Diksha App and Its Effect on Learning Outcomes: Teacher Perceptions

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Abstract. In this digital era, ICT contributes significantly towards enhancing the quality of education at all levels by providing a broad spectrum of sources of knowledge for the learners and helps educators to reach out to those who are handicapped by geographical barriers as well as those who cannot afford formal education. National and state governments have been focused on policies and programmes for revamping the existing formal education system for the younger generation to face the emerging global challenges in a more effective manner. MHRD's Diksha is one of the most compatible and extensive educational social platforms in use since 2017. This study focuses on finding the teachers' perception of using Diksha app or portal for teaching in different schools within the Coimbatore educational district. Mixed-method approach was adopted for which a survey using questionnaire and semi-structured interviews were conducted with 712 and 26 teachers, respectively, from different types of schools. Quantitative data analysis was performed using non-parametric statistical tools and the qualitative data was analysed using thematic analysis. Results indicate that the teachers had positive perceptions on ICT-enabled teaching and also showcase the existing ICT usage variation between the teachers associated with public and private schools which has been discussed briefly.

Introduction

Information and Communication Technology (ICT) is a significant component for the growth of a nation's political, economic, educational, and socio-cultural spheres. It hastily renovates our lives in every aspect which helps us to gratify the demands of the digital world. ICT is a constantly blooming field and the worldwide spending on ICT is estimated to reach $5.2 trillion in 2020, 3.6 percent over 2019[3]. A majority of the spending ($2.7 trillion) will come from the private and public sector while the rest will come from consumer spending as estimated by the IDC[4].

ICT plays a very crucial role in the field of education. The increasing focus on acceptance of ICT for providing better learning opportunities in formal education in the country would enhance learning outcomes among students. ICT potentially offers several benefits to students who have different learning styles and abilities, and also enhances their understanding and imagination capabilities by involving them in related activities.

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[3] https://www.comptia.org/content/research/it-industry-trends-analysis

[4] International Data Corporation (IDC) is a premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets.

Incorporating technology in education is very essential because the level of educational attainment is one of the strongest indicators and most reliable global predictor of an individuals' expertise in using ICT. Countries with a huge tertiary educated population tend to have a population with higher digital skill level which confirms that digital literacy relies on the traditional literacy at the country level. Schools in developed countries make use of ICT in their program at all levels of education, which enhances the learning outcomes and successful school careers (Van Deursen & Dijk, 2014). Informal learning outside of the classroom using ICTs also improved the educational outcome (ITU, 2018) which makes the learning process more learner-centric than teacher-centric (Gholami et al, 2010 ; Watson & Watson, 2011). Further, students who were refrained due to geographical location, time, and scarcity of money were benefited with quality education through ICT (Marina, 2001 as cited in Chandan & Prema, 2019). Students believe that use of computers with teacher's support in the class can help them perform better (Geetika, 2018) and they are very keen about learning through new technologies (Shikha, 2014). Handling classes using multimedia contents creates a pleasing environment which nurtures student's attention in learning (Ramaswamy, 2007). Teachers felt that incorporating ICT in education helped them to improve the teaching and learning outcome (Stephen & Thanuskodi, 2014; Jimoyiannis & Komis, 2007; Sudha, 2019). ICT enabled teaching is an effective way to make students aware of the environment (Mercy, 2017). In order to achieve the full benefits of ICT in education, it is important that teachers and educators undergo regular professional training on the use of ICT (Simin & Rosdy, 2015) because teachers were found to lag behind the application level despite of their positive attitude towards ICT (Joy & Srihari, 2015), especially for teachers from public schools whose ICT usage level is very low (Tapasco & Giraldo, 2017). There is also a need to develop a large number of applications, tools, interactive devices in order to promote creative, appealing, analytical and problem solving abilities in both students and teachers with more focus on the regional government schools.

Indian traditional education has been replaced with more of e-learning with new digital classrooms, distance education through software platforms such as MOOCS, etc., where students are able to enrich their knowledge in a more flexible and interactive way. According to a report submitted by the ITU (International Telecommunication Union) in 2015, India was placed in the 131st position among 167 countries in the ICT development ranking, based on the level of ICT access, use and skills[5]. As per an IMD[6] report, the overall information and communications technology (ICT) expenditure in India is projected to rise to $144 billion by 2023 from $101 billion in 2018 at a compound annual growth rate (CAGR) of

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[5] https://economictimes.indiatimes.com/tech/ites/ict-spending-in-india-will-reach-144-billion-in-2023-globaldata/articleshow/73138501.cms

[6] International Institute for Management Development (IMD) is a business education school located in Lausanne, Switzerland.

7.2 percent[7]. India spent three percent (about 5.6 lakh crore) of its total GDP on education in 2018-19 and ranks 62nd in the total public expenditure on education per student.

There are various policies and programs which have been introduced by the government to make the basic need of education easily and widely available throughout the country. Digital India campaign has gained significant response which aims at bridging the digital gap by connecting every corner of the country through broadband services.

Se Shagun, i.e., School Education Shagun is a comprehensive platform where central and state governments have launched several e-learning initiatives has access to all portals and websites with relevant information pertaining to more than 1.5 million schools, 9 million teachers and 250 million students[8]. Another initiative of the MHRD is the National Repository of Open Educational Resources which provides students access to e- libraries, e-books, e-courses, chances to participate in events online, and theme based education. It has approximately 16000 registered users, and 14527 e-learning resources, 2779 documents, 1345 interactive, 1664 audios, 2586 images and 6153 videos in different languages.

Similarly, e-Pathshala is a digital repository by NCERT for classes 1st to 12th where students can access 1886 audios, 2000 videos, 696 e-books (e-Pubs) and 504 Flip Books.

Diksha (Digital Infrastructure for Knowledge Sharing)

Diksha is one of the most established ICT platforms for education in India. It was launched in September 5, 2017[9] as an association between the Ministry of Human Resource Development (MHRD), the National Council for Teacher Education (NCTE), and the Ek-Step foundation as a state-level open and customisable digital education platform. Diksha has gathered a set of features with the help from state governments, NGOs, and more than 30 public and private organisations, to help teachers progress into more interactive and engaging educators. Diksha's core objective is to host Open Educational Resources (OERs) for school teachers, teacher educators and student teachers. This platform is currently supporting ten Indian languages and has contents on 18 languages[10]. It provides resources such as lesson plans, concept videos, and worksheets mapped to the corresponding syllabi are offered along with modified professional development training and assessments to aid teachers in identifying their strengths and areas of improvement. Teachers can also upload their own training content, classroom resources, and advice to a community which can be used by the other Diksha users. In order to reach such a large community, Diksha is

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[7] https://www.financialexpress.com/economy/how-much-india-spends-on-education-hint-its-less-than-rich-countries-average/1772269/

[8] https://seshagun.gov.in/about-us

[9] https://Diksha.gov.in/about/

[10] https://www.mhrd.gov.in/sites/upload_files/mhrd/files/pragyata-guidelines_0.pdf

designed to overcome the existing limitations by integrating ICT platforms in education and bringing ICT into the classroom. Materials in local languages are made available both online and offline for smartphones, tablets and other devices. Teachers can also conduct digital assessments of students on the platform. Using mobile phones increased the teaching outcome and teachers opined positively for using mobile devices in class for teaching (Kleopatra et al, 2020). The successful outreach of the Diksha app is mainly because of accessing the app through smart phones. India have 430 million smartphone users[11] and 390 million mobile internet users which is 73 percent of India's total web traffic[12]. With a smartphone one can also get easy access to internet services offered by network operators at affordable cost. With all such increasing infrastructural support, Diksha app has already reached more than 56 lakh hours of usage time and for more than 22 crore times learning activities were commenced using Diksha by the learners. Diksha comprises more than 80,000+ energised text books and this would overwhelmingly increase every year as there is going to be more dependency on ICT-enabled teaching and learning systems in future.

