DIFFERENT ASPECTS AND DIMENSIONS OF INTEGRATION OF ICT IN EDUCATION SECTOR: A REVIEW

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Abstract

Exponential growth has been seen regarding the use of ICT in various countries across the globe. For supporting this purpose, this paper has presented both the national and international perspectives of different authors and researchers. The exponential growth, especially in India, can be attributed to low cost of operations, vast pool of IT professionals as well as availability of delivery structure that is innovative in nature. Both the light and shady parts of integration of ICT have been highlighted in this review from different perspectives. The most common of which are lack of technological infrastructure, lack of access to internet and also lack of training sessions for teachers regarding development of knowledge and skills of ICT. The review paper has adopted a meta-analysis where eighteen relevant papers based on keyword search has been selected and analyzed critically. From these papers, one aspect that comes up as relevance is that the ICT application in different educational institutions across the world in both developed and developing countries is not at the expected level. Therefore, this study can present future opportunities for other researchers to focus on the loopholes and continue further research to fill in those gaps in this concept.

Keywords: Information and Communication Technology, ICT Integration, Students, Teachers, Teaching-Learning Process, ICT Training.

Introduction

Any form of technology that is applied in the process of education for delivering instructions to students is considered as Information and Communications Technology. It incorporates both software and hardware approaches like use of machine and materials, application of methodologies as well as strategies of teaching learning. The impact of ICT in education of

children has been found to be immense in present times. Students nowadays prefer to learn autonomously and at their own pace, therefore this autonomous learning is being promoted for students with the incorporation of new technologies. Apart from that, technology integration within the learning process also promotes student flexibility. These digital alternatives can include online courses which help students to optimize their time and resources. It also helps them to learn at their own pace due to the flexibility that is provided to them by connectivity and digitalization. The impact of digital learning or ICT is evident when the teachers involved in the process are digitally literate and also have a deeper understanding on how this can be successfully integrated into the curriculum. A varied set of ICT tools are being used by schools in order to create, communicate, store, disseminate and manage information. This process has become an integral part of the teaching learning interaction where approaches like interactive digital whiteboards are replacing chalkboards to all extents. It also includes students using their own smartphones during class time for learning purpose. Along with that, the 'flipped classroom' model is also prevalent where lectures by teachers are watched by students on the computer at their home and they use the time in classrooms for more interactive exercises. These interactive approaches can result in higher order thinking skills in learners when the teachers are trained efficiently to use ICT and are digitally literate. It also helps them to provide personalized and creative options for learners so that they are able to greatly express their understandings. Students are also left in better place to deal with the ongoing and also upcoming changes in technology at the workplace and within society. Therefore, for all these methods to become reality and be effective, the ICT issues planner must consider supplying and maintaining the required infrastructure and the total cost of benefit equation.

Objectives:

The objectives of this review study are:

1. To analyse the different types of work that has already been done related to integration of ICT in school education.

2. To find out any development or findings related to use of technology by digitally literate teachers.

3. To study the impact of using advanced technologies in school education for better teaching learning process.

4. To evaluate prominent research opportunities for future that is related to the impact of using ICT in school education.

Methodology:

This paper is a type of meta-research that includes the main keywords for the literature search like ICT, school education and digital literacy. A total of twenty-five authentic and relevant articles were selected. Then, after analyzing their contents, abstracts and subject-matter for this review, the prominent and significant eighteen articles were taken into consideration.

Studies undertaken for reviewing

International Perspectives:

Ghavifekr and Rosdy (2015) investigated on "Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools". The purpose of this paper is to understand the importance of technology-based teaching and learning methods into the national curriculum of schools in Malaysia. The study also aims to evaluate the perception of teachers in these

schools on how effective is the integration of ICT in the study process is so that it can support the teaching-learning procedure in these classrooms. For this purpose, a random distribution of survey questionnaire was done among a total of 101 teachers chosen randomly from 10 public secondary schools in Kuala Lumpur, Malaysia [1]. After collection of this information, the quantitative data was analyzed using SPSS (version 21) software for both descriptive and inferential statistic. From the findings, it has been concluded that it is important for the teachers to be digitally literate that is well-equipped with ICT facilities and tools for the success of technology-based teaching and learning in schools. In order to enhance students' quality learning, it was also found that teachers had to undergo professional development training programs. There is also the need for future research studies by considering other aspects of the ICT integration particularly from the viewpoint of management in relation to policy making and strategic planning.

