

The Impact of Technology on Education: A Case Study of Schools

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Abstract. *The current research examines the effects of integrating technology into K-12 classrooms specifically in rural school environments regarding its advantages and disadvantages, effects on student attentiveness or interest, and effect for students' equality in school and teaching methods. This paper thus employs a case study to examine how digital means have impacted on classroom interactions and made education more diverse to rural learners. The study shows that the extent to which technology increases students' interest and helps manage students' diverse learning needs is great but the implementation is constrained by infrastructural deficiencies, insufficient professional development, and lack of preparedness. Moreover, inequalities are rising with ever more diverse educational ICT access outside the school environment deepening the existing inequalities. The study shows that technology integration can be best understood as a reconstructive-process level and thus requires attention to infrastructural issues, pointed continuation of the teacher education program, and a fair distribution of the digital assets. Thus, the study calls on all the educational stakeholders especially policymakers, educational institutions and local authorities to embrace full implementation and support the use of technology to foster education for children in rural areas.*

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INTRODUCTION

Integrated technology with learning is most times perceived as the magic bullet, the silver bullet for ailment that has befallen classes all over the world. In urban schools, the narrative is straightforward: technology introduces change, provides students with a plenty of materials and equip them for the future. Still, this story, as powerful as it is, breaks down when we shift our focus to rural schools. But in this context the narrative is not so clear it is, in fact, much more intricate and ambivalent.

Some of the literature underemphasises rural schools as miniature versions of urban schools while they function in a system of difficulties peculiar to their setting. Lack of geographical mobility, restricted access to material provisions and permanent insufficiency of funds form the framework, within which educational options are predetermined. In this regard, it is also apparent that the addition of technology to this already fused and intertwined equation does not equal the playing field; on the contrary, it even amplifies the inequalities. Here, the digital divide is not a mere metaphor it is a living reality which determines the educational process of many rural students (Reddick et al., 2020)

But what does all of this mean about integrating technology in to a rural classroom? Thus, it refers to the conditions in which students cannot always count on a stable and fast connection, devices are limited or old and teachers are not prepared or facilitated to integrate technology in their lessons (Ewing & Cooper, 2021). It means coming to terms with the fact that although IT can help to broaden the range of sources for learning by increasing the numbers of students who are

able to access it and use it for enhancing their learning, IT can reverse the process and deepen the inequity if some students cannot access it outside school (Ferri et al., 2020).

The potential that technology holds for enhancing education in these region is not only in bringing in physical tools, but in changing the practice of teaching, the practice of learning and the practice of delivery of education in areas that have hitherto been marginalised (Huang et al., 2020). But transition is not always a smooth process. To be effective, it calls for a radical transformation of classroom practice, of aims and objectives, and of the teacher's function. The teachers of the rural schools on the other hand are role models, fixers of problems, and keepers of their communities and they are involved with far more than in the traditional teaching aspect (Joshi et al., 2020). To expect them to adopt technology in their classroom without the right assistance or training is wrong, it is unfair actually.

Think about what changes to teaching practices are introduced by technology use. When it comes to the instructional models, it is possible to state that constructivism, which postulates students' engagement and activity, is the best fitted for the use of technology in classroom (Sintema, 2020). Nevertheless, these theories require that the teacher should have adequate knowledge of how technology can be integrated into learning as more than a horse to carry in students, but as an instrument that has potential for the improvement of learning among the students (Kidd & Murray, 2020). This is not an easy achievement, especially for teachers practicing in impoverished districts where professional development is scarce; and in any case, the mantra of "more for less" is pervasive.

However, the use of technology in rural school increases pertinent questions about equity. While using technology in the delivery of education is a way of availing education resources that many students from the rural areas could not access earlier, it is a way of breeding new forms of inequalities. Greenhow et al. (2021) has provided an example of this the homework gap refers to students who have little or no access to Internet or digital devices at home hence have disadvantageous learning environment as compared to other students. The above said split is not merely with reference to the wishes and comforts of the individuals; but entails stark consequences for one's educational path and the subsequent career.