Energised Textbooks (ETB) and QR code

Energised textbooks will have QR codes to link the created digital content with the existing textbooks. Different resources can also be linked to textbooks via QR codes. Quick Response (QR) Code is a machine-readable code consisting of an array of black and white squares, typically used for storing web-links or other information for reading by the camera on a smart-phone. Many paid or open source apps are available with the ability to scan the codes and which will redirect to an URL where you can access the digital content. QR coded energised textbooks which have content in 18 languages will benefit nearly 25 crore school going children across the country. Over the next three month a large number of high-quality e- resources for learning and teaching will be made available on Diksha through the recently launched VidyaDaan Program[13]. VidyaDaan is conceptualised as a common national program for individuals & organisations across the country to donate/contribute e-learning resources for school education to ensure continuity of quality learning[14].

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[11] https://www.google.com/amp/s/m.economictimes.com/tech/internet/india-has-the-cheapest-mobile-data-in-world-study/amp_articleshow/68285820.cms

[12] https://www.statista.com/statistics/558610/number-of-mobile-internet-users-in-india/

[13] https://taxguru.in/chartered-accountant/pm-evidya-program-reform-education-sector.html

[14] https://vdn.Diksha.gov.in/

Significance of the study

It is essential to conduct a study on the use of the Diksha app since it is one of the major initiatives by Indian government in the education sector with more than 10 million users. This education ICT platform is being implemented in several states including Tamil Nadu. Hence, the present study which aims to find out how the teachers perceive the use of Diksha app in their teaching and how it is beneficial to the students. Findings of the study will help the government and educators to further improvise the Diksha app so as to increase its outcome. Effective implementation of ICT in school education on the lines of Diksha will greatly reduce the knowledge gap between the student communities arising out of their socio economic conditions.

Objectives of the study

The primary objective of the study are:

- To understand school teachers' perception towards Diksha app for teaching.
- To find out whether the teachers' Diksha app usage for teaching differs based on their demographic factors (age, gender, education, teaching experience, type of school, stream of education, classes and subjects handled).
- To make suitable recommendations for improving the Diksha app/portal further from the perspectives of the teachers.

Past studies

Young people have more positive attitudes towards ICT adoption (Jennings & Onwuegbuzie, 2001), their adoption level, readiness in implementing modern technologies is very high (Cáceres & Chaparro, 2019; Jimoyiannis & Komis, 2006) and young teachers have greater confidence in using ICT effectively for both teaching and learning process (Peralta & Costa, 2007). Male have higher computer self-efficacy, and more positive thoughts about computers than female (Whitley, 1997). Female teachers had scored less than their male counterparts on computer usage (Volman & van Eck, 2001), technology integration in teaching and confidence level for integrating new technology (Jamieson-Proctor, Burnett, Finger, & Watson, 2006). But results from recent studies show that no such gender difference exists in using technology (Arkorful et al, 2021), also confirms that female teachers have more attitude towards mobile learning (Baek et al, 2008).

Less experienced teachers are more positive about the role of ICT in education and their adoption level is found higher than the teachers with high experience (Jimoyiannis & Komis, 2006; Hernández-Ramos, 2005; Smerdon, et al, 2000). Also, little experienced teachers were willing to adopt technology (Baek et al, 2008) and more competent in using ICT for teaching (Kpolovie & Awusaku, 2016). Teeroovengadum et al (2017) found that the level of education qualification do matter to some extent in determining the educators ICT adoption level in the teaching learning process in the context of a developing country,

however this research findings was in contrast with the study conducted by Inan & Lowther (2009). Aramide et al (2015) found that educational qualification as one best predictors of ICT use among science teachers.

There is a difference between ICT adoptions in private and public funded schools, especially in urban areas (Ogundile et al, 2019, p. 63). Private school has good ICT facilities over public schools, Poonam & Bala (2014) concluded in her study that aimed to find out the factors influencing the ICT adoption among the secondary school teachers and teachers proficiency level with ICT tools such as computers, projectors, digital cameras, mobile phones, etc. is expectedly higher in private schools (Asaolu & Fashanu, 2012). Also, a study conducted by Malero et al (2015) shows that private secondary schools in Dodoma municipality are better off than public secondary schools in ICT usage readiness. A survey conducted by Singhavi & Basargekar (2017) reveals that teachers' perception was highly influenced by school level factors like board of education and language of delivery used in the class. Karishma et al (2020) observes that matriculation schools have produced the best result despite aided schools' good teaching method and teaching process. Alsauidi (2016) observed that incorporating modern technologies in the teaching learning process is one major reason influencing parents to opt for the private schools (CBSE/ Matriculation).

Padmavathi (2013) found that teachers' actual use of computers tends to vary significantly by teaching subject, where Science teachers were found to be more confident in using ICT (Gray & Souter, 2003; Walan, 2020). Also, a study conducted by Sim & Theng (2014) found that Mathematics teachers generally perceived themselves to have better computer knowledge and they frequently used ICT for teaching in the classroom.

Similarly, Thapaliya (2014) found that English teachers at the secondary level have positive attitudes towards the use of ICTs. Shapka & Ferrari (2003) found a difference in teachers' attitudes towards technology adoption based on the classes handled by them, where secondary school teachers are more likely to use computers in classroom than the primary school teachers (Whitley B. E., 1997).

Research Approach

The present study employed a mixed method approach to understand the research problem better and to achieve the objectives of the research. "Mixed Methods is an approach to inquiry that combines or associates both quantitative and qualitative forms" (Creswell & Clark, 2011). Interviews and surveys allow the researcher to conduct the study in a more natural setting. These methods are widely used in social science research (Creswell & Clark, 2011; Wimmer & Dominick, 2010). Quantitative method is used because statistical analysis can offer meticulous valuation of patterns of responses (McCusker & Gunaydin, 2014) and helps to define the strength of the relations between the set of variables within the

framework (DeCoster & Lichtenstein, 2007). Hence quantitative data is used in this study to analyze the respondents' Diksha app usage frequency.

Qualitative method is used since it provides a deep understanding of the experiences, attitudes and perception of the respondents (Tewksbury, 2009) and generates subjective data based on the perspectives of the people. Hence, a qualitative method is used in this study to understand the respondents' perceptions on using Diksha app for teaching, also to get a deep insight regarding the pros and cons of Diksha app.