Schindler *et al.* (2017) devised a literature review on "Computer-based technology and student engagement: a critical review of the literature". The major purpose of this article is to present a critical review of the literature that is linked to blogs, wikis, web-conferencing, software, social networking sites and digital games in order to influence engagement of students from the last 5 years. The findings revealed three types of student engagement in higher education related to computer-based technology like emotional, behavioral and cognitive. After studying all the types of computer-based technology for higher education, it has been found that digital games have the most far-reaching influence when it comes to different types of student engagement [2]. This is closely followed by Facebook and web-conferencing. However, on the other hand, studies conducted within the past 5 years have been found to be less significant and less conclusive in terms of blogs, wikis and Twitter. Strong emphasis has been given by universities regarding the enhancement of student engagement as it has been found to be linked to a number of outcomes from academic perspectives namely grade point average, retention and graduation rates. Particular importance has been put on increasing external pressures to improve learning outcomes that also prepares the learners for academic success.

Richter *et al.* (2019) instigated the "Systematic review of research on artificial intelligence applications in higher education- where are the educators?" Educators, even after 30 years of emergence of Artificial Intelligence in Education or AIEd, struggle with how to make pedagogical use of it in the teaching and learning process. Therefore, this research has selected 146 relevant articles for final synthesis from the 2656 papers that were initially selected between the years 2007 and 2018 after maintaining the exclusion and inclusion criteria. The descriptive results after the synthesis of the selected papers highlight that most of the disciples have come from STEM and Computer Science that are directly involved in AIEd papers [3]. It has also been found that in these empirical studies, most frequently used method was the quantitative method. These papers put forward the 4 areas of application of AIEd in administrative services, institutional and academic support services. These areas were namely assessment and evaluation, intelligent tutoring systems, profiling and prediction, and adaptive systems and personalization. Further research is necessary based on the exploration of these approaches from both educational and ethical perspectives in the application of AIEd in higher education.

Pittas and Adeyemi (2019) carried out a research work on "Technology integration in education: Effectiveness, pedagogical use and competence- A cross-sectional study on teachers' and students' perceptions in Muscat, Oman". This study examined the views of students and primary and secondary teachers about integration of technology into teaching and learning process. For this purpose, a total of 44 teachers and 219 students from two

international schools and two bilingual schools were selected in Oman. The results of the study highlighted that although most of the teachers were digitally literate and were aware of the advanced technologies, only some of them integrated technology into their teaching methods [4]. On the other hand, it also showed that majority of students made use of various types of technologies to do research and projects within their curriculum. Both the teachers and students have been found to be similarly evaluating the effectiveness of technologies available for the curriculum. This research, in practice, aimed to provide suggestions to educational authorities on the use of technology for enhancing, supporting and extending the necessary curriculum.

Peled and Parzon (2021) formulated a study on "Systemic model for technology integration in teaching". The aim of this research was to find out and evaluate the factors that influence the teachers of Israel who participated in the national 'Laptop for Every Teacher' or LET program. This program was a three-year technology integration program. For this purpose, the researchers selected a sample of 52 teachers belonging to 11 Israeli schools that participated in the training program for technology integration in teaching. 71% of them were Social Science teachers and 29% of them were Natural Science teachers. The seniority of the participants ranged from 19 years to 37 years in teaching with an average of 26.65 years [5]. With the approval of the school principals, teachers were handed out the questionnaire at each school for participating in the training. After analysis, the results of the study show that there are differences in attitude of teachers regarding the use of technology in teaching and learning process. This can be explained by the technology use before the training, receiving support from the management and seniority in teaching. It has also been found that the participation of school principals was important in the long-term process of changing the school's culture. Moreover, the teachers of these schools were more likely to continue teaching in methods that are familiar to them without the necessary support from school administration.

Timotheou *et al*. (2022) carried out a study on "Impacts of digital technologies on education and factors in influencing schools' digital capacity and transformation: A literature review". For this purpose, a non-systematic literature review was conducted by the researchers that cover the research published and main theories in practice over the last 17 years on the topic. The papers were taken by the way of meta-analyses of papers found in peer-reviewed content databases, scholarly and other key reports and studies related to the concepts studied [6]. Thematic organization was carried out of the results of the literature review. These findings were based on the evidence about how technology impacted education in schools and also the factors that were responsible for the digital capacity possessed by the schools as well as digital transformation. It has also been found that the impact of ICT education was more than just on the performance of students as it has been found to affect several aspects that are related to schools as well as stakeholders.

Akram *et al*. (2022) investigated on "Teachers' Perceptions of Technology Integration in Teaching-Learning Practices: A Systematic Review". A systematic analysis of the selected papers on the topic from 2017 to 2021 was carried out by the researchers. The collected literature was representative of dealing with experiences and perceptions of teachers during the process of integrating ICT in their practice of teaching and learning. The findings of these papers reveal that the teachers in schools had positive perceptions of integrating technology in the process of education as this process helps them to effectively enhance their teaching practices in institutions and make the learning process more interactive and exciting for the learners [7]. It has also been found that there are certain barriers while incorporating technology in education that include load shedding, online teaching experience, lack of

training, and slow speed of the internet. Therefore, for enhancing the experience of teachers, it is important to pay specific attention to supplying necessary facilities and adequate opportunities for career development.

