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Teachers' Knowledge and Practice of Using ICT Tools in Secondary School Science Teaching and Learning

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Abstract

Information and communication technology (ICT) tools are the integral part of innovative science teaching. Effective uses of ICT tools play a vital role in teaching and learning in this era. This research was done to analyze the level of expertise and practice of using ICT tools among teachers in classroom teaching. The study is based on quantitative descriptive design. Four municipalities and 16 schools were selected randomly. Fifty science teachers were selected on the basis of census sampling from Siraha district. The collected data were evaluated by utilizing statistical tools which indicates that most science teachers have inadequate access to ICT tools and have moderate knowledge and practice of handling them. All teachers used mobile phone and internet for personal purpose but ICT tools practices were poor in an integrated science classroom. The traditional lecture-based pattern of teaching, lack of ICT-specific knowledge and practice, content-based knowledge of teachers, aged teachers, inadequate ICT infrastructure and lack of ICT-friendly environment are the major barriers to the transfer of ICT teaching-learning process. The study suggested that there is the need for conducting of ICT based educational training, and preparing the teaching guidelines for regular use of ICT tools.

Keywords: Competency, impact, tools, traditional, transformation.

Introduction

IInformation and communication technologies (ICT) originated from merging electronic and communication technologies, and now comprise a wide range of web technologies and related software applications. The use of ICT enables students to collect, store, retrieve, process, and analyze data. For educational and curricular transformations, ICT is an integral component for recent teaching. It provides opportunities to create learner-centered teaching as a substitute for conventional educator instruction. This has brought modifications in learning techniques for newcomers as well as in the techniques of instructors (Tezci, 2010).

In addition, ICT is taken as an application system and a skill for life. However, everyone agrees that students need to understand how to use this type of technology from the time they enter school. At the same time, these new demands on educational institutes have led to a growing focus on tutoring ICT teachers, as it allows them to acquire certain skills and competencies. However, the effective application of ICT in education is challenging due to lack of time and organizational assistance.

The fourth IT (Information Technologies) revolution has been ushered in by the current ICT trend (Kaino, 1985). Like other countries, South Asia accepted ICT as an agent for renovating their education systems. Generally, SAARC countries like Bangladesh, Nepal, and Sri Lanka are in the preliminary stages of adopting ICT for the advancement of education. There has been a growing understanding of the potential of ICT to address the issues related to educational equity, quality, and efficiency at the national and school levels in Bangladesh and Nepal (Asian Development Bank, 2017). However, several policies and strategies for the expansion and inclusion of ICT in education have been provided by the GON's IT Policy (2010), SRRP (2009-2015), and Three-Year Plan (2011–2013). Likewise, the Master Plan of ICT (2013-2017) has highlighted that one of the basic prerequisites for the creation and application of ICT in education is human resources. To employ ICT to enhance student learning, competent and trained human resources are required.

The efficacy of using these technologies in education process heavily relies on the teachers' expertise in how to use them. In addition, Nepal has also tried to change the traditional pattern of science paradigm shift in teaching and learning in the recent ICT-based teaching-learning practice gradually (Yadav, 2019). Teacher's knowledge and practice of ICT tools and their outcomes on modern education have a profound impact on our day-to-day lives. Most instructors are familiar with ICT tools like

blogs, discussion forums, and chat rooms, which have a lot of promise for facilitating online communication between them. Through the use of these new ICT technologies, educators can broaden their understanding of the world, which increases their ability to create stimulating learning environments (Ndibalema, 2014).

Understanding and explaining the practice of ICT as an alternative teaching tool in the classroom can be described through the approach of psychological theories about the relationship between knowledge, attitudes and behavior. Learning through expertise and research outcomes is crucial for shaping a person's activities and could result in greater behavioral change. The study of KAP Model (Knowledge, Attitudes, and Practices) examines the link between knowledge, attitudes, and actions. The concept of planned behavior describes what individuals know, feel, and act in relation to certain situations (Gusti, 2016). Based on the above-reviewed theories regarding what factors drive individuals to behave as they behave, this study will follow the KAP Model that highlights the interrelationship among knowledge, attitude, and practice/behavior.

In this context, it is necessary to integrate ICT in school as a discipline and as a teaching tool, however data shows that internet facilities have reached only 35% of schools, and only 13 % of schools may be eligible to run online courses (Dawadi et al., 2020). Teachers are essential in altering teaching-learning methods, and involving students in ICT-enabled learning settings (Asian Development Bank, 2017). As the report mentioned, Nepal is in the initial stage of applying ICT in school, therefore, it is necessary to have an idea about teachers' knowledge and practice of ICT. Additionally, there is also a dearth of studies associated with knowledge and practice of ICT among the secondary-level teachers as a teaching tool. This research was therefore attempted to address this gap.

