| 1 | .695(a) | .483 | .443 | .483 | 12.147 | .004 |
| 2 | .721(b) | .520 | .511 | .037 | 8.453 | .003 |

a. Predictors: (Constant), General use of ICT

b. Predictors: (Constant), General Use of ICT, Possession of social networking account/s

**Table 4 Coefficients for the Best Predictors of Level of ICT Use in Teaching  Physics from Stepwise Multiple Linear Regression Analysis**

| Model | Unstandardized B | Standardized Beta | t | Sig. |
|---|---|---|---|---|
| 1. (Constant), General use of ICT | .766 .546 | .695 | 1.214 3.485 | .246 .004 |
| 2. (Constant), General Use of ICT, Possession of social networking account/s | .328 .560 .254 | .727 .032 | 1.068 6.825 2.806 | .265 .000 .007 |

a. Dependent Variable: Level of Utilization of ICT in Instructional Process

The above findings confirm the findings of Bingimlas (2009) and Peralta & Costa (2007) that teachers with more computer experience are more competent and have higher self-confidence in their ability to use computers. Teachers' confidence in using computers for instruction is also influenced by their limited ICT knowledge and skills, with their students being aware of this. Using ICT and social networking sites more frequently makes the Physics teachers' presentation more engaging, motivating, and meaningful.

**4. Conclusion**

The Physics teachers in the study are mostly middle-aged females, married, have attended limited computer-related trainings at the local level, and are a mixture of young and old in the teaching profession. They had a weekly teaching load of 20 to 30 hours, access to computers with a weekly teaching load of 20 to 30 hours. They had been using ICT in teaching, and frequently used Facebook as their primary social networking site. The computer was the most common hardware they owned, but they had limited internet access. Meanwhile, digital educational applications are the most common software they own. Word processing and spreadsheets are the general office suites that teachers most frequently have access to. The ICT is not being used by the physics teachers with any or minimal confidence, either for personal use or for teaching.

Teachers are not fully utilizing ICT in teaching Physics, despite its potential benefits, as they only use it at an average level

in lesson preparation, motivation, evaluation, and summarization. Electronic spreadsheets, video/LCD projectors, word processing, CD/ROM, and DVD/VCD were the most frequently used ICT application tools. Teachers face challenges in using ICT in Physics due to a lack of digital resources, inadequate ICT pedagogy skills, and limited time. The best set of predictors of ICT usage include confidence in its general use and the possession of social networking accounts.

## 5. Recommendations

The study suggests that schools covered in the study should enhance their Teacher Training Program, focusing on ICT, software applications, and hardware peripherals, to ensure all school teachers are equipped with this technology. The schools should purchase more ICT resources, like computers, LCD projectors, video cameras, and the corresponding software materials. These ICT tools should be made available for teaching and not only for office use. Findings of the study should be used in designing an extension program for other schools in Ilocos Sur, Philippines particularly on along ICT Training Program. Moreover, similar studies should be conducted on a broader scope and consider other variables not included in the study.

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