Table 1: Research approach

	Quantitative	**Qualitative**
Objective	To find out the teachers' Diksha usage	To find out the teacher's perception on using Diksha for teaching.
Data collection method and tool	Survey Questionnaire using frequency scale.	Semi structured interview with open ended questions.
Sampling technique	712 purposely selected teachers from Government, Government Aided, and Private schools.	26 samples comprising Head of the institutions, teachers and administration officers from Government, Government Aided, and Private schools.
Statistical tools and analysis	Non parametric tests (Krusal wallis and Man Whitney U test) have been done to analyze quantitative data using SPSS 16 software.	Thematic analysis has been done using NVivo 12 software to analyse the qualitative data.

Variables

Quantitative method is used to analyse the respondents' Diksha app usage frequency, and the demographic variables (age, gender, educational qualification, teaching experience, type of school, stream of education, classes handled and subject handled).

Study area

The study was conducted in Coimbatore city, which is one of the largest corporations in Tamil Nadu that serves 1,050,721 citizens. The city, with an average literacy rate of 83.98%, ranked eighth among the first batch of 20 smart cities in implementing and completing projects under the Smart City. Coimbatore is a major educational hub which is a home for 8 universities, 66 engineering colleges, 3 medical colleges, 2 dental colleges, 26 polytechnics, 53 arts and science colleges, 34 college of education, 12 teacher training institutes. There are 207 Pre-Primary Nursery Schools, 866 Primary Schools, 266 Middle Schools, 113 High Schools, 152 Higher Secondary Schools, 72 Central Schools, 75 Matric. High Schools, 204 Matric. Higher Sec. Schools, 3 Anglo Indian Schools in Coimbatore district.

Hypotheses

The following null hypotheses were formulated based on the findings of the previous research studies and they were tested for significance with the primary quantitative data collected through a survey.

> H1: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to their age.
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> H2: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to their gender.
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> H3: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to their educational qualification.
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> H4: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to their teaching experience.
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> H5: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to the type of school they are associated with.
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> H6: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to the stream of education they are associated with.
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> H7: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to the classes handled by them.
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> H8: Respondent's Diksha app usage for teaching doesn't differ significantly with respect to the subjects handled by them.

Quantitative study: sample

The sample for the study consisted of teachers in the age group of 21-30 years, 31-40 years, 41-50 years, and 51years and above from different streams of education and different types of school. A sample of 712 senior secondary and higher secondary school teachers who were incorporating ICT in their teaching were selected using purposive sampling from private, government and government aided schools of Coimbatore educational district.

Table 2. **Distribution of the sample on the basis of the independent variables**

	Samples	Frequency	Percent
Age	21-30	72	10.1
	31-40	243	34.1
	41-50	282	39.6
	51 and above	115	16.2
Gender	Male	224	31.5
	Female	488	68.5
Education qualification	UG	93	13.1
	PG	619	86.9
Teaching experience	less than 5 years	75	10.5
	6 years to 10 years	178	25.0
	11 years to 15 years	223	31.3
	16 years to 20 years	111	15.6
	21 years and above	125	17.6
Types of school	Government/Corporation	283	39.7
	Government Aided	122	17.1
	Private	307	43.1
Stream of education	State Board	377	52.9
	Matriculation	256	36.0
	CBSE/ICSE	79	11.1
Classes handled	Secondary(8,9,10)	358	50.3
	Higher secondary	354	49.7
Subject handled	Language	149	20.9
	Science	229	32.2
	Math's	145	20.4
	Computer science	79	11.1
	Others	110	15.4

Table 2 shows that the sample comprises 72 (10.1 percent) respondents from the age group 21-30 years, 243 (34.1 percent) respondents from age group 31-40 years, 282 (39.6 percent) from age group 41-50 years, 115 (16.2 percent) from the age group 51 years and above. Gender wise, the sample had 224 (31.5 percent) male respondents, 488 (68.5 percent) female respondents. Education wise, there were 93 (13.1 percent) undergraduates, 619 (86.9 percent) postgraduates. Regarding teaching experience, there were 75(10.5 percent) respondents with teaching experience less than 5 years, 178 (25 percent) with 6 to 10 years , 223 (31.3 percent)

with 11 to 15 years of teaching experience, 111 (15.6 percent) with 16 to 20 years of teaching experience, and 125 (17.6 percent) respondents with teaching experience of 21 years and above. In the sample, 283 (39.7 percent) respondents were from Government/corporation schools, 122 (17.1 percent) from government aided schools, and 307 (43.1 percent) from private schools. 377 (52.9 percent) respondents were associated with the state board stream, 256 (36.0 percent) with matriculation streams and 79 (11.1 percent) with CBSE/ICSE streams. The sample had 358 (50.3 percent) respondents handling secondary classes and 354 (49.7 percent) respondents handling higher secondary classes. Regarding subjects handled, 149 (20.9 percent) respondents handled languages, 229 (32.2 percent) science subjects, 145 (20.4 percent) handled Maths, 79 (11.1 percent) respondents handled computer science and 110 (15.4 percent) respondents handled other subjects.

DATA ANALYSIS
Quantitative data analysis
Kruskal-Wallis nonparametric test

The Kruskal-Wallis test (Kruskal and Wallis 1952, 1953) is an extension of the Wilcoxon-Mann-Whitney two sample test (Ostertagova, Ostertag, & Jozef, 2014), a nonparametric equivalent of a one-way ANOVA and it performs better than the parametric equivalent ANOVA method in case of non-normal distribution (Montgomery & Runger, 2011; Hecke, 2013).

Table 3. Kruskal–Wallis test for usage by demographic profile

Factors	Categories	N	Mean Rank	Chi-Square	Df	Asymp. Sig.
Age	21-30	72	383.62	28.258	3	0.000
	31-40	243	363.47			
	41-50	282	379.06			
	51 and above	115	269.47			
	Total	712				
Teaching experience	less than 5 years	75	385.66	43.929	4	0.000
	6 years to 10 years	178	382.79			
	11 years to 15 years	223	388.37			
	16 years to 20 years	111	342.95			
	21 years and above	125	256.73			
	Total	712				
Type of school	Government/ Corporation	283	441.78	149.188	2	0.000
	Government Aided	122	415.95			
	Private	307	254.26			
	Total	712				
Stream of education	State Board	377	434.54	153.260	2	0.000
	Matriculation	256	298.63			
	CBSE/ICSE	79	171.61			
	Total	712				
Subject Handled	Language	149	357.64	6.953	4	0.138
	Science	229	369.99			
	Mathematics	145	368.82			
	Computer science	79	352.01			
	Others	110	313.85			
	Total	712				

The results, as shown in the above Table 3, are significant at 0.01 level for the respondents age, teaching experience, type of school they are associated with and stream of education, also significant at 0.05 level with (p=0.138) for the subject handled by the respondents . This confirms that the respondents Diksha app usage had differed significantly on the basis of their age, teaching experience, type of school and stream of

education they are associated with, and subject handled by them. Hence, the Null hypotheses H01, H04, H05, H06, and H08 are rejected.

Post-hoc test was conducted to find out the difference between respondents belonging to different categories of age, gender, educational qualification, and teaching experience, type of school and stream of education they are associated with.

