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Research Article

Teacher Concerns on the Uptake of Auto-CAD in the Teaching of Building Drawing in Zimbabwe Secondary Schools: A Case of Masvingo District

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Abstract: A qualitative case study was conducted to explore teacher concerns on the uptake of Computer Aided Drafting (Auto-CAD) in the teaching of Building Drawing (BD) in secondary schools of Masvingo District in Zimbabwe. The study was motivated by the failure by all the fourteen secondary schools offering Building Technology and Design in the district to integrate Auto-CAD five years after the introduction of an updated curriculum. The Ministry of Primary and Secondary Education (MoPSE) introduced an updated curriculum in 2017 which ushered in the use of ICTs in school curriculum in the country, but as of May 2022 secondary schools in the district offering the subject had not embraced Auto-CAD in their teaching as per new syllabus requirement. The study was guided by the transition theory by Shlossberg (1981). The study population included 15 subject teachers, as well as 14 H.O.Ds in the district. The study revealed that although subject teachers supported the use of Auto-CAD, they however sounded concern on the challenges they faced in trying to embrace it in their teaching. Challenges ranged from lack of expertise on the part of teachers on how to use Auto-CAD to shortages of key resource in the district. The study recommends that subject teachers be staff developed on how to use AutoCAD for them to remain relevant in the classroom. Resources such as laptops, Auto-CAD software as well as stable electrical power should be availed in schools for the ease adoption of this software package in secondary schools in the district.

Keywords: Auto-CAD. Information Communication Technology, Building Technology and Design, Building drawing.

INTRODUCTION

Drawing is an integral means of conveying architectural, mechanical, building or engineering details on the different parts of the design components of the structure (Oyebode *et al.,* 2015). Drawings can either be made using the traditional or the modern method and the former implies the use of a drawing board, a T-square, an erasure, a ruler and a paper while the latter is produced electronically through the use of Information Communication Technologies (ICT) packages such as Computer Aided Drafting (Auto-CAD) or Architecture Computer Aided Drawing (Archi-CAD). These software programs are used to create working drawing for buildings, bridges, and computer chips, among other things. In developed countries computers are now part and parcel of the different parts of society where people find themselves in. Dağhan, (2017) laments that technology is quickly entering into people's daily lives and activities while at the same time, making life easier in many ways. Technology is also becoming a driving force in many areas of life globally and is important in the progression of people's social life as well as providing a dynamic structure in the education system, which is important in the twenty -first century (Hrehová & Teplická, 2020). It is suffice to say that computer technologies have some

space in today's classroom discourses, although most developing countries are lagging behind in this front.

The Nziramasanga Commission of Inquiry into education and training (CIET) of 1998 which made inquiries into the Zimbabwean curriculum recommended that technical education be revamped to complement academic subjects (Nziramasanga, 1999) and it ushered in an updated curriculum which recommended among other issues the use ICT based technologies in schools in the country. The ICTs were initially introduced in the 1960s and have since been developed over the years to be more user friendly by introducing packages such as Auto-CAD (Oyebode *et al.,* 2015). Notwithstanding the fact that the use of Auto-CAD software in drawing has a number of advantages such the production of accurate and quick working drawings (Chandra, 2021), however the failure to adopt the use of this software in the teaching and learning of drawing lessons in Msvingo district could be a result of a number factors which could be beyond the schools control. The fact that at the time of conducting the study, Masvingo district had 14 secondary schools offering Building Technology and Design but none of them was using Auto-CAD software for drawing lessons five years after the introduction of the updated syllabus, implied that a study of this scale be conducted

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to explore factors inhibiting the integration of this software package in secondary schools in the district.

Statement of the Problem

The Ministry of Primary and Secondary Education in Zimbabwe introduced an updated curriculum in 2017, which advocated among other things the use of ICT drawing competences in Building Technology and Design. In 2022, about five years on, all the fourteen secondary schools offering the subject in Masvingo district had not adopted Auto-CAD in the subject. The fact that more than five years elapsed before schools adopted the use of AutoCAD in secondary schools in district meant that there could be challenges faced by teachers, hence this study to explore their concerns on the introduction of Auto-CAD in Masvingo district of Zimbabwe.