To meet these challenges, we have to depart from inevitability of technology as a solution and acknowledge the fact that its effectiveness is conditioned by the environment in which it is employed. This work aims at establishing these subtleties, in the context of technology adoption, curriculum delivery, and fairness in rural learning contexts. In this manner, using a case-to-case approach, it is possible to consider how technologies are implemented in rural schools, what problems accompany this process, and what consequences it might have for educators and learners. This research however, is not only about defining conflicts, it is also about resolving them. It is about exploring how the technology can be a tool that fosters instructional interventions for educational equality in rural schools not a weapon that fuels them. It is about understanding the additional difficulties that characterizing rural education and coming up with relevant solutions. Finally, this study endeavours to provide a more contextual and critical analysis of the use of technology in education to avoid the construction of a rather unrealistic picture of the process and reflect more accurately the experiences of teachers and students in rural schools.

METHODS

The method used in this study is a case study method because of its ability to give detailed understanding of the phenomenon under study by highlighting the context in which the implementation is being done.

The research focuses on a purposively selected rural school, chosen based on specific criteria: low technological advancement, majority of the student's originates from low income families and previous Hoyt studies showing problematic access to educational resources. This site was chosen in order to capture the general environment for rural education in the region, and

therefore make the findings relevant to similar institutions. This purposive sampling strategy was deemed appropriate in order to discover worthwhile and transferable knowledge from case study schools in the rural area.

Data collection was done in several ways in order to embrace all aspects of the research problem. Teachers, school administrators, students, and parents were interviewed using semi structured interviews so as to get details of their insights, encounters, and difficulties in implementing technology in the classroom. I decided to employ a semi-structured approach because it offered the respondents the possibility to enrich their accounts while guiding them through the discussions of all the chosen topics. Besides interviews a set of classroom observations were conducted to determine ways in which technology is being incorporated into practice. These highlights had a primary interest on teachers' and students' behaviors as well as the levels of technology integration in the classrooms. In the matter of the intended goals and objectives of the observations, the actual and planned observations were aimed at covering as many kinds of teaching modes as possible and covering different areas of knowledge distribution within a two-month period. In addition, a study of school records where; records of discipline, student performance level, attendance and records of utilization of technology has also been analyzed still as more of an objective measure of the effects of technology. These archival data also assisted in crossverification from interviews and observations so as to have a more reliable study.

In this study data analysis was conducted by applying the thematic analysis technique which was a process of identifying, coding analysing and reporting patterns within the data. The first step involved in the analysis process was where all the collected data was transcribed and reviewed repeatedly in order to gain a familiarization of the data The first set of codes were created to attach meaning to apparent aspects of data collecting, which were further classified into themes that highlighted commonly identifiable patterns within the various mode of data collecting. These themes were creatively developed and finally refined in several rounds to make sure that they are actual and relevant to the research questions. The last overall themes offered a good storyline of the subject of interest on how technology influences education in the chosen rural school. In an attempt to increase the credibility of the results obtained from interviews, observations, and archive data, various forms of data collected were cross-checked for the purposes of triangulation and check and balance forms of research.

RESULTS AND DISCUSSION

Impact of Technology on Student Engagement

Bringing technology in the rural school context uncovered the effect of technology on the learners and this was supported by the teachers and students.

“The students also appear to be more interested in engaging when activities are on the interactive white boards or online whatever it is. They are not glued to just staring at the screen anymore they want to ‘touch’ things.”

This quote particularly re-emphasises how technology has the capacity to change the classroom environment from the traditional teacher – centered paradigm to the student – centered one. The observed change from passive to the active attitude to learning can be discussed based on the constructs approach, according to which students honestly build knowledge not just receiving it as a passive result. In this construction though, cognitive tools such as the Interactive Whiteboards and Online resources help in the construction of knowledge as well as higher order thinking skills. Also, its implementation helps in different learning approaches, which consider different learning characteristic of students in class. However, this change also brings them new concerns in that they must be able to effectively navigate the challenges of teaching in these media rich environments while at the same time help students use these technologies for learning instead of fun. The observation of the teacher can be discussed as

a part of the more general trends in educational technology concerning the shift from using the technology as the addition to the fact that it is incorporated into the process of teaching.

