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An Evaluation of the Infrastructure in the Implementation of the Design and Technology Subject in Secondary Schools of Kapiri Mposhi District, Zambia

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Abstract: *The purpose of the study was to evaluate the infrastructure for the Design and Technology subject in selected secondary schools in Kapiri Mposhi district. The mixed research approach was used to collect and analyse the data. An embedded research design was used. Questionnaires were distributed to 64 Design and Technology subject learners to collect the quantitative data while the interviews were conducted to collect qualitative data from 10 Design and Technology subject teachers, 4 head teachers, 4 deputy head teachers, 4 practical subjects heads of department, 1 Senior Education Standards Officer (SESO) and 1 District Education Standards Officer (DESO). The quantitative data were analysed using descriptive statistical analysis. Cross-tabulations were conducted for categorical variables to compare levels of agreement. The weighted mean was calculated to measure overall perceptions on specific questions, with results interpreted based on whether scores fell above or below the weighted mean. Constant comparative method of qualitative data analysis was used to analyse the data from the interviews. The findings of the study indicated that schools had inadequate workshops and that those that were there had small rooms with inadequate space to accommodate all learners, the teaching and learning resources and the products. The same rooms were congested during the teaching and learning process because the same rooms were used as store rooms for the products. It is recommended that the Ministry of Education to upgrade existing workshops and build new ones with sufficient space and resources. The new workshops should be big enough to accommodate all learners, teaching and learning resources and the artifacts learners come up with. The Ministry of Education should fund schools that offer Design and Technology subject to upgrade existing workshops and build new ones with sufficient space and resources. The new workshops should be big enough to accommodate all learners and the artifacts learners come up with.*

Keywords: *Evaluation, infrastructure, implementation, workshops, space, Design and Technology.*

1. INTRODUCTION

Learning environment is important for learners' good academic attainment. Thus schools should have enough classrooms with adequate spaces for the effective teaching and learning of the Design and Technology subjects (Hatiya, 2016; Kathrine, 2018). This is because the spacious environment encourages collaborative efforts among learners; hence promote teamwork and peer-to-peer learning which is also crucial in design and technology education. The adequate space in the classroom allows for the arrangements that facilitate group discussions, presentations, and critiques, promoting dialogue and knowledge exchange among the learners. Kwangu and Muzata (2019) discussed that workshops with inadequate spaces discourage collaboration among learners, and do not promote teamwork, peer learning, and sharing of ideas essential in Design and Technology education.

Kasaro (2021) indicated that planning for Design and Technology should be organised well with the provision of adequate enabling environment, specifically, functional workshops and laboratories. For effective teaching and learning to take place, appropriate infrastructure such as classrooms, specialised rooms, laboratories, workshops and resource rooms. Kersh and Juul (2015) discussed that the infrastructure should be well stocked with adequate equipment and materials needed for effective teaching and learning. Therefore, they should have user-friendly facilities for learners. This is because they serve as resource-rooms in learning institutions. Therefore, it must have adequate and appropriate infrastructure for the Design and Technology subject implementation.

Furthermore, schools that adopted Design and Technology subject should have appropriate and standard context (infrastructure) in which teaching and learning of Design and Technology should take place. Thus without adequate and conducive context with appropriate inputs, it would be difficult to effectively and successfully implement the subject to achieve its main intended goals and objectives. This was also explained by Mubangwe (2016) that the environment where teaching and learning of Design and Technology subject takes place is an important educational factor that needs to be considered by everyone concerned, the environment needs adequate attention in the area of infrastructural facilities, and made conducive for learning purposes in order to achieve the set goals and objectives. Kakupa (2017) discussed that the 2013 curriculum declared the vocational career pathway as a progressive and a giant step in helping youths acquire skills for self-reliance, but its successful implementation remains uncertain.

There has been an observed consistent and steady decline in financing the education sector from 2015 to 2022 (Ministry of Finance National Budget, 2015-2022), which does not only pose a threat to the furtherance and aspiration of the country's ability to sustain the provision of quality education, but is also fundamentally dichotomous to the global/regional benchmark of 20% or 4% - 6% of GDP of annual national budget to the education sector (UNESCO, 2018; Hampongo, 2020). Sustainable quality education cannot be realized without a significant and well-targeted increase in financing the sector (UNESCO, 2016; World Bank, 2019; and Yang, 2019) for required demand driven investments. Masaiti et al., (2018) also observed an amusing drastic steady reduction in sectoral budgetary allocations from 2015 to 2017 with an emphatic recommendation for an in depth analysis of the phenomena as no study had been done to specifically address the occurrence.