Research Questions

The study sought to answer the following research questions:

- Why were teachers not prepared to integrate Auto-CAD in the teaching of Building Technology and Design in the district?
- What were some of the barriers that inhibited teachers' smooth integration of Auto-CAD in the district?

THEORETICAL FRAMEWORK

The study explores teacher concerns on the uptake of AutoCAD in the teaching of BD in secondary schools in Zimbabwe. This study resonates with the transition theory which looks at how people perceive change (Shlossberg 1981). When faced with new innovations, people's responses often varies in the way they consider these changes. Building Technology and Design teachers have been teaching this subject for many years without the use of Auto-CAD now that new changes are coming teachers behave differently to this change. Schlossberg (2008), argues that transition involves approaching the change first, taking stock of the change and then taking the change itself. This implies that once faced with new changes people should have a deep and clear understanding of what they ought to do, so that they become prepared for the change mentally otherwise they will not adopt it. Further, it also implies that transition is a process where people should understand it before taking charge of the envisaged change. The perception of people about change are very important as this affects their reaction to the change. The fact that Building Technology and Design teachers in Masvingo district took about five years before integrating the use of AutoCAD in schools implied that teachers don't just consider change without understanding the gist and/or implication of that change. Teachers in the district can implement the changes once they feel that it's time they should adopt it.

LITERATURE REVIEW

Teacher preparedness to integrate Auto-Cad in secondary schools in the district

Teachers do embrace new changes in the curriculum if they feel that their views are respected and they are part to the change process in the new curriculum. Hence for any new educational program to be successfully implemented in schools, teachers play a critical role for its success or failure (Nevenglosky *et al.,* 2019). The implementation of the 2017 updated curriculum was fraught with challenges such as lack of adequate consultation by the curriculum designers after leaving out important stakeholders such teachers (Mabena *et al.,* 2021). Teachers are the curriculum implementers hence they should take part on any curriculum change right from designing, consultation up to its implementation stages (Alsubaie, 2016). Once teachers feel that they were not part of the curriculum making process they would not be at liberty to implement it with fidelity. It thus follows that teachers can easily implement programs which they feel they were consulted right from its initial stages of development.

Even personal attributes such as teacher's personal experiences and educational level can have a bearing on the uptake of new ICT programs such as AutoCAD in secondary schools (Dintoe, 2018). Recent studies suggest that some teachers' training programs had no pedagogical preparation in ICT which prevented them from becoming literate at an early stage in their academic lives (Pongsakdi *et al.,* 2021). If teachers are not fully ICT literate then they cannot use it for the instructional processes such as Auto-Cad to learners and their readiness to embrace ICT in schools will be a mammoth task (Hero, 2020). These teachers believe that they can teach without using ICT gadgets and attain favorable results using the good old ways of drawing and oral passing of information to learners (Rapanta *et al.,* 2020). Nakhla, (2020) adds that teachers' fear of failure instills a sense of lack of confidence on their part to introduce new programs in schools, hence their lack of confidence in the use of computers is testimony to their limited ICT knowledge.

While adequacy of computers is a factor in adopting their use in schools, however their presence at school may not guarantee their use but teacher attitude towards the use of ICT is believed to be a strong indicator of whether teachers will use ICT or not. Some earlier studies revealed that there is a link between the attitude of teachers towards technology and their chances of integrating Auto-CAD into teaching and learning (Kere, 2016). Teachers with higher chances of implementing ICT based technologies are those who are literate, confident and with a positive attitude in their ability to use computers effectively (Ghavifekr, & Rosdy, 2015). Safiee *et al.* (2019) lament that there are four major factors affecting the introduction of Auto-CAD in schools which are skills, knowledge, training

and attitudes. It follows that teachers with the skills to use computers, those who have the knowledge as well as good attitudes towards computers could introduce them without challenges when compared to those with low skills levels.