Hershkovitz *et al*. (2023) conducted a research on "Technology integration in emergency remote teaching: teachers' self-efficacy and sense of success". Regarding this quantitative study, the researchers selected a total of 735 K-12 teachers in Israel. These teachers taught both in middle-schools and high-schools during the period of 2020/21 and also before the advent of the pandemic in 2019. Through this, the researchers explored the various factors that were responsible for the sense of success during emergency remote teaching [8]. It also determined the aspects of self-efficacy for incorporating advanced use of technologies within teaching practice following the duration of teaching-learning process during the period of COVID-19. The results of this research highlight that for enhancing the sense of success among teachers in Israel, the experience of teachers integrating technology in their everyday teaching was important. Beyond this, the risk factor was considered to be emotional difficulties during the times of emergency and that teachers taking a leading role would be an effective protective factor in this case.

Mdhalose and Mlambo (2023) devised a study on "Integration of technology in education and its impact on learning and teaching". Secondary sources were used for collecting the data for this study. In that case, several sources like published and unpublished dissertations, encyclopedias, peer-reviewed journal papers and online and print textbooks. The findings, based on the review of relevant literature, suggest that the effects of technology due to its integration, is contradictory. Therefore, the collaboration between students and teachers within classrooms is found to be way more efficient than ever due to the presence of information technology. Due to this, their intellectual and academic horizons are broadened, thereby making these learners more versatile within classrooms [9]. Remote learning, by means of technology is also now possible due to the presence of the internet. Moreover, dishonest students are also now able to get more edge over their classmates due to schools using developing technologies like small cameras, high-tech gadgets and graphical calculators.

Lampropoulos (2024) devised a study named "Virtual reality and gamification in education: a systematic review". The focus of this study is on virtual reality learning environments, also related to gamified virtual reality learning environments which are responsible for integrating gamification mechanisms and elements. For this study, a systematic literature review was carried out based on PRISMA or Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Limitations that include type of subject, study, educational level and year of publication were not set. The following databases were used for retrieving information for this study like IEEE, Web of Science, ERIC, SCOPUS and Google Scholar [10]. A total of 16 research questions were explored from the selected 112 articles based on which a thematic analysis was conducted. The integration of virtual reality and gamification into education can transform the traditional teaching methods and learning processes that were positively assessed by both the teachers and students. Through the introduction of these aspects, positive changes were observed in students regarding their attitude, behavior and mentality. It also helped to improve their emotional, physical and cognitive developmental aspects as well.

National Perspectives:

Koehler and Mishra (2009) devised a study named "What is Technological Pedagogical Content Knowledge?" The TPCK framework has been described by the researchers in this

paper. This framework is responsible for teacher knowledge for technology integration, also known as TPACK that is Technology, Pedagogy, and Content Knowledge. This framework is effectively based on construct of pedagogical content knowledge or PCK by Lee Shulman to include technology knowledge [11]. The development of this framework has been found to be quite effective for integrating technology within the teaching process. This paper has considered both the analog and digital modes of technology, by discussing on the other hand how teaching process gets complicated due to the inclusion of technology in pedagogy.

Pall and Batra (2016) investigated on the "Adoption of ICT in instructional setup of Indian school education sector". The application of Information and Communication Technology has grown on a huge range in India due to a number of reasons like operations held on a low cost, wide pool of IT professionals, and also the availability of innovative structure of delivery [12]. However, from the previous literature selected for this research, it has also been found that the Indian education sector has still not been successfully able to integrate ICT. Only a few traces of this aspect is visible that is also in the form of media and digital devices. Nonetheless, the application of social networking applications that is beyond Twitter, Whatsapp and Facebook is also very rare for the purpose of instruction.

Mondal and Ali (2018) devised "A study on use of ICT among higher secondary students in North 24 Parganas district, West Bengal". For this purpose, the researchers have randomly selected a total of 144 students from 5 Higher Secondary schools in North 24 Parganas. Data were collected through survey method and followed by descriptive research. For the survey, a three-dimensional questionnaire based on availability of resources, use by teachers and use by students [13] was prepared. The results of study suggest that there is a significant difference between the availability of ICT resources in the urban areas from the rural areas. Low correlation between the use of ICT resources among teachers and students have been found along with prominent variations with the use of the technologies by male and female students.

Bindu (2019) formulated a research on "Barriers to ICT integration in teaching: A case study of teachers in Kerala". For this purpose, the researcher selected a total of 17 teachers from both aided and unaided secondary schools located in Palakkad district in Kerala. The criteria based on which they were selected are years of teaching experience, gender and subjects taught by them. 7 different schools of the region were concerned for this study, 4 of them were aided schools and the remaining 3 of them were unaided schools. This case study method adopted by the researchers analyses the barriers that were hindering the teachers' ability to integrate ICT in teaching [14]. Data were collected for this study through classroom observations and interviews. The findings of these data highlight that there are a few major hindrances to ICT integration in education by teachers. These are namely lack of time, influence of traditional approach in teaching, lack of training and lack of the ICT equipment within classroom.