ZANEC (2017) got concerned with the education budget for 2017 which was at 16.5 % from 20 % in 2014 of the total budget, and that education system continued to receive diminishing funds. This might have directly affect the implementation of vocational education. Thus the spillover effect of the inadequate financing of education would manifest itself in the failure of the government to ensure learners develop practical vocational skills (UNICEF, 2022). Design and Technology requires a lot of funding for its effective and successful implementation due to its high cost (UNICEF, 2016 and Kakupa, 2017). Zambia's budget distribution to the education sector as a percentage of the overall national budget in the last seven years shows a downward public education expenditure budget trend from 2014 to 2022. The Education 2030 Incheon Declaration and Framework for Action, a global plan agreed upon by countries in 2015 for the implementation of SDG 4, urges governments to allocate at least 15-20 % of their total public expenditure at all levels of education, while the second, more widely accepted, set spending of 4-6 % of GDP on education (Global Partnership on Education, 2016). Zambia's declining share of education has significant implications for attaining SDG 4 and Vision 2030.

In the 2022 budget, the Government announced a K18.1 billion allocation toward education. The proposed expenditure on education represents a 31% increase compared to the 2021 allocation of K13.8 billion. This amount also represents a marginal increase compared to 2021 when expressed as a share of GDP. However, as a share of total expenditure, the allocation to education reduced from 11.5% in 2021 to 10.4% in 2022 (Banda, 2021 and UNICEF, 2022). Therefore, the subjects under vocational track in secondary schools are likely to face very difficult implementation process due to the decline in budget expenditure on education.

The implementation of Design and Technology seems expensive and difficult to undertake in the Zambian context. The availability, usability and functionality (state) of the context and inputs and how the Design and Technology is implemented have not been assessed in secondary schools amid declining fundings towards the Ministry of Education from 2014 when it was introduced in schools. Therefore, there is no well-documented evidence-based research evaluating the context in which the Design and Technology subject in secondary schools in Kapiri Mposhi district is implemented, which was the researcher's motivation and therefore was the pre-occupation of the study.

2. LITERATURE REVIEW

This section presents the review of relevant literature to evaluate the adequacy, usability and functionality of the infrastructure necessary in the implementation of Design and Technology curriculum in secondary schools.

Global Studies on the Teaching and Learning of Design and Technology Subject

The context design and technology subject should be implemented as a replica of the environment such as workshops and laboratories where learners will apply Design and Technology knowledge and skills acquired from school. The learning context establishes the foundation for the development of the learning expectations and learning processes for the school. The context should be a replica of the working environment such as industries; workshops trained personnel apply their acquired knowledge and skills (Roberts, 2015; Paliwe, Siphelo, Veronica and Maria, 2015). Thus schools should have laboratories, workshops and classrooms for practical lessons for Design and Technology subject be effectively implemented and achieve its intended objectives. Todd and Dunbar (2018) explained that the context in which Design and Technology subject is being taught should be conducive for the teaching and learning of the subject to allow for exchange of ideas, thoughts and skills among the teachers and learners.

Tang and Shi (2017) supported Valerie (2014) that the infrastructure and mechanical systems of the building should be exposed, making the building a learning tool. These infrastructures should be well stocked with tools and equipment as teaching and learning resources (inputs). Ebenechi etal (2016) recommended that suitable infrastructure, equipment and facilities should be put in place to support the implementation of practical subjects. There should be specific infrastructure for the subject and resources in place in implementing Design and Technology. Mkonongwa (2017) discussed the need for specific infrastructure such as workshops, classroom blocks and laboratories to support an effective implementation of the Design and Technology subject.