The objective of the study

This research aims to evaluate the level of knowledge and existing practice of ICT tools among teachers in classroom teaching.

Method

This study is based on quantitative survey research design with focus on the understanding and usage of ICT tools in classroom teaching and learning among science teachers. Sixteen community secondary schools of Siraha, Sukhipur, Mirchaiya, and Lahan Municipalities of Siraha district were selected through simple random sampling method. Four community schools from each municipality had been

randomly selected. All 50 secondary level science teachers were selected following the census sampling method.

A survey questionnaire and a 5-Point Likert rating scale were used for determination of ICT competence in the collection of data. The questionnaire was pre-tested among five teachers at the school nearby. After preparing the tools, the researcher collected data by administering a questionnaire to selected teachers. The researcher himself filled out a checklist. Data was checked and edited, calculation of frequency and percentage was adopted for analyzing data (Best & Khan, 2006). Tables and figures were used to present the analyzed data.

Results and Discussion

The demographic questionnaire focused on the teacher's gender, age, level of education, professional training, and teaching experience of teachers. These indicators had also directly or indirectly affected the knowledge and practice of ICT tools during ICT-integrated science teaching.

Table1: Socio-demographic characteristics of science teachers

Factors	Descriptions	Siraha n (%)	Sukhipur n (%)	Mirchiya n (%)	Lahan n (%)	Total n (%)
Gender	Male	12(92%)	10(91%)	10(91%)	12(80%)	44(88%)
	Female	01(o8%)	01(09%)	01(09%)	03(20%)	06(12%)
Age	Up to 40 years	06(46%)	03(27%)	04(36%)	05(33%)	18(36%)
	41 years or above	07(54%)	08(73%)	07(64%)	10(67%)	32(64%)
Teaching Experience	10 years or fewer	05(38%)	03(27%)	03(27%)	06(40%)	17(34%)
	11 years or more	08(62%)	08(73%)	08(73%)	09(60%)	33(66%)
Qualifications	B.Ed. Sc.	02(15%)	02(18%)	02(18%)	03(20%)	09(18%)
	B.Sc.	10(77%)	09(82%)	08(73%)	10(67%)	37(74%)
	M.Ed./M.Sc. or Above	01(08%)	00	01(09%)	02(13%)	04(08%)

Professional Training	TPD	09(69%)	07(64%)	07(64%)	09(60%)	32(64%)
	Ten-month Professional Training	02(15%)	03(27%)	02(18%)	03(20%)	10(20%)
	Subject-wise Training (above 15 days)	01(08%)	01(09%)	01(09%)	02(13%)	04(08%)
	ICT Short-time Training	01(08%)	00	01(09%)	02(13%)	04(08%)

Source: Field Survey 2022

Table 1 presents the socio-demographic background of 50 teachers who responded to the questions. More than 88% of teachers were male which the rest 12% were female. Similarly, 36% were in the age group of less than or up to 40 years, and the majority of teachers i.e. 64% were in 41 to above age group. The data also showed that most of the teachers (64%) had only short-term TPD training whereas 8% of them had ICT training. So, most of the teachers were not familiar with ICT tools and their use in science learning. The table also indicated that only 18% of them were from B.Ed. science background but 74% of teachers had a B.Sc. background and had little concept of pedagogy. Only 34% of teachers were below 10-year experience due to their younger age and two thirds had more than 10 years of experience, but due to older age groups, they could not be familiarized with ICT and taught only the content based traditional patterns of teaching. The result showed that the factors related to age, qualification, ICT training, and previous ICT experience were also correlated in ICT tools-based teaching-learning activities.

The finding of this study coincides with the study done by (Yadav, 2023) who found that teachers' age could be correlated with ICT competency among university teachers. In the same line (Kerzic et al., 2021) found that the age and self-reported use of ICT were correlated with each other. Thus, younger teachers were more likely to use the ICT for educational, and personnel purpose. This finding supports another research done by (Van Braak et al., 2004), and (Inan & Lowther 2010), which claims that ICT use decreases with teaching experience and that younger teachers integrated ICT into their teaching more comfortably than experienced and competent ones. The Morocco upper school teachers (Krumsvik et al., 2016) of 50 or older have less digital competencies due to the lack of supportive environment. The similar study of Science teachers' perception of ICT capacity building (Etiubon & Akpan, 2017) indicated in

their result that online/ digital supportive activities had no association with the age of teachers, but a strong and significant association and significant with ICT qualification and previous use of ICT.