“I used to sleep in class and even if I was awake I would not understand anything the teacher said, not that I didn't like school, I never liked sleeping in class or even closing my ears to what the teacher was teaching, but when it got to a point that I had to start sleeping in school because my parents could not afford to feed me, things became really hard, but now that has changed.”

This self-reflecting student's experience falls in place within the framework of the Self-Determination Theory (SDT), more specifically in regard to the intrinsic motivation. In promoting motivation, SDT focuses on three basic psychological needs; namely, autonomy, competence and relatedness. Games and videos help to increase students' independence in the learning process by offering them choices of the interactions with the material. Furthermore, many of these tools are based on the concept of game design and thus involve such practices as providing instant feedback which make students feel competent. The outcome is an environment which is conducive to learning, hence making learners more enthusiastic and placing more effort in learning hence improving the chances of retaining more information. Nevertheless, it is imperative that an analysis of such engagement is taken a notch higher to understand whether this engagement is skin deep or leads to learning outcomes. The difficulty is in creating such content and interfaces to engage the students and successfully precipitate interest that will foster deeper thinking.

“Some of the students who used to lag behind in the classroom have gotten involved. I have realized that when the content is in form of technology they easily grasp it”.

This view is in accordance with the Universal Design for Learning (UDL) model which focuses on offering mode of representation, modes of action/ expression as well as mode of approach to cater for different students. Available options, especially technological ones that work with digital formats, respond to different senses and ways of thinking, thus making it possible for a larger number of students to both get and understand the content. For instance, Graphic or spatial learners may understand who is or a multimedia presentation while Physical or active learners may learn more through demonstration and practical involves simulations. It increases the understanding and at the same time minimize the disparities in the class by availing the content in formats that could be easily understandable to students that maybe have difficulty in understanding texts. However, it does provoke much needed questions about the teacher as the go-between of these technological interactions. Despite the supportive effect that technology has on the learning process, it should not come as a substitute for the teacher's role in showing the students how knowledge is constructed and making sure that the use of the technology in the classroom is complementary and not the sole means of getting students to think deeply and really learn.

The study also shows that embracing of technology can lead to increased student learning in rural classrooms, such that the dull classrooms are turned into an innovative hub for basic learning. This discusses with the increasing interest in motivational advantage of educational technology as espoused in various literature (Macgilchrist, 2019). When students engage themselves more in their learning process, then technology helps them to move from the mere reception of information to reconstruction of information. Such change is especially salient in rural areas where students avail limited educational information sources and where learning remoteness has confined students' engagement.

However, even greater engagement is all well and good, but we need to look at the sustainability and depth of this engagement in question. According to the literature review, adoption of technology in the classroom increases students' interest at the beginning but the generalized effect on the students' achievement over time, depends on how these gadgets are incorporated into the learning process (Sintema, 2020). It is not enough to merely include technology into learning; it has to be incorporated for purposes of using the technology to

complement instructional practices that allow for the creation of high order thinking abilities and deep understanding. This necessitates the fact that instead of just applying the technology as a direct replacement for the conventional techniques of teaching, teachers should apply the use of this technology to come up with more authentic and challenging learning activities (Rahiem, 2020).

Challenges in Technology Integration

However, the same study made it clear that there are tight-screwed difficulties of integrating technology in class, mainly on the areas of infrastructure and teachers.

“Our biggest challenge is the limited availability of good internet connection.’ said one student ‘It is such a let off when we cannot finish a lesson because of a bad connection.”

This quote summarizes the fact that the problem of inequality in the availability of information technology is present today and the fact that rural schools are among the worst affected. Internet connectivity cannot be just a technicality that is a ‘problem of access,’ but rather a large impediment to learning as a fundamental right. As a critical approach, the division between ‘information rich’ and ‘information poor’ individuals can be classified as a reflection on originating social relations that are running through society. Schools that are located in rural areas do not receive several infrastructural developments as their counterparts in urban areas hence the inequalities that persist in the distribution of education. The teacher frustration voiced in the story represent the difference between the vision of educational technologies and their application in low resource setting. This issue calls for a more in depth analysis when it comes to policy and funding to consider the infrastructural deficits in rural schools. If these issues are not addressed then one finds that the potential of technology in education does not deliver on its potential and sustains the gaps or existing disparities in education.