The Teaching and Learning of Design and Technology Subject in Africa

Constantino and Mariana (2015) discussed that the availability of a conducive infrastructural base is an important contributor to the successful and effective implementation of Design and Technology in secondary schools because the subject requires conducive infrastructural facilities and material resources for practical teaching and learning to help learners acquire knowledge and develop practical skills. The nature of infrastructure in teaching and learning Design and Technology in colleges of education is of great importance in the development and making of a teacher. Thus, the quality of learning facilities in educational institutions should have a positive relationship with the quality of teaching and learning activities leading to the attainment of goals set. The quality of the school buildings and furniture determine how long such last while comfortable classrooms and adequate provision of institutional resources facilitate teachers' instructional task performance and learners' learning outcomes. David (2018) indicated the need for specific infrastructure such as workshops, classroom blocks and laboratories; influence an effective implementation of Design and Technology subject. Therefore, in schools where the classrooms are inadequate prevents the exposure of the learners to practical experiences, acquisition of relevant skills and change of their attitudes towards the subject without any hindrance.

The quality of the workshop and learning environment strongly influences the academic standard, which is an index of quality assurance in implementing the Design and Technology subject in schools. Mkonongwa (2017) discussed that inadequate physical facility leads to poor school curriculum implementation, and compromises the implementation of the subject because topics meant to be taught practically are taught theoretically due to a lack of supporting physical facilities and equipment. For this reason, Kwaira (2016) discussed that adequacies of workshops foster a good environment for learners' engagement, and lead to improved retention and understanding of theoretical concepts. Thus adequate workshops encourage learners develop the hands-on skills critical in design and technology, preparing them for practical applications in the field.

The condition of the school's learning environment including infrastructure has an important impact on teachers' effectiveness and learners' academic performance (Scot, 2015; Shamsa and Munazza, 2018). The facilities that are needed to facilitate the effective teaching and learning in an educational institution which include the classrooms, offices, libraries, laboratories, conveniences and other buildings as well as other furniture items. The quality of infrastructure and learning environment has strong influence on the academic standard which is an index of quality assurance in the implementation of the Design and Technology in the institutions of learning. Egunsola (2020) discussed that the inability to provide right facilities can force the introduction of alternative undesirable that can undermine the goal of practical

subjects in schools. Thus, infrastructure in teaching and learning of Design and Technology plays a crucial role in teaching and learning process. Puyate (2014) explained that no practical teaching and learning could occur without without adequate provision of learning facilities like workshops. Nyamumbi (2023) indicated that suitable infrastructure should be available to support the implementation of practical subjects in schools. Thus infrastructure is an integral component of the learning and teaching of Design and Technology because it enables learners and teachers to access a wide range of tools, service and resources to support learning and teaching within the environment it is being implemented.

Implementation of the Design and Technology Subject in Zambia

The implementation of the Design and Technology subject require schools to have all the necessary educational requirement, which includes infrastructure (workshops, laboratories and classrooms). Mubangwe (2016) studied the nature of infrastructure in the teaching and learning of Design and Technology in Technology Studies at Kitwe College of Education. The result of the study revealed that the four (4) built industrial arts workshops infrastructure with machinery and equipment were no longer used as were intended. Kitwe College of Education turned its workshops infrastructure for teaching Design and Technology into ordinary classrooms. This implies that the quality assurance practice of training teachers to equip and handle Design and Technology after training remains questionable. Also, the results revealed inadequacy of workshop equipment, and the college had no standard rooms or workshops for Design and Technology.

Hatiya (2016) carried out a study on the relationship between a school's infrastructure facilities and learners' outcomes. The study showed that good infrastructure facilities always support the education enterprise and that the shortage of classrooms poses challenges for schools to conduct practical lessons and this eventually denies learners of knowledge and practical skills. A good learning environment is important for learners' good academic achievement. However, equipping the workforce with relevant job skills is a continuing challenge worldwide. Thus schools should establish infrastructural facilities for practical subjects in secondary schools for effective implementation of Design and Technology subject.

Research gap and its justification

From the reviewed literature, there is no empirical study that evaluated the infrastructure of the Design and Technology subject from 2014 when the 2013 curriculum was first implemented in secondary schools. Thus this study was conducted in Kapiri Mposhi district of Central province in Zambia in order to reduce the gap.