Since many teachers in the classroom today have limited skills, lack important knowledge, have no training and with negative attitude towards computers, staff development programs are important in improving ICT literacy, thereby filling the void created by these deficiencies in skills levels. Without staff development programs teachers are not confident to discharge their duties and their status in the classroom is at stack. Edmond & Burns (2005) posit that:

> When computers are involved … programs must address not only teachers' technical skills, but also their concerns about logistics, about how to use computers with students, and about risks to their status in the classroom (p.30).

It follows that teachers status should be looked at seriously in the classroom because they should not appear as novices in front of their students. However the cost of training to staff develop them may be prohibitively high such that teachers can still be deterred to partake them so as to match the required skills to operate the computers. Teachers who are computer illiterate believe that retraining in ICT skills is costly and unnecessary (Siddiquah & Salim, 2017). Mupa & Chinooneka, (2015) reveal that teachers who go for retraining do so using personal resources. Hennessy *et al.* (2010) add that even when training has been organised by schools and computer centres, payments in many of the cases have been from personal purses of the teachers' concerned which is very discouraging from the teachers perspective. Once discouraged teachers tend not to go for those refresher courses hence the failure by the schools to introduce the ICT programs in schools.

There isn't much documentary evidence from empirical data on concerns by teachers to the adoption of Auto-CAD in secondary school setting in Zimbabwe especially in the context of the updated curriculum introduced in 2017. Studies of this nature have been few since no research studies known to the researcher were conducted in Masvingo district to establish teacher concerns on the introduction of Auto-CAD in secondary schools. This study, hence provides a new trajectory for an ongoing academic debate on the concerns by teachers in implementing new programs in secondary schools in the country and elsewhere.

Barriers Faced by Teachers to Effectively Integrate AutoCAD in Secondary Schools

A number of obstacles do affect the introduction of new curricular programs in schools. Challenges such as the provision of resources as well as teacher support can act as barriers affecting the implementation of AutoCAD in schools. According to Mafang'ha (2016) computer aided instruction happens to be one of the most required skills for a classroom practitioner but is the least possessed by teachers. For teachers to successfully implement computer based programs in schools, they should be supported with basic resources such as laptops, desktops, reliable electrical power, laboratories and software at school level, (Brown, 1999). Recent studies also reveal that teachers do implement a program if factors such as resource provision, skills mastery and educational experience with regard to the program are in their favour (Coman, *et al.,* 2020). Adequate resources imply that the implementation of the program is done with ease and skills mastery as well as adequate experience means that teachers will be confident to introduce it (Nevenglosky *et al.,* 2019). Hence secondary schools without electricity find it very difficult to introduce the ICT programs which enable the smooth implementation of Auto-CAD in schools. However the fact that these resources cost some considerable amount of money means that poor schools have very low chances of acquiring them. It thus implies that poor and remote secondary schools without a strong financial base are finding it difficult to acquire the very basic requirement in terms of resources to run an Auto-CAD program in secondary schools.

The successful implementation of computer software in schools is also determined by the availability of school infrastructure such as computer laboratories. Meaningful learning in computers can be achieved if the school has a well-resourced computer laboratory with functional desktops and/or laptops as well as the expertise to assist learners. In some rural secondary schools in Zimbabwe, computers were donated by the politicians and some of these computers were often outdated, defective or no one at the school could them and subsequently, they remain idle gathering dust in storerooms. Further, these computers required upgrading or new software such as Auto-CAD which could be beyond the reach of these poor schools consequently rendering them useless. The computers were mostly donated to schools for purposes of campaigning without due regard to them serving the school and the community meaningfully. It thus goes without saying that for optimum use of computers in schools they should be well resourced, cared for by a competent teacher or technician who will assist learners and other teachers at large.