“Even our teachers are not completely prepared in integrating the new technologies into the learning-teaching process; some of them do not dare venture into using the technology for a reason that they are not confident.”

This statement highlights the need for teacher-professionals in the evaluation of the use of technology in learning. Teachers were found to have little confidence and little experience in using such technologies in the classroom as evidenced in the research that indicates poor training provided to teachers. From this point of socio-cultural perspective it actually constitutes a part of the problem of technology integration within educational organisations. Teachers are not only receivers who put into practice ideas of using the technology and making changes to it but dynamic part of teaching learning process whose feelings, opinions and perceptions have a strong impact on promotion of use of technology. It follows that professional development must be broad, continuous, and located; focused on both the concepts that must be understood to apply new tools and the instructional practices that must be used to implement them. Also, such programs should be developed in a way that promotes a growth mentality about the technology to the teachers, and so they would embrace the change as the technology transforms to complement their teaching instead of undermining it.

“Sometimes the teachers do not understand how to solve problems when computer is not responding and then we just wait”.

This student’s experience best illustrates how today’s classes rely heavily on technology, and how certain disturbances could happen when things go wrong. Overall, from a critical perspective, this state of affairs illustrates that technology dependent learning environments are predisposed to interruptions of educational processes were effectiveness of teaching and learning may be hindered by technical malfunctions. This also underscores the kind of technical support that schools require in developing a viable system that seems to be non-existent in underprivileged schools. As for the waiting time noted by the student, this is not only the time that is lost instructional but the time that highlights all the problematic areas of technology use in education. These findings imply that schools require investing in the right technology, and in

the right human capital, in order to support the effective integration of the technology. This also encompasses equipping the teachers with skills that they ought to use to solve most minor technical hitches but also having the another crew of IT directors who will be able to resolve most of the technical hitches that arise.

The analysis of the difficulties inherent in the integration of technology into the teaching/learning process in the present study with reference to both infrastructure and teacher education, tally well with what the digital divide literature suggests. Another challenge affecting the use of technology in rural school setting is lack of infrastructure for technology in which schools struggle to update their internet or equipment (Bottiani et al., 2019). This technology split also does not allow to achieve a potential positive impact of using technology in education and at the same time increases inequality between students from rural areas and urban area (Kaden, 2020).

Teacher training was also identified as another area to note on the actual implementation of the technologies. The fear of the teachers to embrace new technologies as evidenced in this study has attributed to inadequate confidence and professional development (Zhou, 2022). The literature states that professional development for technology integration should be continuous in nature and context-sensitive relying more on teaching practices on how to incorporate technology into teaching (Backfisch et al., 2021). This supports the results of this study, which indicate that, unless the teachers are provided with necessary training and resources to support their use of the technology, the latter remains unfulfilled as a tool for teaching and learning improvement.

The Role of Technology in Enhancing Educational Equity

This research also sought to establish how technology could be of assistance in improving equality in public school education to the children on the rural poor schools.

“As students are able to use resources available on the web, we are able to show them subjects and materials that we could not previously provide.” I like that it says here that the world is in the palms of students’ hands”.

In this statement, one is able to see the presentation of a more egalitarian system in education through technology in particular rural areas where technologies are rare. The use of technology avails a wide range of learning resources, which enable a rural learner a chance that he or she would not have been able to attain. This is in congruence with the ‘distributed cognition’ where knowledge and learning do not belong to person, but is within populations, artifacts, and settings. The extensive source of information that is the World Wide Web complements the student’s mental and cognitive endowment by extending his/her learning facilities well beyond the four walls of a school. However, this democratization of knowledge also throws pertinent questions about the ability to judge those sources that are available on the social media (Mößner & Kitcher, 2017). Especially if the student fails to receive proper guidance, the sources can be easily fake news, thus getting a rather shallow or mislead perception of what they are studying.

“My child has always had a love for science but I had no access to the resources to help him/her by finishing school we had no money for school or books now my child has been able to take online classes and even do science projects through the Internet.”