3. RESEARCH METHODOLOGY

The study employed both the qualitative and quantitative research methods to collect, integrate and analyze data. The study utilized the embedded research design. The research sample size of the study was 88. These were 4 head teachers,4 deputy head teachers, 4 practical subjects heads of department, 1 Senior Education Standards Officer, 1 District Education Standards Officer, 10 Design and Technology subject teachers and 64 Design and Technology subject learners in the selected secondary schools of Kapiri Mposhi district. Simple random sampling was employed with the use of the lottery method to select the Design and Technology learners while purposive sampling was used to pick the head teachers, deputy head teachers, practical subjects heads of department, Senior Education Standards Officer, District Education Standards Officer, and Design and Technology subject teachers.

The quantitative data were collected through questionnaire using the five point likert scale (1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A) and 5 = Strongly Agree (SA)) from the Design and Technology subject learners while the interview guide was used to collect data from the head teachers, deputy head teachers, practical subjects heads of department, Senior Education Standards Officer and District Education Standards Officer. The interview schedule was used to collect data from the Design and Technology subject teachers. The quantitative data were analysed using descriptive statistical analysis. Cross-tabulations were conducted for categorical variables to compare levels of agreement. The weighted mean was calculated to measure overall perceptions on specific questions, with results interpreted based on whether scores fell above or below the weighted mean.

Constant comparative method of qualitative data analysis was used to analyse the data from the interviews.

4. Results and Discussion

Adequacy of Infrastructure for Design and Technology Subject in Schools

Learners revealed a concerning picture regarding the infrastructure provided for the Design and Technology subject in schools. The findings indicate a lack of adequate workshops, as reflected by a low mean score of 2. This inadequacy directly impacts practical lessons, which are core to mastering the subject. Similarly, the limited space in both workshops and laboratories was highlighted as a significant issue, as these facilities could not accommodate all learners effectively, resulting in low perception score (mean = 2). Interestingly, perceptions about classroom adequacy were highly positive, with a mean score of 4. Learners believed the classroom spaces could sufficiently support their learning, though with limitations in resources for hands-on activities. A critical revelation was the absence of libraries, as unanimously reported by all learners (mean = 5). This gap not only limits access to supplementary resources but also underscores the lack of holistic academic infrastructure, which is essential for fostering independent learning.

Table1.1. *Perceptions of learners on the Infrastructure for the Design and Technology Subject in Schools.*

Items	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	σ	Decision
We have enough workshops for DT	19 (29.69)	31 (48.44)	11 (17.19)	2 (3.13)	1 (1.56)	1.984	0.864	Low Perception
We do not have enough laboratories	-	-	-	21 (32.81)	43 (67.19)	4.672	0.473	High Perception
We have enough classrooms for DT	-	-	-	37 (57.81)	27 (42.19)	4.422	0.498	High Perception
Library is not available	-	-	-	-	64 (100)	5	0	High Perception
Spaces in the workshops accommodate all learners	06 (9)	45 (70)	02 (3)	08 (13)	03 (5)	2	1	Low Perception
Spaces in the laboratories for DT do not accommodate all learners	41 (64)	08 (13)	-	06 (9)	09 (14)	2	2	Low Perception
Spaces in the classroom for DT accommodates all learners	-	-	02 (3)	13 (20)	49 (80)	5	5	High Perception
Spaces in the school library does not accommodate all learners	-	-	-	28 (44)	36 (56)	5	1	High Perception

Key: *SD = Strongly Disagree, D= Disagree, N= Neutral, A = Agree, SA= Strongly Agree.* σ *= Standard deviation*

Decision (weighted average) $= \frac{29.672}{8} = 3.709 = 4$

Through interviews, it became evident that the workshops designed for Design and Technology were deemed inadequate. Thus one teacher said that:

> *For the workshops, in terms of if you want to carry out practicals, with learners; the rooms are not adequate because the rooms that were meant for workshops were turned into classrooms. So we only have one workshop at now which is working as a work room and we have a lot of things to keep as items we make as artifacts as well, which make it inadequate for the teaching and learning of Design and Technology subject. We do not have adequate rooms for Design and Technology subject for us to do practicals, so I can say the rooms or work rooms are not adequate for the learners. The dimensions for the rooms are just very okay, but the room that was meant for the workshop has been turned into classroom, hence we only remained with one workshop against all the components of the subject. The same room we are supposed to keep our materials for practicals is the same room that the children have to use for learning, which is what makes not to be adequate for teaching and learning as well as practicals to be conducted. We do conduct practicals, but the space is not adequate to accommodate learners and other things inside (*TR2 A).