Table 4. Post-hoc test for usage based on their demographic profile

	(I)	(J)	Mean Difference (I-J)	Sig.
Age	21-30 years	51 years and above	0.58418*	0.001
	31-40 years	51 years and above	0.44992*	0.001
	41-50 years	51 years and above	0.55433*	0.000
Teaching Experience	less than 5 years	21 years and above	0.63467	0.000
	6 to 10 years	21 years and above	0.58980	0.000
	11 to 15 years	21 years and above	0.63114	0.000
	16 to 20 years	21 years and above	0.39286	0.034
Type of School	Government/ Corporation	Private	1.02851*	0.000
	Government Aided	Private	0.92543*	0.000
Stream of education	State Board	Matriculation	0.73213*	0.000
	State Board	CBSE/ICSE	1.51590*	0.000
	Matriculation	CBSE/ICSE	0.78377*	0.000

The results of Post-Hoc analysis, as shown in the above table (Table -4), are significant at 0.01 level. It shows that respondents belonging to the age groups of 21-30 years (MD=0.584, p= 0.001), 31-40 years (MD=0.449, p= 0.001) and 41-50 years (MD=0.554, p= 0.000) were found to use Diksha app more than those of 51 years and above. Overall, it may be concluded from the analysis that respondents of the older age group i.e. 51 years and above were less inclined to use Diksha app in their teaching when compared to others. There was no significant difference between the other three groups in this regard.

Table – 4, also shows that respondents with teaching experience less than 5 years (MD=0.634, p= 0.001), 6 years to 10 years (MD=0.589, p= 0.000), 11 years to 15 years (MD=0.631, p=0.000) and 16 years to 20 years (MD=0.392, p=0.034) had used Diksha app more for teaching purpose than the respondents with teaching experience of 21 years and

above. Overall, it may be concluded from the analysis that respondents with higher teaching experience i.e. 21 years and above were less prone to use Diksha app in their teaching when compared to others. There was no significant difference between the other three groups in this regard. Above table shows that respondents associated with government/corporation schools (MD= 1.0285, p=0.000) and government aided schools (MD= 0.925, p=0.000) had used Diksha apps more for teaching purposes than the respondents associated with private schools. Overall, it may be concluded from the analysis that the government and government aided school teachers are more inclined to use Diksha app in their teaching when compared to the private school teachers. Also the government/corporation and government aided teachers do not differ significantly based upon their Diksha app usage.

Also table shows that respondents associated with state board stream (MD= 1.515, p=0.000) and matriculation stream (MD= 0.783, p=0.000) had used Diksha app more for teaching purpose than the respondents associated with CBSE/ICSE stream, also respondents associated with state board stream (MD= 0.732, p=0.000) had used Diksha app more for teaching purpose than the respondents associated with matriculation stream. Overall, it may be concluded from the analysis that the teachers associated with the state board stream had used Diksha app more for teaching purpose than the teachers from matriculation and CBSE/ICSE stream.

Man Whitney U test

It is the non-parametric equivalent of the independent-samples t-test but unlike the t-test it tests for differences in the overall distribution across groups rather than for differences in the meanand can be used when the data do not meet the requirements for a parametric test (i.e. if the data are not normally distributed; if the variances for the two conditions are markedly different; or if the data are measurements on an ordinal scale.

Table 5. Mann-Whitney U test for Usage based on demographic profile

	Categories	N	Mean Rank	Sum of Ranks	MW U	Z	Sig. (2-tailed)
Gender	Male	224	353.84	79259.5			
	Female	488	357.72	174568.5	54059.5	-0.246	0.805
	Total	712					
Education	UG	93	363.69	33823.5			
	PG	619	355.42	220004.5	28114.5	-0.381	0.703
	Total	712					
Classes Handled	Secondary	358	384.30	137580.5			
	HSC	354	328.38	116247.5	53412.5	-3.817	0.000
	Total	712					

Above table (Table 5) shows that the results are not significant at 0.05 level for gender (U=79529, p=0.805) and educational qualification (U=28114.5, p=0.703) of the respondents. Hence, the Null hypotheses H02 and H03 are accepted, which confirms that respondent's Diksha app usage doesn't differ significantly based upon the respondents gender and educational qualification. Table 5, also confirms that results are significant at 0.01 level for classes handled by the respondents (U= 53412.5, p=0.000), which confirms that the Diksha app usage differed significantly with respect to the classes handled by the respondents. Hence, the Null hypothesis H07 is rejected. Where the mean rank of secondary teachers (384.30) for Diksha app usage is greater than that of the higher secondary teachers (328.38). Therefore, it is concluded that the secondary teachers use Diksha app more for their teaching than the higher secondary teachers.

Summary of the findings of quantitative data analysis
- Young teachers are found to be more frequent users of the Diksha app than the senior (aged) teachers.
- There is no significant difference between male and female teachers in the use of the Diksha app.
- Educational qualification of the respondents does not have any significant influence on the use of Diksha app.
- Respondents with less teaching experience use Diksha app more than those with long teaching experience.
- The study results show that Government and Government aided school teachers were found to use Diksha app more than the private school teachers.

- Teachers associated with state board streams use Diksha app more for teaching than the teachers associated with matriculation and CBSE/ICSE streams.
- Secondary teachers use the Diksha app more than the higher secondary teachers.
- The study found no significant difference in the use of Diksha between teachers of different subjects.

Qualitative data analysis

Qualitative research is an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyses words, reports detailed views of informants, and conducts the study in a natural setting (Creswell J. W., 1998).

Sample for the qualitative study

An Interview guide was created to understand the teachers' perception regarding the Diksha app usage for teaching for which semi structured interviews were conducted with 26 educators comprising 15 teachers and 11 heads of the institutions from the government/ corporation, government aided and private schools within the Coimbatore educational district as shown in the table below.

Table-6: Qualitative sample distribution

S.No.	Type of school	Designation	Numbers
1	Government/ Government Aided	Head master	8
2	Government/ Government Aided	Teacher	10
3	Private	Head master	3
4	Private	Teacher	5

Thematic analysis was used to analyse the qualitative data collected from semi-structured interviews, since it is more organised and transparent, as it holds the dominance of themes to be so important, without diminishing the depth of analysis (Joffe, 2012). As an supporting tool for analysing the qualitative data NVIVO 12, a QDA software (qualitative data analysis software), a product of QSR international has been used by the researcher to manage the "coding" procedure and is considered best in this regards for diminishing the complexity of the data analysis (Hilal & Alabri, 2013).

The researcher initially uploaded qualitative data in the NVivo 12 software and then got familiarised with the data by doing a thorough reading, and code was created

inductively. Later the code was sorted under two main categories (Benefits and Limitations of using Diksha app) which has been presented below.

Benefits of using Diksha app

- Most of the respondents interviewed mentioned that the Diksha app helped students to understand the topics easily.
- Most respondents also noted that during ICT enabled teaching students are more focused on the subject without any distraction in the class. One of the respondents said that ICT helped teachers to provide an effective pedagogy.
  Some respondents observed that students' interaction got increased after imparting the Diksha app in their teaching. A Private school principal said that ICT created a favorable context in classrooms for more interaction between students and teachers.
- Some of the respondents observed improvement on student's examination scores after incorporating Diksha app in teaching. A headmaster from a government school said that ICT enabled teaching positively affects the student's academic performance and they scored more marks in examinations.
- Some of the respondents mentioned that teaching through the Diksha app saved a lot of time for the teachers who would otherwise have to spend time on miscellaneous things in handling classes. A computer teacher told 'Diksha app saved the time getting wasted on moving students to and fro from their regular class to smart class room'
- Some respondents felt that the Diksha app motivates students towards additional learning on the subject. A science teacher said that students get motivated because of the energised text book with QR Code in it.