This parent has described the possibilities of technology enable the delivery of learning experiences that will be unique for every talent and interest of each student. E-learning through offering such opportunities as the ones that let students take courses online and participate in virtual science fairs opens up new chances for learners and facilitates the formation of a

“Some students successfully learn technologies; however, others lose their credit because, in their homes, they don’t use technologies. Thus, it contributes to new forms of discriminant”.

Precisely this observation opens a crucial paradox in the discussion of the problem of educational equity. On one hand, technology makes it easier to overcome inequalities in

educational material availability; on the other hand, it tends to exacerbate such inequalities in case some children do not have access to these tools during learning at home. This so-called 'homework gap', has become a new form of digital divide much more severe in rural communities because of limited internet connection and digital devices. From this, we have; students who have no access to a computer, internet connection or cannot stay at home to undertake their learning activities may lag behind, resulting to widening achievement gap. It also emphasizes the necessity of more extensive policies to focus on acquiring the equipment in the school and on students' possibility for having access to technologies with which they would continue their educational endeavours at home. Some of these could be making internet connection available to areas with little or no connection, giving out cheap or free tablets and laptops and making learning centers with access to technology and help for the students.

Finding out how technology intervention can improve educational equity in the given study paints the picture of what is possible and what is not possible. On one hand, technology means that students in rural schools can reach out for more and for different resources and experiences and this idea aligns with trends identified in other literature (Oztemel & Gursev, 2020). The feature of the internet environment to offer online courses and attend science fairs and numerous subjects allow offering opportunities for rural students that were not available before (Tijian et al., 2019).

But the study also points to a new form of inequality that has arisen from the differential use of technologies outside of school. More about this "homework gap" is available in the literature and presents as a major factor that hinders a parity of the education (Boldureanu et al., 2020). The learners who have no access to reliable internet or digital devices at home are put at a disadvantage they cannot leverage on the digital learning tools that may come in handy to any student as they may not consider them to be a big deal. This has shed more light on the effectiveness of global policy interventions that must capture in-school and out of school access to technology. These gaps might be reduced through provision of affordable internet connection, establishment of community technology centers and school based device borrowing programs among others (Reddick et al., 2020).

Teacher Adaptation and Pedagogical Shifts Due to Technology Integration

The use of technology in schools in the rural areas has required some modification from the teachers, which has brought out advantages and disadvantage in terms of teaching and learning styles.

"What I have learned is that I have had to re-shift the approach to teaching altogether, with the new technology, am not just presenting information, but am a moderator of the content and of the students themselves".

This quote marks a major shift of strategy in effective instruction from an expository mode of delivery typical of traditional teaching to a more guiding or mentoring mode in concordance with the constructivist theory of learning. In this model, teacher is considered as a mediator and the learner is an active participant who builds his or her own knowledge system. This is made possible through the applications of technology that affords the students opportunities to engage, manipulate, and exercise information within a variety of contexts (Alammary et al., 2020). However, this transition means the teachers themselves must unlearn what they know and become a new person, which is not easy particularly in contexts whereby professional development is scarce. This shift however also presents crucial questions about the level of interaction between the technology and the teacher. Even in cases where technology assists in achieving differentiated content Delivery and furthering student's understanding of content areas and concepts, it is highly important that teachers do not let go of the reins and let students and the technology determine their learning processes and path (Asbari et al., 2020).

“Integrating technology in classroom learning has made me change often in my approach to teaching whereby I need to adjust with different learning paces and styles, which was not such a big issue before.”

This statement draws the need for teachers to become more proactive in their strategy in teaching and this is made possible by the use of technology. The flexibility mentioned by the teacher is highly associated with differentiated instruction where through technology learning can be adapted to fit the students’ needs. Such flexibility is useful when considering the learning rates and attitudes within any class, especially in the rural schools where the assets are often scarce, and the students have different backgrounds knowledge in computers. Nevertheless, such a shift towards better flexibility in the classroom has its problems, one of which is the multiple progression of learning tracks that may be a problem for teachers as they have to deal with both tracks at the same time. Further, it entails substantial knowledge of both the detailed workings of these tools and the educational approaches necessary for the successful implementation of these solutions for meaningful improvement of the learning processes.