The inadequacy of workshop facilities poses substantial challenge to the comprehensive implementation of the Design and Technology subject. Thus schools that do not have adequate infrastructure for the subject face challenges when it comes to the practical teaching and learning as learners are most likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of the practical skills essential for their learning process (Valerie, 2014, Paliwe, Siphelo, Veronica and Maria, 2015).

One teacher from school C submitted that:

> *We have the workshop for the subject. But I feel it is not conducive to teaching and learning about Design and Technology. It was initially a classroom which was later turned into a workshop. I therefore feel the room was not meant for a practical subject like Design and Technology subject. Therefore, I would say it's not so adequate for the teaching and learning of the subject. The classroom is small, so I would not say the space is enough because imagine all what our learners come up with are kept in the same room. I wish these products or artifacts that our learners come up with have a spare room they are kept, and imagine it is the same room the teaching and learning of the subject take place. What I'm trying to say is that the room is so congested (*TR1 C).

The other teacher from school D also indicated that:

> *The way I see it, we do not have a workshop fit for teaching and learning the components of the design and technology subject in school. Before the introduction of the Design and Technology subject at this school, the workshop was meant for a single component of the subject, which is wood work. I'm saying so because of the availability of the tools for wood work found in the workshop, most of the tools are for wood work there. Now, the workshop is not adequate. By not adequate I simply mean that it is very small for all the 3 components of the subject. Imagine, it is the same workshop where the teaching and learning of the components of the Design and Technology subject take place, it is the same workshop where we store the artifacts, it is the same workshop the benches are. I can simply say the workshop do not have enough space for an effective teaching and learning of the practical subject (*TR3 D).

Ignasia (2018) explained that when the workshops are not adequate in schools learners are likely not to be able to develop job oriented skills, participate fully in society, take control of their own lives, and continue learning. Thus Design and Technology education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of the Design and Technology subject can only be given to learners when the teaching is done similarly with the same environment, operations, tools, and machines as in the occupation itself.

Ayeni (2022) discussed that the condition of the school's learning environment has an important impact on teachers' effectiveness and learners' academic performance. Therefore, the quality of the learning environment has strong influence on the academic standard which is an index of quality assurance in the implementation of the Design and Technology subject in the teaching and learning process. The shortfall of workshops for the Design and Technology subject is likely to affect learners' readiness for future careers or higher education in Design and Technology. The inadequate workshops impede the development of hands on skills, creating a disparity between theoretical knowledge and practical application. Thus Okebuka (2016) explained that without adequate and appropriate structures to create a supportive infrastructural base, implementation of practical subjects including Design and Technology subject would be a mockery to learners and society at large. This is because the subject requires good and supportive infrastructural facilities and material resources for practical teaching and learning to help learners acquire knowledge and develop practical skills.

One of the deputy head teachers interviewed submitted that:

> *The workshop is there, but it was not meant for the Design and Technology subject. It is a classroom that was just turned to a workshop. On the workshop, I can simply say that it is just oke, only that the workshop is too small for the practical subject. All the same the teaching and learning of the Design and Technology subject go on well. But what I can say is that the space is too small inside and we are in the process of trying to put up a workshop with the recommended dimensions. This will motivate of course both teachers and learners of the Design and Technology subject. In short, the space in the workshop is not enough, it is a challenge because it is in the same space the teaching and learning of the subject takes place. Besides this, the tools, and other resources are kept there including what learners come up with or the artifacts. So, I would not say that the space in the workshop is adequate when I look at how squeezed thing are inside (*DHTR D).

Carbonilla (2016) also explained that schools that do not have the infrastructure for the Design and Technology subject are likely to face challenges when it comes to the practical teaching and learning of the subject because learners are likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of their skills. The inadequacy of the workshops compromises the implementation of the Design and Technology curriculum in schools. The condition of the school's learning environment teachers' effectiveness and learners' academic performance (Kekeya, 2014). Okebukola (2016) discussed lack of adequate infrastructure and large classes, as the major challenges to effective teaching and learning of practical subjects. Thus workshop inadequacy profoundly affects the implementation of the Design and Technology subject by impeding practical learning, curbing creativity, limiting exposure to modern resources, hinders practical skills development and eventually compromise the educational quality.