'Contents provided in the Diksha app helped students to understand a topic in depth by providing additional information and also audio visuals' said a government school headmaster. Another government school AHM said that students were very happy to sit and listen to the classes handled with the Diksha app. A Physics teacher from a government aided school said that 'Diksha app is very useful and it greatly increased the student – teacher bonding' and he also added that students regularly attended the classes handled with ICT. Subject materials for ICT enabled teaching can be prepared easily with the help of ICT, said a government school headmaster. A biology teacher complained that they don't have internet enabled system facility. '... Because of this QR code facility, students on their own try and learn the subject prior to the respective classes and therefore are in a position to clarify their doubts later during classes' as observed by a government school head mistress. She also added that QR code initiated self- learning among students.

A Biology teacher said that the functioning of the heart can be well explained with vibrantly animated video which is not possible through chalk and talk methods. 'Proper way

of pronouncing a word is well explained in videos by the subject expert which is not possible without ICT/ QR code option' said an English teacher. The above said were quoted by the teachers as the benefits of using Diksha app/portal for teaching.

Limitations of using Diksha app

Study also revealed that there are certain limitations or negative effects of the use of Diksha as stated by the respondents of the interviews.

Majority of the private school teachers aren't using Diksha for teaching because they are opposed to using smartphones inside the class. Also most of the private school teachers complained that the quality and quantity of contents available in the Diksha portal is very poor over the other private e-content providers, and the same was the feedback given by most of the government and government aided teachers too.

One of the science teachers from a private school mentioned a reason for not using the Diksha app, that YouTube provides free and better animated audio visuals, and lecture for subjects contents which is far better than most of the Diksha contents.

Most of the respondents said that delayed technical service and lack of fund allocation for maintaining the available technology in the school is a barrier to effective ICT usage and teachers aren't happy about it.

'.. Lack of timely service, lack of funding for ICT maintenance...' are found to be the major problem for effective ICT usage as mentioned by a government school AHM

Some of the respondents from the private school mentioned that the subject contents available on the Diksha app are less and not updated regularly.

'Higher secondary syllabus need more e - contents upgradation' as observed by an Assistant Headmaster and a mathematics teacher said that Diksha app have very less subject related contents for Higher secondary classes.

Some of the respondents complained about the poor internet connection in their school. A government school head master mentioned that 'Slow and limited internet connection is one of the major problems for not using Diksha app regularly'

Some of the respondents mentioned about the difficulties in completing the portions in time. Teachers found it difficult to complete the subject portion in time with the Diksha app. 'With ICT enabled teaching it is very tough to complete the syllabus in time' said a biology teacher of a private school.

A few respondents expressed concerns that ICT use has affected the writing habit of both students and teachers to a considerable extent.

'...ICT usage diminished the students' writing habit' a English teacher mentioned when asked about the negative effects of Diksha usage and another English teacher accepted that 'the writing habit diminished a bit but the teachers habit of writing on board is replaced by creating PPT slides, surfing for audio visual contents and relevant images for effective

teaching'. A Mathematics teacher from a private school said, 'Sometimes students are distracted and get exposed to unwanted contents while they are surfing on the internet for subject related contents'. '..It is difficult to teach a large number of students using the Diksha app because of the small display of mobile phones and mostly the audio won't suffice clearly for the students seated very far from mobile devices', mentioned by a Tamil language teacher from a government aided school.

Summary of findings of qualitative analysis

Overall, the study reveals that most of the teachers were found to be more optimistic about the results of using ICT in their teaching practice and have a positive attitude towards Diksha app. Majority of the teachers stated that students easily understood complex topics when taught using the animated audio visual contents provided in the Diksha portal. Students' involvement is more and classes become more interactive whenever there is ICT enabled teaching. A simple scan through their smartphone to access the contents saves much of their time spent on writing and drawing, preparing slides, gathering subject related videos from YouTube. Student centred learning was initiated where they have easy access to all the information which motivates them to learn more.

Teachers are of the opinion that students' were able to score more in their examinations as these contents helped them to retain information/concepts for a longer time and recall the same at the time of examination. ICT also increased the student -teacher bonding and interaction between them. Students regularly attended the classes when the classes were handled using audio visual aids.

Study also pointed out some limitations such as inadequate audio visual contents for many topics and no extra examples provided for better understanding of the subject. Poor internet connection which disturbs their Diksha usage in classrooms. Some teachers expressed concerns about the negative impact of technology in learning, saying that it has affected the writing habit among both teachers and students. Teachers also stated that with ICT tools it becomes hectic to complete the subject portion in time, especially at higher secondary level so as to enable the students to have time for board exam preparations. Teachers observed that ICT sometimes is a source of distraction for students and are exposed to undesirable contents while searching for subject related contents on the internet.

Discussion

Young teachers tend to use the Diksha app more for their teaching
than those who are in the age group above 50 years.

These findings are in line with the previous researches conducted in various countries. Age is generally considered an important factor in ICT adoption because of the existence of the digital divide among the older adults at the higher end of the age spectrum and those who are just entering that category (Eastman & Iyer, 2005; Neves & Amaro, 2012). Younger people

not only experts in using technology but also play a key role in the aged peoples' technology adoption process (Roxana & Angelo, 2019). However, older people who are healthier have shown interest in the use of computers than those who are unhealthy (Tsipi & Efrat, 2013).

Diksha app usage for teaching was similar for both male and female teachers.

This finding is consistent with results of previous studies (Suri1 & Sharma, 2013 ; Kleopatra et.al, 2020) where gender had no impact on the teachers' perceptions on imparting mobile phones for teaching, since the level of expertise depends upon the individual interest. The result is in contrast with the findings of (Jamieson-Proctor et.al, 2006), where female teachers were integrating technology into their teaching less than the male teachers and their confidence level was found to be lower than the respective male teachers.

Teachers' educational qualification doesn't have any influence on
their Diksha app usage for teaching.

This finding is consistent with results of previous studies (Alazzam, Bakar, Hamzah, & Asimiran, 2012) where teachers' educational background has no significant effect on the ICT readiness. Smartphone usage doesn't differ with respect to the user's education but the purpose of usage of smart phone might change with respect to one's education. Even students from 6th grade have become proficient in using smartphones for various purposes than their graduate teachers. Hence, educational qualification doesn't determine teachers Diksha app usage.

Diksha app usage for teaching purposes decreases with increase in teaching experience.

Teachers with more teaching experience are on the verge of their retirement from the service. They would have practiced traditional methods of (Chalk and talk) teaching over the years and hence, aren't curious to learn and adopt new technologies for teaching. They feel that the traditional method of teaching is better than the modern methods involving new technologies. This finding is consistent with results of previous studies (Osman, Kubra, & sacide, 2020), where professional experience, teaching level and computer training have impacts on their ICT usage in teaching .