“I see them as more independent now, but that freedom requires me to pose different challenges for them, however, a regular test will not reveal what they learned.”

This observation opens up the idea of the dynamic nature of assessment in context of technological affordances for teaching and learning. With more students being encouraged to learn in a more individual manner given the level of personal technology available, traditional paper and pencil forms of assessment such as examinations and standardized tests may not give a true picture of the students’ capabilities. This correlates with the increasing trend of function assessments and other approaches to assessment and evaluation: projects, portfolios and peer assessment. The demand for creativity in assessments speaks to the paradigm change where knowledge and information content knowledge are no longer the only things that can be measured; what also can be assessed are thinking skills, problem solving competency and a student’s ability to solve problems in contexts. This progression of change in the way that assessment is done entails the teachers being able to move beyond being enablers of learning and knowledge but knowledge designers that could be evaluated using various and meaningful formats. But this change also implies the need for teachers’ continuing education and training to facilitate their usage and enactment of new forms of assessments

The results pertaining to teacher adaptation and the instructional changes as a result of technology incorporation reflect general trends of practice. The change from teacher-centered to student-centered leading by use of technology supports today’s modern learning theories like constructivism and connectivism by Rice (2018). These theories promote the learning model in which the student is constructing his or her own understanding by manipulation and manipulation of the environment under the guidance of a teacher.

Nevertheless, this shift also puts new expectations to teachers in terms of their practices and skills which consist not only technical skills but also the ways in which the technology can best be used in the context of teaching and learning (Rodrigues et al., 2021). This is where the call for creativity especially when it comes to assessing, as the study pointed out, becomes more necessary. Standard assessments may not incorporate skills acquired by the students under technology integration. However, online tests which are different from class tests such as the project-based learning, Portfolio assessment may give a better understanding of the learning achievement of the students (Chang & Tseng, 2011).

These findings highlight the need to provide teachers with the professional development that is focused on teacher education as well as the education that focuses on technology integration into the teaching learning process. Organization provided support is also important in the teachers’ ability to use technology to enhance the teaching learning processes and to meet calendar challenges in their tasks (Alhujayri, 2018). Policymakers and practitioners can benefit from the implications arising out of this study that has been discussed in this paper as follows. First, solving the problem of inequities in access to technologies in rural schools is imperative for

policy makers. This entails not only having funds for construction of the infrastructural facilities as presented in the analysis above but also funds which will be a long-term support to teachers for them to blossom in the use of information technology. Second, educational equity through technology promotion have to be systemic and include both in school access to technology as well as out of school access to technology. Last of all, it is clear that the change in the patterns of instruction brought by integrating technologies into teaching and learning implies evaluating the processes of professional development and accountability for teacher educators, focusing on stimulating innovation and creativity in classrooms.

CONCLUSION

The implication of technology in rural education as studied in this paper has its advantages and weaknesses. The present study shows that technology can help improve students' experiences within the classrooms in rural areas by increasing students' interest, promoting differentiation of the student, and expanding the pool of teaching resources. These benefits go a long way in making education easier especially with learners in rural areas where there are few materials to help them learn. But, we also see significant issues that need to be resolved to achieve the full benefits of massive use of technology in such settings. Technology incorporation restraints like absence of info structures including unreliable internet connection are still a barrier. Moreover, the technology integration in education also highly depends on teachers' readiness and ability to incorporate such tools in classroom practices in which constant training and professional development should be provided for teachers. Unless such concerns are resolved, the advantages which come with trends in technology can be ineffectively distributed; making some disparities in learning more profound. In the same breath, despite the promise of improved educational equality by giving rural students a chance to participate in learning experiences, which hitherto was a remote likelihood, the use of technology brings about new strand of disparity. The issue of technology divide, or the lack of access to technology at home and other settings beyond school becomes an issue that limits genuine equity in education. It is thus important to make sure that none of the students lacks the appropriate equipment that would allow him or her to be an active participant in the learning process that is supported by the use of digital technologies, as otherwise the tech gap will only widen.

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