In trying to justify the inadequacy of the workshop for the Design and Technology subject in schools, one head of the practical subjects head of department said that:

> *For Design and Technology subject, we have just transformed one classroom into a workshop; therefore we just improvised the room for the subject. The design of the school was not meant for Design and Technology subject. It was meant just for ordinary school because where the school is supposed to have Design and Technology subject, the workshops should be designed for that. Now this secondary school was not designed for that. But all the same plans are underway to put up a workshop for learners who are doing Design and Technology subject (*HoD B).

One of the Education Standards Officers submitted that:

> *In terms of adequacy, I think they are fair as the case is in most of the practical subjects. They may have the basic workshops of the practical subjects. But I strongly feel that they are not adequate as required in an ideal set up (*ESO 2).

It becomes evident from the participants' viewpoints that the existing workshop facilities as inadequate. The inadequacy of workshops for the Design and Technology subject may limit learners' hands on learning opportunities. This is because workshops serve as an environment where theoretical concepts

are transformed into tangible creations. For this reason, the inadequacy of workshops limits learners' exposure to practical experiences, hindering their ability to grasp the aim of learning subject in schools. This is the more reason why David (2018) suggested the need for specific infrastructure such as workshops and classroom to support the effective implementation of the subject in schools to enable the exposure of learners to practical experiences, acquisition of relevant practical skills.

Adequacy of Space in the Workshops for the Design and Technology Subject

The data collected through interviews showed inadequate spaces in the workshops for the Design and Technology subject in secondary schools where the subject is taught. Thus one teacher from school B submitted that:

> *Since we only have few classes, each time a class comes into this single room, the space is not enough because we keep on changing since they are things that do not go well, you will find that others which are for system technology are found in the same room. Only the children who move out of the workshop and come back, but things are just kept under one roof. The space is not enough and we have decided that whenever the learners make a product, we allow them to buy so that we can create room and then the money that comes out there is used to buy other materials for other projects to be used, that is how we have tried to maintain the space in the small classroom turned into a workshop for Design and Technology subject (*TR1 B).

Figure1.1. *Design and Technology Workshop - Secondary School B*

Source: Field Work, 2023

At school B, one teacher was convinced that the space in the workshop was inadequate, thus indicated that:

> *So far, I think this school do not have a standard workshop, just a make shift that we have since I came I was just introduced to a workshop which is just a room turned into a workshop, though I believe that there is more to be done. When I look at the standard of the workshop maybe it was meant for a subject possibly wood work, where metal work and graphical communication go on. I do not see much of the metal work tools there, indicating it was meant for wood work. The workshop is quiet big, but by space I mean, there should be some areas designated for different subjects; metal work, wood work and graphical communication, but it is clustered into one area. Nowadays, we do not just teach wood work, metal work and graphical communication, we teach plastic, ceramics, composite materials we call smart materials. There are different materials involved. Now where you have metal work, wood work, it is not enough. That is why the space in the workshop is not enough for me (TR3 B).*

Schneider (2022) explained that the nature and the role of infrastructure in the teaching and learning of subjects are basically the enhancement of the knowledge acquisition and attainment of quality assurance. Thus school facilities directly affect teaching and learning of the Design and Technology

subject. The poor conditions of school workshops may make it difficult for teachers to teach and impart adequate practical education to learners. because the design innovation thrives on an environment conducive to creative exploration just like Matenda and David (2017) indicated that when pupils learn in an environment modelled after the workplace, they are likely to acquire not only trade related skills but also develop employable skills required to make an effective transition from school to work, an understanding of career development and planning, an understanding of the importance of becoming an autonomous, lifelong learner to adapt to the skills and knowledge needed in the future.

Successful implementation of Design and Technology curriculum directly relates to the availability and adequacy of space in the workshop in schools. The workshops are the enabler of the practical teaching and learning processes, this is why Chedi and Hamza (2019) explained that schools that lack appropriate workshops with ill equipped laboratories experience challenges in implementing the practical subjects schools. This reasonates well with Kukano etal (2020) that the learners' choice of learning practical subjects depends on the availability of infrastructure, physical facilities, equipment and trained teachers. Thus the inadequacy of space in the workshops hinder the effective implementation of the Design and Technology curriculum in schools.