Government and Government aided school teachers used Diksha app more
for teaching purposes than private school teachers.

Diksha app usage was made mandatory for teaching students in government and government aided schools after energised textbooks. Whereas in private schools teaching through smartphones are not allowed and they are facilitated with better ICT modules like projector, smart board, etc., for effective teaching, teachers are also capable of creating the e-contents on their own with the provided resources.

Teachers from state board streams often use the Diksha app to teach when compared to matriculation and CBSE/ICSE stream teachers.

State Board schools are maintained by the state government where teaching through Diksha is mandatory by providing energised textbooks enabled with QR code which helps them to access subject-related digital content for better teaching and learning through the smartphone/tablets. Matriculation and CBSE/ICSE have Edu-Comp kind of facilities in their campus who will take care of their 'e' needs related to education. Also teachers are opposed to using smartphones in classrooms and most of the teachers from the matriculation and CBSE/ICSE stream of young age can surf and create their own teaching materials.

Secondary class teachers use Diksha app more than higher secondary teachers

It is because higher secondary teachers are expected to complete the syllabus well in advance so that students can take as many revision tests before they appear for their public examinations. Whereas, secondary class teachers can use technology for teaching without any institutional pressure on portion completion till 9th standard. Insufficient time allotted for using ICT in the classroom due to exam-oriented curriculum is one of the major barriers that evades teachers ICT usage for teaching (Chandan & Prema, 2019; Alwani, 2005 & Sicilia, 2005) as cited in (Simin et.al, 2016).

Diksha app usage for teaching purpose was the same between teachers handling different subjects

The finding is in contrast with the results of previous studies (Gray & Souter, 2003; Sim & Theng, 2014; Padmavathi, 2013) where significant difference was found between the ICT usage of different subject teachers'. In this study, the difference doesn't exist because the Diksha app is loaded with visual contents of the topics given in the book, which was found to be an effective supplement for the traditional method of teaching and teachers don't want to surf the internet for the subject content. More importantly, they can easily assess the available audio visuals during the classes through mobile phones or projectors. This has made teaching interesting for both students and teachers. Also, it helps the teachers to explain complex topics very easily and the students understand without any difficulties.

Conclusion

Diksha app/portal is now a widely used ICT platform in school education in many states. The study highlights the need for further improvisation of the Diksha portal through regular updating of the subject contents for all the standards in school education, more importantly for the higher secondary grade. A special task force consisting of subject experts may be entrusted with the responsibility of reviewing and monitoring the implementation based on feedback assessment.

The study points out that poor internet connection, software and hardware issues are often the major problems affecting the use of Diksha. Proper utilisation and sustained use of the ICT tools need upgradation and regular maintenance. Allocation of special funds for the purpose should be made by the government for public schools and its utilisation has to be monitored by local education authorities. Corporates can involve in building ICT infrastructure in public schools especially in semi-urban and rural areas under CSR (Corporate Social Responsibility). Most of the private schools are in a better position when compared to government and government-aided schools in ICT usage readiness because of the availability of efficient ICT infrastructure in their classrooms. Also, most students of CBSE/ICSE schools have a good economic background and can afford to subscribe to private e-learning apps such as BYJU's, Unacademy and Merit Nation for their extra learning. With all the required technologies and extra resources available, these private institutions could provide a better learning environment to their students when compared to government schools and such disparities will further widen the knowledge gap between the student communities having different socio-economic backgrounds.

Providing quality subject contents and regular updates on Diksha by subject experts and taking necessary efforts to ensure effective use of the technologies would help achieve the long-term objectives of education. In view of the constant changes in technology innovations and the challenges in the adoption of new ICT tools, teachers need to be oriented and trained on ICT usage periodically by the educational institutions as well as the government. In this study, it was found that teachers in Coimbatore educational district have attended workshops on handling classes using QR code which has provided them with basic knowledge on using the smartphone for teaching in classrooms. They felt the need for workshops and short-term training at regular intervals in order to update their knowledge about the nuances of new technologies. It will also improve their self-efficacy by lessening the anxiety towards adopting such new technologies. ICT training and attending ICT conferences both positively affected the teachers' perception on mobile learning benefits and preferences (Kleopatra et al, 2020).

ICT-enabled teaching and learning, besides the advantages, poses several serious challenges and social problems. Issues related to cyber security, cybercrimes, digital divide, information-rich–information-poor, creating a knowledge society, inclusive growth, etc., need to be addressed more seriously by all the stakeholders in the context of the social and economic disparities existing in our society. Considering these factors, a comprehensive ICT policy framework with a special focus on ICT in school education is the need of the hour. It is equally important to ensure strict monitoring and implementation of such policies towards the creation of a better society tomorrow.

References

Alwani, A. (2005). *Barriers to integrating Information Technology in Saudi Arabia Education.* University of Kasan. Kansas: Doctoral Dissertation.

Alazzam, A.-O., Bakar, A. R., Hamzah, R., & Asimiran. (2012). Effects of Demographic Characteristics, Educational Background, and Supporting Factors on ICT Readiness of Technical and Vocational Teachers in Malaysia. *International Education Studies, 5*(6), 229-243. Retrieved from https://files.eric.ed.gov/fulltext/EJ1067080.pdf

Alsauidi, F. (2016). Reasons Influencing Selection Decision Making of Parental Choice of School. *International Journal of Research in Education and Science , 2*(1), 201-211. Retrieved from https://files.eric.ed.gov/fulltext/EJ1105167.pdf

Aparicio Diaz, L. C., & Romero, D. H. (2020, February). Analysis of the Use of Ict in Elderly Teachers in a Mexican University. *RA Journal, 3*(2), 171-177.

Asaolu, O., & Fashanu, T. A. (2012). Adoption of ICT and its Comparative Impact on Private and Public High Schools in Lagos State, Nigeria. *International Journal of Science & Emerging Technologies, 3*(1), 1-6.

Augustine, M., Abbas, I., & Majuto, M. (2015). ICT Usage Readiness for Private and Public Secondary Schools in Tanzania, a Case of Dodoma Municipality. *International Journal of Computer Applications (, 129*(3), 29-32.

Baek, y., Jung, j., & Kim, b. (2008). What makes teachers use of technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers and Education, 50*(8), 224-234.

Cáceres, R. B., & Chaparro, A. C. (2019). *Information, Communcation and Society, 22*(2), 256-266.

Chandan, S., & Prema, B. (2019). Barriers Perceived by Teachers for Use of Information and Communication Technology (ICT) in the Classrooms in Maharashtra. *The International Journal of Education and Development using Information and Communication Technology, 15*(2), 62-78. Retrieved from https://files.eric.ed.gov/fulltext/EJ1220774.pdf

Creswell, J. W. (1998). *Qualitative Inquiry and Research Design: Choosing Among: Ave Traditions.* New Delhi: SAGE Publications.

Creswell, W. J., & Clark, v. L. (2011). *Designing and conducting mixed methods research* (2 Ed.). Washington DC: SAGE.