Availability of ICT Tools in Teaching

Figure1 given below shows that ICT tools are available in almost all the schools. But the numbers of tools were different according to the capacity of schools and ICT access of teachers. The figure also indicates that android mobiles are a basic need in the present situation for use in the learning process. Almost majority of teachers (78%) had availability of android mobile which is easily used but 22% of teachers lacked android mobile due to traditional practice and their old age. Similarly, out of 50 teachers only 15(30%) were having own laptop/ desktop. Nowadays, 78% of teachers had access to these facilities in schools despite the poor rate of use and 24% were out of reach in these facilities. It means all schools are trying to rapidly increase digitalization in teaching but the teachers who are lacking the facilities and having poor ICT knowledge create big problems for the paradigm shift towards adopting ICT-integrated teaching.

Projector is an optical device widely used in audio and visual modes of the effective teaching processes. The data shows majority of teachers (95%) and 20% of schools are having a lack of projectors. The digital learning process is lagging in science classroom because most of the teachers do not have access to projectors. It does not make a good impact on the ICT-integrated teaching and learning process.

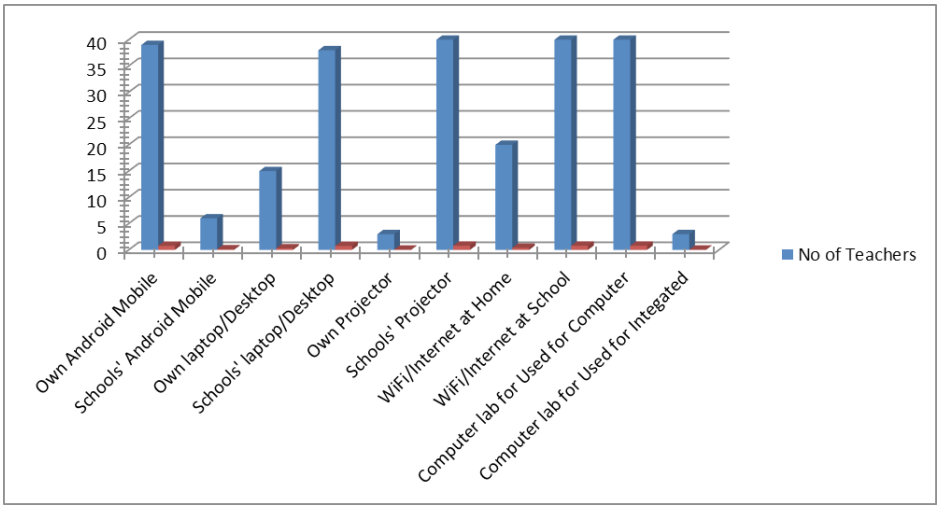

Figure 1: Availability of ICT tools among science teachers

Internet connection is a networking medium connected in most of the ICT devices. Nowadays, it has been part of life and is widely used in the education system. In the study, 80% teachers have this connection in schools and 40% of teachers were linked at home personally. Similarly, 20% of schools lack an internet connection at school. Another study done by (Bansal, 2016) found that two-thirds of schools have internet facility. In this situation, these schools are unable to do ICT integrated teaching-learning. The interesting finding is that majority of younger, female, and ICT-skilled science teachers were interested in digitalized teaching, but senior and aged teachers and poor-income based schools had inadequate ICT access. This finding is also supported by (Jabaidah, 2002) elementary school's learners were more motivated to use ICT in learning. However, all school's teachers had also tried to increase the utilization of ICT tools utilization in instructional operations.

A similar method used by (Gunstone, 2002) also found a lack of software in schools, and teachers over 50 and older age was also the reason of poor use of ICT facilities in teaching. Unlike these findings (Pandit, 2020) shows that more than half of the people have internet facilities, but it is accessible to only one-third of schools, and more than one in ten (13%) can conduct digital classes. The study (Mohite, 2020) has also highlighted that Zoom and Google meet as teaching-learning tools. Arguing this finding, (Nadezhda, 2020) has found that the use of zoom is one of the most effective ways of teaching and learning during pandemic time.