Luhana (2021) indicated that vocational education can be efficient in proportion when the environment in which the learners are learning is a replica of the place in which they must subsequently work; therefore, effective implementation of the Design and Technology education can only be given to learners when the teaching is done similarly with the same workshops and operations as in the occupation itself. The small workshop spaces restrict learners' ability to engage in hands on learning experiences. Therefore, the insufficient room of the workshop impedes learners' ability to explore with the tools, materials, and machinery. This limitation compromise learners' ability to work or construct their projects, and eventually constrain the scope of their practical learning experiences. Dasman (2017) explained that the inadequacy of space in the workshops for Design and Technology subject curtail creativity and innovation in learners. This is because space constraints impose boundaries on creative exploration as the subject often demand ample space in the workshops. When confined, learners' ability to experiment with diverse design ideas and fabrication techniques is stifled.

Valerie etal (2014) explained that learners need to benefit from what the good infrastructure can offer to the teaching and learning of practical subjects. The schools that do not have adequate infrastructural space for Design and Technology subject face challenges when it comes to teaching and learning because learners are likely to be denied the opportunity for practical acquisition of knowledge and development or improvement of their practical skills. The infrastructural space is an integral component of the learning and teaching of Design and Technology subject in schools. Todd and Dunbar (2018) explained that the context in which the Design and Technology subject is taught should be conducive for the teaching and learning. Therefore, the dimension of the workshop for the subject should be designed in such a way that it allows for a free exchange of ideas, thoughts and skills to achieve the expected educational goal by considering the physical and psychological needs of the learners.

One of the HoDs interviewed from school C said that:

> *The space in the workshop is not enough for the learners because there are many children who are showing interest in the Design and Technology subject, and the workshop is too small to cater to 50 learners per class who are doing the Design and Technology subject. You know Sir! There is an issue of having benches and tools in the workshop, so the workshop itself is not very big. No wonder we have just put them in groups during practicals to carter for everyone or every child who is doing Design and Technology subject. During the time of doing practicals, we put them in groups after doing the normal teaching since the room is too small to carter for every child. The same room is used for other non-practical subject (*HoD C).

Furthermore, in trying to justify the inadequacy of the workshops for the Design and Technology subject, one HoD from school C indicated that:

> *The workshop is there at this school, but I feel that it is not very adequate for the teaching and learning of the Design and Technology subject. Due to the inadequacy of the classrooms, other non-practical subjects are taught in the workshop. You would*

> *find the other furniture not supposed to be in the workshop is found there. When it comes to space in the workshop, the room is so congested because of the fact that it is in this same room where the teaching of metal work, wood work, electrical and graphical communication takes place. The place is so congested with also what learners make and other resources for the subject. The space is not also adequate as expected on how a standard workshop for the practical subject should look like (*HoD C).

Figure1.2. *Design and Technology Workshop - Secondary School C*

Source: Field Work, 2023

Another Education Standards Officer revealed that:

> *The space is not adequate. Most of the workshops that we have around the district are classrooms, and a classroom space is not adequate for workshop's space because once the benches have been put there, it means only a limited number of learners will have to access those working benches. So that hinders somehow the learning in that learners who can access those resources will be limited, and they have to exchange. The situation would have been better if bigger workshops were to be constructed just for that purpose so that when a bigger number of learners goes to the workshops, the teacher will be able to attend to so many at a go (*ESO 2).

The study established that with the presence of desks, other information subjects were taught in the same workshop meant for Design and Technology subject as shown in figure 1.3.

Figure1.3. *Design and Technology Workshop - Secondary School D*

Source: Field Work, 2023

The responses from the participants indicated that the space in the workshops for the Design and Technology in schools was inadequate. This is why one head teacher pointed out that:

> *We have the workshop in place for the Design and Technology subject. But I would not say that it is adequate considering the number of Design and Technology subject learners that we have. The adequacy in this case can be in terms of how big the room is where the teaching and learning of Design and Technology subject takes place. What I can say is that the room is small and we definitely need atleast a bigger workshop for the subject that can accommodate a bigger number of learners including machines and other artifacts Design and Technology learners come up with (*HTR B).