METHODOLOGY

A qualitative case study design was adopted to generate data so as to establish teacher concerns on the adoption of Auto-CAD in the context of teaching Building Drawing in secondary schools in Masvingo district. A qualitative case study design was adopted to take advantage of its merits such as encouraging the researchers to appreciate the views of participants in

their natural setting (McMillan & Schumacher, 2010). This design was suitable for this study as it allowed the researchers to listen to stories of the Building Technology and Design teachers while at their work stations as well as creating detailed explanations of their feelings, attitudes, and perceptions.

Participants and Setting

A sample comprised of ten (10) Building Technology and Design teachers taking the subject from form one to four was purposively selected to participate in the study. The sampled teachers had different levels of teaching experience, different qualifications, different sex and different ages. Teacher experience spanned from less than five to above 25 years, while teaching qualifications ranged from diploma to degree holders and the youngest teacher was less than 30 while the eldest one was slightly less than 60 years of age. Purposive sampling was used to select the ten teachers who had different backgrounds as it was felt that they could provide rich details and descriptions of their concerns on the integration of Auto-CAD in the teaching of the subject in the district (Cohen *et al.,* 2011). It was also felt that this sample due to its diversity and heterogeneity would provide the much needed data in this study.

Instrumentation

A self-constructed interview guide and a semi-structured questionnaire which both yielded qualitative answers were created. The interview guide and semi-structured questionnaire solicited participants' views on the benefits, challenges and solutions to the integration of Auto-CAD in the teaching of Building technology and design in the district.

Procedure

On getting to the school, the researchers started by administering the questionnaire to teachers and later on facilitated the interview guide with all the head of departments. The interview lasted around forty-five minutes and it was audio-taped with the participants' permission.

Data Analysis

Findings of the study were presented in tandem with thematic issues based on the two research questions used. Data was transcribed, coded, and organised verbatim into themes through the use of constant comparative mode of data analysis (Cohen *et al.,* 2011). The constant comparative method is a type of analytic technique of qualitatively comparing and contrasting data from different sources of data with a view to identifying categories and patterns among these categories (McMillan & Schumacher, 2010). The constant comparative approach was in line with triangulation which was attained through data collection through the use of the interview guide and the questionnaire methods.

Trustworthiness

To establish the trustworthiness of data, researchers concentrated on achieving dependability, credibility, transferability and conformability (Guba, 1981). In most qualitative approaches, reliability is guaranteed by triangulation where information gathered uses many tools for soliciting the same data (Gray, 2009). Data for this study was collected using focus group discussion and questionnaires. In order to establish how participants responded to questions, some questions in both methods were similar. Such a method resulted in effecting methodological triangulation that facilitated the credibility of the qualitative study, making sure that the researchers were confident of the research results.

Ethical considerations

Permission to conduct the study was granted by the permanent secretary through the provincial office. Participation in the study was voluntary and the information generated was treated in utmost confidence. For purposes of protecting the identity of participants, pseudonyms were used in the study and this was made known to participants. It was also made clear that since their participation in the study was voluntary, participants were free to withdraw any time they felt that they could not continue.

RESULTS

This study sought to explore teacher concerns on challenges, merits and possible solutions to perceived challenges to the integration of Auto-CAD in secondary schools offering Building Technology and Design in the district. After going through the responses from the focus group discussion and transcriptions from semi-structured questionnaires, several times, data was categorised into themes which were developed from research questions that guided the participants' narrative responses. The following were the themes transcribed from the study: the extent to which subject teachers were prepared to introduce Auto-CAD in secondary schools in the district and barriers to effective implementation of Auto-CAD in secondary schools in the district, thereby affecting their professional development, experiences perceived as negatively affecting teachers in the classroom setting, and how these teachers can be made more effective.