Knowledge of Educators Related to ICT Tools

Table 2: The Teachers' knowledge of ICT application tools

Descriptions	Excellent f (%)	Good f(%)	Fair f(%)	No capacity f(%)
Knowledge of mobile				
Knowledge of installing Apps from the Play store	14(28%)	21(42%)	07(14%)	08(16%)
Knowledge of Chatting from mobile	13(26%)	26(52%)	05(10%)	06(12%)
Using Mobile for audio/ visual clips	17(34%)	24(48%)	04(08%)	05(10%)
Using Mobile for social media	14(28%)	24(48%)	10(20%)	02(04%)

Knowledge of laptop/ desktop				
Knowledge of operating and handling Laptop/Desktop	12(24%)	17(34%)	15(30%)	06(12%)
Using a Laptop/Desktop for audio-video Clips	11(22%)	15(30%)	12(24%)	12(24%)
Knowledge of MS Office package	12(24%)	17(34%)	15(30%)	06(12%)
MS-Word	10(20%)	15(30%)	17(34%)	08(16%)
MS-Excel	10(20%)	15(30%)	15(30%)	10(20%)
MS-PPT	12(24%)	15(30%)	15(30%)	06(12%)
Use of Web browser Preparation of Report	10(20%)	15(30%)	15(30%)	10(20%)
Knowledge of projector				
Knowledge of Working Mechanism	06(12%)	16(32%)	15(30%)	13(26%)
Knowledge of Simple maintenance	06(12%)	15(30%)	17(34%)	12(24%)
Knowledge of simple maintenance	04(08%)	06(12%)	10(20%)	30(60%)
Knowledge of Internet/Wi-Fi service				
Knowledge of Internet connection	10(20%)	25(50%)	09(18%)	06(12%)
Knowledge of Internet searching and Collecting information	09(18%)	25(50%)	13(26%)	08(16%)
Knowledge of Download and Saving documents	10(20%)	25(50%)	09(18%)	06(12%)
Knowledge of Installing	09(18%)	18(36%)	13(26%)	10(20%)

Source: Survey report, 2022

In recent days, the use of mobile has increased significantly. It helps in sharing latest information on teaching-learning process. Table 2 shows that knowledge related to ICT tools are used by the school science teachers. The data shows that on average one-fourth of science teachers had good knowledge about the use of mobile in teaching-

learning and below 10% have little knowledge of it. However, 15% teachers had excellent but around 8% of them had no capacity to use mobiles for various purposes.

A laptop/desktop is one of the necessary ICT tools, not only for teaching-learning but also for all personal and official purposes. But results showed that only below 24% of teachers had excellent knowledge about the use of laptops/desktops and more than one-fourth had middle-level knowledge. It showed that 12% to 24% of school science teachers had no capacity of using these tools. In the case of projectors, only below twelve percent of teachers had the knowledge of working mechanism and maintenance, and one-third of them used only with the help of other ICT persons. More than one-third of teachers could not use projectors in classroom teaching. Internet/Wi-Fi are necessary tools in teaching, but 12% to 20% of teachers had no knowledge of internet and its use in teaching. Only below 20% of teachers had excellent knowledge about the internet.

The result also demonstrated that ICT-familiar, younger and interested teachers have better knowledge about ICT tools in integrated science teaching, but their presence is just one-third in schools. They tried to update their existing teaching pattern. More than one-third of science teachers could not understand it due to the lack of specific knowledge of ICT tools and new technological skills.

Recently, knowledge and skills on evolving ICT technologies have enabled the science teachers find creative ways to make science learning pleasure. They require training and re-training which may be achieved through capacity building workshops (Etiubon & Akpan, 2017). Studies claim that the use of ICT and its good knowledge among teaches is a must. Arguing this statement (Fahadi, 2022) found that the knowledge of technology-integrated learning is a must in education. In the same line, (Paidican & Arredondo, 2022) found that technological and pedagogical knowledge is needed for the successful deployment of ICT in education. Furthermore, (Acharya et al., 2022) found that collaboration between the teachers and students is needed for better understanding in schools. The similar study of How curriculum delivery translates into entrepreneurial skills (Iqbal et al., 2022) found that the role of ICT is useful for entrepreneurship in education

The practice of science teachers to use of ICT tools in teaching

In table 3, it is reported that ICT competencies are related to the practice of ICT tools used in classroom teaching. Significantly, it plays crucial role in upgrading integrated

holistic science teaching. The result showed that android mobiles, laptops/desktops, projectors, and the internet are basic ICT tools available to most teachers and used in their daily life. Very few (4% to 14%) science teachers were found using it always for teaching-learning purposes. But the percentage of teachers using these tools usually, 'sometimes' and 'rarely' ranges from 15% to 30% on average.