Olagboye (2014) viewed utilisation of school infrastructure and learning environment as the extent of usage of school buildings. Thus, lack of infrastructural facilities and under resourced workshops are directly associated with the failure to acquire and develop expected practical skills and low academic performance of learners in Design and Technology subject. The workshops for Design and Technology subject in schools should be a replica of the working environment such as industries; workshops trained personnel apply their acquired knowledge and skills (Roberts, 2015; Paliwe, Siphelo, Veronica and Maria, 2015).

Robert (2015) explained that the learning context establishes the foundation for the development of the learning expectations and learning processes for learners. Thus the context should be a replica of the working environment such as industries and workshops where trained teachers should apply their acquired knowledge and practical skills for effective implementation of the subject. Puyate (2014) argued that no practical teaching and learning can occur without adequate provision of learning facilities such as workshops, textbooks, classrooms, tools, and equipment. Thus practical education cannot be complete without adequate infrastructural space. The successful and effective implementation of Design and Technology subject requires enough space in workshops and a lot of teaching and learning resources. The teaching of the subject should not just be looked at in terms of its desired possible results or benefits, without adequate workshop space, teaching and learning of Design and Technology subject is likely to be as theoretical as academic ones. The lack of adequate space in the workshop affect the quality of the subject implementation as rote learning is promoted, instead of actual practical performance (Odu, 2020). Thus, the quality of the school buildings and adequate provision of the resources facilitate teachers' instructional task performance and learners' learning outcomes.

The nature of the workshop where the Design and Technology is taught at secondary school A had limited space as shown in figure 1.4.

Figure1.4. *Design and Technology Workshop - Secondary School A*

Source: Field Work, 2023

One of the deputy head teachers was convinced that the space in the workshop for the Design and Technology subject was inadequate. This is why he revealed that:

> *We have a workshop which was initially a classroom. Now, I would not say the workshop is adequate for Design and Technology subject at this school. The room was not specifically meant for the teaching and learning of the subject. What I can say is that the room is small but even if the room is not enough, the teaching and learning of*

> *the subject goes on. Considering the number of components that make up Design and Technology subject, I think the space is not adequate. The teaching and learning resources for all the components are kept in the same room. You can imagine in a small room is not conducive for the subject to be taught well (D*HTR C).

It was observed that the workshop at secondary school B was congested, hence space reduction as shown in figure 1.5.

Figure1.5. *Design and Technology workshop – Secondary School B*

Source: Field Work, 2023

The Education Standards Officers who were interviewed also revealed the inadequacy of the space in the workshops for the Design and Technology in schools that teach the subject. One of the Education Standards Officers said that:

> *The nature of the subject needs an environment which has enough space. Now, when you talk of space, it is very inadequate especially with the advent of free education. Free education has brought about over enrolment, so because of that, the space in the workshops is not adequate (*ESO 1).

Puyate (2014) explained that no practical teaching and learning could occur without adequate provision of learning facilities such as classrooms and workshops. The practical teaching and learning cannot be complete without adequate facilities. Thus, the successful and effective implementation of Design and Technology subject require adequate workshops in place. The study found that space in the workshops for the Design and Technology subject in schools was inadequate. The inadequacy of workshops for Design and Technology subject constrain the creativity and innovation among learners. This is because the heart of Design and Technology subject lies the cultivation of creativity and innovation for learners. Ebenechi (2016) discussed that workshops are the playgrounds where learners should experiment and bring their ideas to practical sense. Inadequate facilities curtail the scope of exploration, and confine learners to restricted set of tools or materials. The shortage of workshops is therefore a great challenge that affects the practical teaching and learning of the subject. The inadequacy of workshops compel the implementers of the curriculum to change their Ayeni (2022) explained that the nature of infrastructure in the teaching and learning of the Design and Technology subject is of great importance in the development and making of learners. The workshop inadequacies are therefore likely to make teachers to adapt the Design and Technology curriculum to accommodate the limitations. The adaptation might reduce the emphasis on hands on experiences and eventually compromise the depth of practical learning of the subject.

5. RECOMMENDATIONS

i. The Ministry of Education to upgrade existing workshops and build new ones with sufficient space to accommodate all learners, teaching and learning resources and the artifacts learners come up with.

ii. The Ministry of Education should fund schools that offer Design and Technology subject to upgrade existing workshops and build new ones with sufficient space and resources.

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