The Extent to Which Teachers Were Prepared to Embrace Auto-CAD in Secondary Schools in the District

Study results showed that the majority of participants were of the view that it was very beneficial to use Auto-CAD when teaching Building Drawing but teachers were not prepared to take it on board in the classroom teaching and learning. The following questionnaire responses representing what was alluded to by several participants:

As a building Technology and Design teacher I am very keen to use Auto-CAD because it is

quicker and more accurate than using the drawing board but it's difficult to use ICT gadget at a school where there is no electrical power (Mr Moyo-teacher).

The problem with this Auto-CAD technology is that some of us were not trained on how to use it, making it difficult for us to introduce it. It would be ideal if the powers that be could arrange for refresher courses so that many teachers can benefit. In the absence of these courses it will be difficult for it to take off the ground (Mrs Muzara-teacher).

The same sentiments were also echoed by the majority of participants in the interview guide and this is what they had to say:

Auto-CAD is a very important software in drawing but it is difficult to introduce it when teachers don't have the knowledge on how to use it. Most of the teachers taking Building Technology and Design in the classrooms today were not trained on how to use it. This is a big problem unless teachers are trained on how to introduce otherwise it will remain a pipe dream (Mr. Mpofu- HOD).

Respondents generally showed that teachers had no adequate knowledge on how to use Auto-CAD hence it was difficult for schools to introduce it if they did not have the manpower to use it.

Barriers Faced by Teachers in Implementing of Auto-CAD in Schools in the District

The majority of participants were of the view that resource shortages played a big part in inhibiting the integration of AutoCAD in secondary schools in the district. The following were the subject teachers' responses from the interview guide:

Lack of adequate resources such as text books, lap tops, desk tops, software, and electrical power dampened the spirit of teachers to integration AutoCAD in schools. Whenever you make requests to the school administration about Auto-CAD it would seem as if you are very ambitious on issues which are difficult to introduce in rural areas (Mr Shoko- school teacher).

Auto-CAD needs gadgets like computers, internet connectivity and stable electrical power which are prohibitively high for poor communities like Masvingo district. It is almost impossible for a school to electrify the school using its own resources let alone acquire internet without the assistance from the donor community and/or central government, it follows that it's very difficult for schools to embrace Auto-CAD at their stations for this these reasons (Mr Billy- school teacher).

The Head of Departments shared the same view to that of teachers and this is what some of them had to say:

One current problem is the cost of training, teachers who have an opportunity to staff develop themselves through acquiring University degrees have a chance of acquiring the knowhow to use Auto-CAD but the cost of going for further training is high especially during difficulty economic times the country is going through at the moment (Mr. Shiri-HOD).

Some teachers have a negative attitude towards new innovations so that even in cases where schools have adequate power and internet facilities the teacher may not make an effort to acquire such items as lap tops but would be comfortable to stick to traditional methods of drawing (Mr. Joko-HOD.

Mr Mbiri also an HOD had this to say:

Some teachers have a problem of low ICT skills making it very difficult for these teachers to navigate Auto-CAD which is a bit more challenging when compared to computer literacy. Once teachers have certain deficiencies in a given area it will be difficult for them to take a lead to introduce those new areas (Mr Mbirri-HOD).

Given these responses it was clear that teachers could not easily integration Auto-CAD in secondary schools in the district. The fact there is no statutory instrument forcing schools to integrate the software in teaching and learning means that it will take time for some schools to seriously consider introducing the same.

DISCUSSION

The study sought to explore teacher concerns on the integration of Auto-CAD in the teaching of Building Drawing in secondary schools of Masvingo district in terms of their perceptions, obstacles faced and suggestions on the way forward. Findings show that subject teachers were not very keen to integrate Auto-CAD in secondary schools in the district due to a myriad of factors that impeded the uptake of the program. Recent studies confirm that the integration of new technology in education is hinged on the preparedness by subject teachers and is also affected by schools readiness to introduce that technology (Petco, Prasse, & Cantieni 2018 in Safiee *et al.,* 2019). Many teachers in the district were not competent to use the software because to them it was a new phenomenon, which they did not come across during their training at college. Studies also reveal that teachers have very low computer skills which make it difficult for them to introduce Auto-CAD (Safiee *et al.,* 2019). Alkahtani (2017) also conducted a study in Saudi Arabia and results show that lack of basic knowledge among both teachers and students as well as how the equipment

functions; lack of mastery of ICT teaching techniques—and lack of teacher training to bridge the gap, was an obstacle that inhibited the introduction of ICTs in schools. It was thus difficult for teachers to implement this program because they were not confident to introduce it since they were novices in the area.