Eastman, J. K., & Iyer, R. (2005). The impact of cognitive age on Internet use of the elderly: an introduction to the public policy implications. *International Jornal of Consumer Studies, 29*(2), 125-136. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1470-6431.2004.00424.x

Geetika, N. (2018). Perception of Secondary School Students towards Use of ICT in Learning Science. In V. K. Kanvaria (Ed.), *International Conference on ICT for Education: Glimpse and Highlights* (pp. 158-159). Asian Journal of Distance Education.

Gholami, R., Añón Higón, D., Hanafizadeh, P., & Emrouznejad, A. (2010). Is ICT the key to Development? *Journal of Global Information Technology, 18*(1). Retrieved from https://www.researchgate.net/publication/220500464

Gray, D., & Souter, N. (2003). Secondary science teachers' use of and attitude towards ICT in Scotland. *A Report.*

Hecke, T. V. (2013, June 14). Power study of anova versus Kruskal-Wallis test. *Journal of Statistics and Management Systems, 15*(2-3), 241-247. Retrieved from https://www.researchgate.net/profile/ Tanja_Van_Hecke/publication/228457648_Power_study_of_anova_versus_Kruskal-Wallis_test/ links/54cf82d30cf298d65663a60e/Power-study-of-anova-versus-Kruskal-Wallis-test.pdf

Hernandez-Ramos, P. (2005). If Not Here, Where? Understanding Teachers' Use of Technology In Silicon Valley Schools. *Journal of Research on Technology in Education, 338*(1), 39-64. Retrieved from https://files.eric.ed.gov/fulltext/EJ719937.pdf

Inan, F. A., & Lowther, D. L. (2009). Factors affecting technology integration in K-12 classrooms: a path model. *Educational Technology Research and Development, 58,* 137–154.

ITU. (2018). *Measuring the Information Society Report Volume 1.* Geneva: ITUPublication.

Jamieson-Proctor, R. M., Burnett, P. C., Finger, G., & Watson, G. (2006). ICT integration and teachers' confidence in using ICT for teaching and learning in Queensland state schools. *Australasian Journal of Educational Technology, 22*(4), 511-530.

Jennings, S., & Onwuegbuzie, A. (2001). Computer attitudes as a function of age, gender, math attitude, and developmental status. *Journal of Educational Computing Research, 25*(4), 367-384.

Jimoyiannis, A., & Komis, V. (2006). Exploring secondary education teachers' attitudes and beliefs towards ICT adoption in education. *Themes in Education, 7*(2), 181-204.

Jimoyiannis, A., & komis, v. (2007). Examining teachers' beliefs about ICT in education: implications of a teacher preparation programme. *Teacher Development An international journal of teachers' professional development, 11*(2), 149-173.

Johnson, R. B., Onwuegbuzie, A. J., & Turner, A. L. (2007). Toward a definition of mixed methods research. *Jurnal of Mixed method research, 1*(2), 112-133.

Joy, J., & Srihari, M. (2015). 1) Teachers' Perception and Attitude on ICT enabled education in Leveraging Academic aptitude and Professionalism. *Research Journal of Educational Sciences, 3*(10), 11-16. Retrieved from http://www.isca.in/EDU_SCI/Archive/v3/i10/3.ISCA-RJEduS-2015-033.php

Karishma, G., Naidu, D. J., Kishore, J. G., & Kishan, J. G. (2020). A study of benchmarking of higher secondary schools in Thanjavur district. *Asian Journal of Management and Commerce, 1*(2), 27-29.

Kleopatra, N., Gialamas, V., lavidas, K., & komis, v. (2020). Tecahers' readiness to adopt mobile learning in class rooms: A study in Greece. . *Technology, knowledge and learning,* 1-25.

Kpolovie, P. J., & Awusaku, O. K. (2016). ICT adoption attitude of lectures. *European Journal of Computer Science and Information Technology, 4*(5), 9-57.

Kroll, T., & Melinda, N. (2009). Design for Mixed Methods Research. *Mixed Methods Research for Nursing and the health sciences, 44.*

Lorien, M., Mogen, N., Jean-Paul, v. B., & Wallace, C. (2006). School-level ICT Adoption Factors in the Western Cape Schools. *4th IEEE International Workshop on Technology for Education in Developing Countries (TEDC'06)* (p. 5). Computer Society.

Madhukar. (2017). ICT Mediation in Teacher Education: Barriers and Suggestions. *International Journal of Social Science and Development Policy, 3*(2), 26-31. Retrieved from http://14.139.228.229/Conference/SOCIALVOL3.pdf#page=138

Malero, A., Ismail, A., & Manyilizu, M. (2015). ICT Usage Readiness for Private and Public Secondary Schools in Tanzania, a Case of Dodoma Municipality. *International Journal of Computer Applications (0975 – 8887), 129*(3), 29-32. Retrieved from http://repository.udom.ac.tz/bitstream/handle/20.500.12661/2374/Malero,%20Augustine.pdf?sequence=1

Malina, A. m., Hanne, S. N., & Selto, H. F. (2011). Lessons learned: advantages and disadvantages of mixed method research. *Qualitative research in Accounting and Management, 8*(1), 59-71.

Mercy, E. (2017). *EEffectiveness of Tecchnology Enabled Learning (TEL) on Awarness and Achievement in environmental science among eight standard students of Coimbatore District.* Coimbatore: Bharathiyar University.

Montgomery, D. C., & Runger, G. C. (2011). *Applied statistics and probability for Engineers* (5th ed.). John Wiley and Sons.

Neves, B., & Amaro, F. (2012). Too old for technology? How the elderly of Lisbon use and perceive technology. *The Journal of Community Informatics, 8*(1). Retrieved from https://www.researchgate.net/publication/285277879_Too_old_for_technology_How_the_elderly_of_lisbon_use_and_perceive_technology

Ogundile, O. P., Bishop, S. A., Okagbue, H. I., Ogunniyi, P. O., & Olanrewaju, A. M. (2019). Factors Influencing ICT Adoption in Some Selected Secondary Schools in Ogun State, Nigeria. *International Journal of Emerging Technologies in Learning (iJET), 14*(10), 62-74.

Osman, B., Kubra, U., & sacide, G. (2020). Investigation of Turkish Mathematics teacher's proficiency perception in using information and communication technologies in teaching. *Education and Information Technologies, 25*(1), 487-507.

Ostertagova, E., Ostertag, O., & Jozef, K. (2014). Methodology and Application of the Kruskal-Wallis Test. *Applied Mechanics and Materials, 611*, 115-120. doi:10.4028/www.scientific.net/AMM.611.115

Padmavathi, M. (2013). A Survey of Secondary School Teachers' Perceptions, Competency and Use ofComputers,. *International Journal of Education and Psychological Research, 2*(4), 7-16.

Peralta, H., & Costa, F. A. (2007, August). Teacher's Competence and Confidence regarding the use of ICT. *Educational science journal.* Retrieved from http://repositorio.ul.pt/bitstream/10451/7008/1/(2007)PERALTA,H%26COSTA,F(ICTCompetenceConfidence)S%C3%8DSIFO3eng.pdf

Poonam, & Bala, S. (2014). Teacher's Perception towards Availability of ICT in School. *Educationia Confab., 3*(1), 36-47.