Table 3: *Existing practice of science teachers in using ICT tools for teaching*

Descriptions	Always	Usually	Sometimes	Rarely	Never
Practice of using a mobile					
Installing Apps to teaching learning from the play store	07(14%)	07(14%)	15(30%)	13(26%)	08(16%)
Chatting (audio& video) about teaching-learning with students	06(12%)	07(14%)	14(28%)	13(26%)	10(20%)
Use of mobile to share audio/ video materials for teaching learning	06(12%)	06(12%)	15(30%)	12(24%)	11(22%)
Use of mobile as a learning platform	04(08%)	07(14%)	12(24%)	12(24%)	15(30%)
Practice of using a desktop/ laptop					
Use as prepare for teaching learning and sharing text materials	06(12%)	08(16%)	10(20%)	14(28%)	12(24%)
Use as share audio/ video materials for teaching learning	04(08%)	04(08%)	10(20%)	16(32%)	16(32%)
Sharing teaching learning materials through Facebook/ Messenger/whatsapp etc.	06(12%)	07(14%)	14(28%)	13(26%)	10(20%)
Preparing text reports/ Table/ Charts etc. teaching materials for teaching learning	04(08%)	04(08%)	10(20%)	16(32%)	16(32%)

Preparing PPT slides/ audio-video teaching materials in teaching-learning	06(12%)	08(16%)	10(20%)	12(24%)	14(28%)
Practice of using a projector					
Simple handling practice/ skills about operating of projector	02(04%)	02(04%)	06(12%)	08(16%)	32(64%)
Use as prepare materials presentation in a classroom	02(04%)	04(08%)	08(16%)	10(20%)	26(52%)
Use as audio/ visual documents presentation in teaching	04(08%)	04(08%)	10(20%)	12(24%)	20(40%)
Practice of using the Internet/Wi-Fi					
Practice to connecting and handling of internet device	06(12%)	11(22%)	16(32%)	08(16%)	09(18%)
for teaching through relevant materials search engines	05(10%)	12(24%)	12(24%)	10(20%)	11(22%)
Downloading, uploading, saving &sharing teaching materials with students	06(12%)	15(30%)	12(24%)	07(14%)	10(20%)
Emailing, editing, and collecting teaching materials with students	04(08%)	06(12%)	12(24%)	12(24%)	16(32%)

Survey report, 2022

The results predicted that around one-fourth of teachers never used these information gadgets in their academic course due to shortage of knowledge, old age, traditional practice, and lack of an ICT-friendly environment. The result predicted that these are challenging factors. So, without minimizing these conditions, it could not transform the dogmatic teaching into effective modern science teaching learning. The research report concluded (Ben Ouahi et al. 2022), that the use of simulation with ICT is applicable for educating and learning activities. In the same line, another research found that the integration of ICT gadgets in education provides positive performance

among the students. Arguing this (Dahal et al.,2022) said that the use of ICT helps to understand better. Also (Acharya et al.,2020) suggested that the project-based ICT is required for better performance of students. In the same line, another research pointed out that the use of ICT in teaching increases students' achievement as the teachers deliver lesson in more effective way (Abraham et al., 2022).

Conclusion and Reflections

High school science teachers have moderate understanding of common ICT devices and their application in teaching and learning science. ICT tools will help teachers to interact with students for effective learning. In the case of Nepalese schools, ICT tools can be effective for changing the dogmatic patterns of teaching into modern science teaching. Availability of ICT tools is poor in the schools which is a barrier for better learning outcomes and effective classroom teaching. The study found that less than one fifth of teachers have better understanding and practice of ICT tools. Around one fifth of teachers lack ICT competencies. Majority of teachers were of contents based background, aged had insufficient knowledge of ICT. Due to these conditions, we see the traditional pattern of teaching, lack of ICT friendly environment, etc. These challenges can't be minimized without the development of a positive ICT friendly school environment, specific ICT based teacher training, and sharing the practice of ICT technology among skilled and non-skilled teachers in the schools. Therefore, it is challenging to change of traditional teaching patterns into the modern digitalized teaching by increasing better applicability of modern communication technology in improving education.

Implications

This study helps to inform the stakeholders about the existing situation of schools and their available ICT facilities. Knowledge and practices of teachers lead vital roles in effective teaching-learning, which helps to determine the development of Nepalese IT policies; identify the research gaps for further studies. Based on the study, it is suggested to conduct educational training; and prepare teaching guidelines for the regular use of ICT tools as an integral part of modern teaching.

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