Teacher qualifications is also an important factor on successful implementation of curriculum change and innovation in schools. The lowly qualified teachers tend to feel threatened by new changes and innovations in schools. Although the current study revealed that all the ten teachers who took part in the study were trained, the majority of them were either not degreed or some degree or diploma holders were for other subjects which is not Building Technology and Design. Study results also show that only four teachers out of 10 were university graduates and among the four only one had some knowledge of AutoCAD and related concepts. The majority of teachers had diplomas in the subject and these needed retraining since they did not know how to use ICT in drawing but the traditional method of drawing. The cost of training or upgrading at University was very expensive and many teachers couldn't afford it. Exorbitant ICT training costs prevented teachers to further their education to higher levels.

Regardless of teacher qualification, ICT literacy can be a challenge for many teachers in third world countries, hence teaching BD using computers can be an insurmountable task. This study showed that even if resources are available not all teachers were using them to implement ICT when teaching BTD. Studies have shown a negative correlation between high self-efficacy and the adoption and usage of computers in general, (Campeau & Huggins, 1995). Many teachers taking BTD preferred using the traditional way of drawing citing availability of drawing boards and T squares making it easier for learners to practice at home.

The successful implementation of new programs in schools is also determined to a large extent on resource adequacy for both teachers and learners to use. Results from this study reveal that resources were either inadequate or not available at all. These findings were consistent with findings from other studies (Nivala, 2009; & Ntshakala & Eyono-Obono. 2013), which showed that lack of computer software amongst some of the major challenges hampered the utilization of ICTs in schools. Ndhluvu (2016) posit that the main challenges faced by teachers in ICT application is lack of technical assistance, lack of access to resources, high cost of computer hardware and software as well as interrupted power cuts. Many secondary schools offering the subject were located in remote areas without electricity making it difficult to teach with ICT. The study showed that availability of ICT hardware constitutes a sound basis for the integration of ICT by

the schools in district. This is because access to ICT infrastructure and resources in schools should be a necessary condition promoting the use of ICT in the education sector (Anderson, Law and Quale, 2009)**.** Hence resource adequacy was an area of concern to the successful implementation of Auto-CAD in secondary schools in the district.

CONCLUSION

The Extent to Which Teachers Were Prepared To Integrate Auto-CAD in Secondary Schools
Based on the findings of the research, the following conclusions were made:

- Teachers were not prepared to adopt Auto-CAD in secondary school because most of them were computer illiterate making it difficult for them to operate a more challenging Auto CAD program. If teachers don't have adequate knowledge on a curriculum item they would not be at liberty to introduce it in the classroom.
- A good number of teachers were non-graduate teachers hence were not confident to integrate new programs in their classroom teaching.

Barriers Faced by Teachers in Implementing of Auto-CAD in Schools in the District
The major barriers that hampered the adoption of Auto-CAD in the teaching of BTD in the district were lack of:

- Resources such as adequate computers, software, internet connectivity and laboratories were non-existent in secondary schools in the district.
- Constant power supply either through electricity and/or solar power hence ICT tools could not be used even if available.

Recommendations
After considering the findings of the study, the following recommendations were made:

- The School Development Committee (SDC) and the school administration should provide funding for the procurement of resources such as laptops and internet connectivity in the department.
- Teachers should take in-service courses in Auto-CAD and ICT integration in BTD teaching.
- Subject teachers should upgrade themselves to degree level so that they learn new concepts in the subject.

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