PTI. (2019). *India has the cheapest mobile data in world: Study.* m.econimictimes.com. Retrieved from https://www.google.com/amp/s/m.economictimes.com/tech/internet/india-has-the-cheapest-mobile-data-in-world-study/amp_articleshow/68285820.cms

Qazi, M. (2018). *Number of private unaided schools in Maharastra doubles in four years.* Hindustan Times. Retrieved from https://m.hindustantimes.com/mumbai-news/number-of-private-unaided-schools-in-maharashtra-double-in-four-years/story-0066HyTQBPlgQg3NzlX57L.html'>https://m.hindustantimes.com/mumbai-news/number-of-private-unaided-schools-in-maharashtra-double-in-four-year

Ragin, C. C. (1989). *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies.* California: university of California press.

Ramaswamy, S. (2007). *Development and validation of computer based multimedia packages for teaching History and its effect on learning among secondary school students of Coimbatore district.* Bharathiyar University, Department of Education Technology. Shodhganga@INFLIBNET.

Roxana, B. C., & Angelo, C. C. (2019). Age for learning, age for teaching: the role of intergenerational, intra-household learning in Internet use by older adults in Latin America. *Information, Communication & Society, 22*(2), 250-266.

Russell, G., & Bradley, G. (1997). Teachers' computer anxiety: implications for professional development. *Education and Information Technologies, 2,* 17-30. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.21.4179&rep=rep1&type=pdf

Shapka, J. D., & Ferrari, M. (2003). Computer-related attitudes and actions of teacher candidates. *Computers in Human Behavior, 19,* 319-334.

Shikha, K. (2014). ICT Integration in Teaching and Learning: Empowerment of Education with Technology. *Issues and ideas in Education, 10.* Retrieved from http://dspace.chitkara.edu.in/jspui/bitstream/1/473/1/22019_IIE_Kler.pdf

Sicilia, C. (2005). *The challenges and Benifits to Teachers practice in constructivist learning environmens supported by technology.* McGill University. Montreal: Unpublished master's thesis.

Sim, J. C., & Theng, L. B. (2014). Teachers' perceptions of the use of ICT as an instructional tool in Mathematics and Science . *Research Gate.*

Simin, G., & Rosdy, W. A. (2015). Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. *International Journal of Research in Education and Science, 1*(2), 175-191. Retrieved from https://files.eric.ed.gov/fulltext/EJ1105224.pdf

Simin, G., Thanusha, K., Ramasamy, L., & Annreetha, A. (2016, April). Teaching and learing wiht ICT tools: Issues and Challenges from Teachers' perception. *MOJET, 4*(2).

Singhavi, C., & Basargekar, P. (2017). Factors Affecting Teachers' Perceived Proficiency in Using ICT in the class room. *IAFOR journal of education, 5*(2), 67-84. Retrieved from https://files.eric.ed.gov/fulltext/EJ1156287.pdf

Smerdon, B., Cronen, S., Lanahan, L., Anderson, J., Iannotti, N., & Angeles, J. (2000). *Teachers' Tools for the 21st Century: A Report on Teachers' Use of Technology.* New York: U.S. Department of education - Office of educational research and improvement. Retrieved from https://files.eric.ed.gov/fulltext/ED444599.pdf

Stephen, G., & Thanuskodi, D. S. (2014). Use of ICT by research scholars: A Survey of Alagappa University, Karaikudi, Tamilnadu. *International Journal of Library and Information Studies, 4*(1). Retrieved from citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.723.1377&rep=rep1&type=pdf

Sudha, (2019). Does ICT Influences Rural Government School Teachers Beliefs?-Exploring Teachers Opinion on Usage of ICT as Teaching and Learning Tool. *Indian Journal of Public Health Research and Development, 10*(2), 163-167.

Suri1, G., & Sharma, S. (2013). The Impact of Gender on Attitude towards Computer Technology and ELearning: An Exploratory Study of Punjab University, India. *International Journal of Engineering*

Research, 2(2), 132-136. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?
doi=10.1.1.402.2643&rep=rep1&type=pdf

Tapasco, O. A., & Giraldo, y. J. (2017, January). Comparative Study about Perception and use of ICT among Teachers of Public and Private Universities. *Formacion Universitaria, 10*(2), 03-12. Retrieved from https://www.researchgate.net/publication/316081235_Comparative_Study_about_Perception_and_use_of_ICT_among_Teachers_of_Public_and_Private_Universities

Teeroovengadum, V., Heeraman, N., & Jugurnath, B. (2017). Examining the antecedents of ICT adoption in education using an Extended Technology Acceptance Model (TAM). *International Journal of Education and Development using Information and Communication Technology, 13*(3), 4-23.

Thapaliya, M. P. (2014). English Teachers' perceptions and practices of Information and Communication Technologies (ICTs) in Kathmandu District, Nepal. *International Journal of Academic Research in Education and Review, 2*(10), 251-258.

Thomas, D. R. (2006, June). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation, 27*(2), 237-246. doi:10.1177/1098214005283748

Tsipi, H., & Efrat, K. (2013). Older adults: Are they ready to adopt health related ICT? *International journal of medical informatics, 82,* 209-231. Retrieved from http://www.savie.qc.ca/BaseConnaissances/upload/pdf/3005_heartetkalderon_2013_older_adults_are_they_ready_to_adopt_health_related_tic_Index3005.pdf

Van Deursen, A., & Dijk, V. (2014). *Digital Skills, Unlocking the Information Society* (Vol. 30). New York: Palgrave Macmillan.

Volman, M., & van Eck, E. (2001). Gender Equity and Information Technology in Education: The Second Decade. *Review of Educational Research, 71*(4), 613-634. Retrieved from http://dare.ubvu.vu.nl/bitstream/handle/1871/33662/145237.pdf?sequence=1

Walan, S. (2020). Embracing Digital Technology in Science Classrooms—Secondary School Teachers' Enacted Teaching and Reflections on PracticeSusanne Walan. *Journal of Science Education and Technology,* 431-441. Retrieved from https://link.springer.com/content/pdf/10.1007/s10956-020-09828-6.pdf

Watson, S. L., & Watson, W. R. (2011). The Role of Technology and Computer-Based Instruction in a Disadvantaged Alternative School's Culture of Learning. *Computers in the Schools, 28,* 39–55. doi:10.1080/07380569.2011.552042

Whitley, B. E. (1997). Gender differences in computer-related attitudes and behavior: A meta-analysis. *Computers in Human Behavior, 13*(1), 1-22. Retrieved from https://www.sciencedirect.com/science/article/pii/S074756329600026X

Wimmer, R. (2000). Mass Media Research: An Introduction - 9th Edition. (C. Chakrapani, Ed.) *Marketing Research: State-of-the-Art Perspectives,* 1 - 18. Retrieved from https://www.csus.edu/indiv/s/stonerm/wimmer-dimmic--massmediaresearch.pdf

Wimmer, R. D., & Dominick, J. R. (1994). *Mass Media Research: An Introduction* (4 ed.). Wadsworth Publishing Company.

Wimmer, R. D., & Dominick, J. R. (2011). *Mass Media Research* (9 ed.). Wadsworth, Cengage Learning.