Phutela and Dwivedi (2019) conducted a research study on "Impact of ICT in education: Students' Perspective". Industry transformations have been brought about the incorporation of ICT which is also evident in the education industry. For this study, the researchers have followed the Interpretative Phenomenological Analysis or IPA where a sample size of 15 or more is required. Therefore, fifteen respondents have volunteered to participate in this research as a sample size where 6 are female students and 9 are male students. Primary data have been collected with the help of semi-structured interviews and consequently analyzed [15]. The findings of this study suggest that many initiatives are being taken by the government for continuously improving and developing this platform. However, the learners are still not entirely convinced about the potential advantages of adopting the process of e-

learning despite the efforts made by the administration. Moreover, due to the presence of so many options for students in this platform, they are confused on which one should be effective for their learning.

Kundu and Bej (2021) designed a study named "Ingestion and integration of ICTs for pedagogy in Indian private high schools". It is believed that sufficient resources for integration of ICT are considered to be present in private schools in India for teaching-learning process in the 21st century classrooms. For this research, the researchers conducted a survey among 40 teachers from purposively selected 20 schools that were private high by using a set interview protocol. Following this, the grounded theory approach was used to analyze the collected data [16]. The findings of the study revealed that although there was the presence of high levels of appreciation among private school teachers regarding the integration and use of ICT, there existed certain problems within the classrooms. This included a lack of encouragement from institutions, a lack of sufficient skills among teachers, weak policies and a lack of infrastructure for effective incorporation of ICT.

Mahato and Omkar (2022) investigated on "Tracing the ICT in teacher education in India". The major aim of this study was to explore how ICT can be effectively traced in Teacher Education so that the Discipline in India can be strengthened. For this research, the researchers gathered some available resources and reviewed them so that the current status of ICT in education can be sketched. Apart from that, these papers have also been analyzed by them in order to determine the place of ICT in Teacher Education in India [17]. Later, this information was then used logically by the researchers to suggest on how this use of ICT can be traced in India within teacher education discipline. It has been found from the above results that the use of technology is moderate in teacher education in present times. However, the integration of advanced and world class ICT in teacher education is still weak in India.

Ghosh (2024) formulated a research on "Attitude of secondary school students towards the use of information and communication technology in rural and urban areas of west Bengal: A Study". This study was conducted in the rural area of South 24 Parganas and the urban area of Kolkata districts in West Bengal. For this purpose, stratified random sampling technique has been employed by the researcher to select 200 students from secondary schools in both the districts. 50 males and 50 female students from the rural area and another 50 males and 50 female students from the urban area have been chosen as the participants with their voluntary participation [18]. It has been found that there is no significant variation between the attitudes of the male and female students regarding ICT selected from the secondary schools in both the regions. However, prominent differences have been observed in the attitude of methods of ICT integration within school curriculum between the urban and rural areas that is Kolkata and South 24 Parganas districts of West Bengal.

Conclusion

In the education sector, an important role is played by the Information and Communication Technology or ICT. This is especially visible in the process of application of technology into activities related to education. Tremendously benefitted are those who can successfully integrate the various facets of these technologies in the education sector. It has been found that when the teaching process is implemented and induced by ICT, the students are more likely to immerse themselves in their learning. Various factors are responsible for the successful integration of the ICT in education, therefore, it is considered to be a phenomenon that is extremely convoluted. However, there are certain barriers to the use of ICT which are interrelated and subsequently impede the ability of the teachers to incorporate ICT in their instructional methods. Therefore, these hindrances potentially include lack of internet access,

lack of facilities of ICT, use of outdated systems, thus leading to their frequent breakdown and also lack of teachers' ability and knowledge regarding ICT. Change is required to be brought and deviate a bit from the traditional methods of teaching in order to provide effective and interactive lessons to students. Therefore, this change also needs to be embraced by all the stakeholders in the education sector so that they can make sure that the integration of ICT in classrooms is greatly enhanced. The use of ICTs is put more emphasis by the entire world for all kinds of functions, thus, it is also important for the school authorities or the administration to look after the cause and impart the necessary training to the educators. This will potentially help them to be at par with the recent advanced technological developments. This can be done when the teachers are appointed as the main point of contact when an institution is implementing and promoting ICTs for the better learning of the students. A proper workplace setting is required for conducting workshops, development programs and training sessions for these teachers. Additionally, after successfully clearing the sessions, the institutional authorities should also consider giving professional developmental certificates to them that can be helpful in their employment and teaching also.

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