Deconstructing student teachers' improvisation skills in a graphic material: A case of pre-service Bachelor of education students in a Kenyan university

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Abstract
Government policies exert a great influence on the path taken in curriculum development and implementation. One area which has received attention is that of instructional resource development and use.. There has been a trend towards improvisation of instructional resources especially in developing countries where many issues stand against use of commercially sourced resources. Governments encourage teachers to improvise the media resources where applicable. However, teachers have not embraced the call wholeheartedly. There exists a large number who do not appreciate the essence of improvisation in teaching and learning. Even among those who have heeded to the governments' calls, there still exist loopholes in how the resources are developed. The researchers in this study sought to evaluate the student teachers skills in the improvisation of charts for use in the instructional process. Using qualitative methodology, a case study design was chosen. Document analysis was employed in data collection while thedata was analysed through thematic analysis. The research identified gaps in the student teachers' improvisation skills on the graphic material in varied dimensions.
Key Words*: Instructional media, technological pedagogical content knowledge, charts, graphic materials, media resources, improvisation.*

I.   Introduction

Teaching and learning resources hold a central position in the instructional process. Gould and Barentsen(2014), in the light of this view aver that indeed, materials take a third tier after learning outcomes and teaching strategies in the instructional process. Without them thus, the process is bound to have a chink. Every teacher should make effort to incorporate them in the teaching and learning process. These resources, if effectively used have the potential of arousing learner interest to the content, focusing attention, making understanding of content easy for the learner and aiding learner memory of what has been learnt.(Gould &Barentsen 2014 p.68.)In addition, they encourage good time management practices in the teacher during instruction, stimulate learner power of creativity, observation, reasoning and imagination , encourage active participation of the learner in the instructional process and promote positive values towards learning and living. The resources can also play a vital role in helping a learner develop the 21st century skills such as communication,   cooperation,   creativity   and   critical   thinking(Griffin, McGraw&Care,2012;Sampath,PanneerselVam&Santhanam,2011;Thungu,   Wandera,Gachie&Alumande, 2008;Agumba, Kipsoi, Misigo, Simiyu,&Ongek 2016, Agumba, Mwola,Mbiere&Akinyi, 2015 and Rao2011)

Generally the resources provide the learner with crucial vicarious experience upon which to serve as a springboard for learning. No wonder, Aggarwal (2013:155) observes that they are the stimuli for learning "why" "when" "how" and "where". They are indispensable in the instructional process. Their ability to appeal to our sensual organs makes them to promote effective and meaningful teaching. It has been established that the more sensual organs a resource appeals to, the more beneficial the teaching exercise becomes to the learner (Aggarwal 2013:Patel&Mukwa, 1993: and Romiszowski, 1990)

Technological pedagogical knowledge and technological pedagogical content knowledge are crucial in teacher understanding of instructional resources. Added to both pedagogical content knowledge, technological knowledge and pedagogical knowledge, the issue of teacher improvisation and use of the resources is given a

fillip. Sheminger (2016) brings out how this wide array of knowledge is helpful in technology enhanced learning. Both traditional and modern educational media are relevant in the classroom today. The former can be embedded in the latter to make learning meaningful and lasting. Coupled with adoption of a flipped classroom, teacher work will be easy and effective.

The traditional media still have a place in many classrooms in the developing world. In Kenya for example, logistical issues make use of some types of modern media out of reach to most teachers. Nonetheless, the government advocates for use of information and communication technology in teaching. Impediments such as power, skill and negative attitude of the teacher and poor learning environments have made it challenging for teachers to integrate technology into the curriculum. Tondeur(2019) cites lack of electricity, infrastructure and connectivity as some of the factors preventing teacher use of technology in schools in Kenya. They add that the training needed is complex while the resources needed for it are scarce. Large classes, lack of school leadership support and inadequate time are other factors they cite as presenting more challenges on teacher use of digital technology in the classroom. This is notwithstanding the fact that Kenya ,like many countries in the world has embraced the competency based education and training in its curriculum .This outcome based curriculum lays emphasis on digital literacy in learning hence technology enhanced learning with a biased towards use of vetted digital resources.

In Kenya, teachers use a wide array of instructional resources. Logistics make each school to settle on a resource which its conditions allow. Many teachers, due to financial constraints and power resort to use of graphic materials. Other factors such as ease of use and teacher familiarity have equally made the resources to come handy to most schools.

Generally instructional resources can be categorized into visual materials, audio materials and audio-visual resources. Other categorization have also been adopted (for example see Aggarwal 2003, Rao 2011 Brown Oke and Brown 1982, Ogula and Onsongo 2009, Sampath, Panneerselvan&Santhanam 2001 , Nasibi &Kioo 2005 and Gould &Barentsen 2014)

The graphic materials commonly used by teachers in Kenyan schools include: maps, charts, photographs, pictures, posters, diagrams, graphs, globes, cartoons and comics, and flash cards (Shiganga,2015). These materials are often represented on a plane surface. They secure learner attention by their attractive format and simplicity of layout. Many of these resources convey information or ideas through a combination of visual and/or pictorial messages.

A good graphic material should be judged against certain qualities. Sampath, Panneerselvan&Santhanam (2001) provides the following: boldness, simplicity, legibility, brevity, attractiveness and possession of adequate margins. They add that graphic materials should convey a single concept.

Charts whether manually or digitally made, are the most commonly used graphic materials in Kenyan schools. Patel &Mukwa (1993) define a chart as a combination of pictorial, graphic, numerical and/or verbal materials designed to present a clear visual summary of an important process or set of relationships. Charts come in different types. The nature of content and teacher preference is vital in the selection of the type of chart to be used. In Kenya charts are commercially sourced or improvised by the teacher. In some cases, under the teachers' supervision, learners can also prepare the resource. The government, nonetheless, encourages teachers to improvise the resources where possible.

There are various purposes of charts used by teachers to enhance learning. Aggarwal (2003) ,Sampath, Panneerselvm , Santhanam (2001) , Nasibi &kioo (2005) , Kasirikoi, Wachira , Mulusu (2008) and Agumba, Kipsoi, Misigo,Simiyu and Ongek (2016).They provide the following; bring out relationships through facts and figures, present material symbolically , summarize information, show continuity in a process, present abstract ideas in a visual form, show development of structure , stimulate thinking, motivate the learner, encourage use of other teaching and ,learning resources and as reference materials in future lessons. Charts can also be used to encourage cooperative learning hence help in attainment of collaboration which is one of the core 21[st]century skills.

 Teachers in Kenya, like their counterparts in other parts of the world, have incorporated charts in their classes to realize these purposes. They have done this despite the challenges that are associated with the resource. Some of which have revolved around poor preparation if improvised, too much content, poor use of color, time constraints, cost if used frequently and unsuitability for large groups (Mutoro and Muhati,2007, Okoth and Agumba,2011; Agumba , Kipsoi, Misigo, Simiyu and Ongek,2016;Thungu , Wandera,Gachie and Alumande,2008 and Githaiga, Maigut, Amaya, Maosa and Kurgat, 2008). Nonetheless the advantages of using the resource far outweighs the disadvantages. No wonder, this resource has held a pride of place in the Kenyan Secondary school landscape for over the years. We have also observed student teachersduring practicum use it more than any other instructional resource. Most of the charts they use are often improvised.

The idea of student teachers and teacher use of improvised teaching and learning resources is well embedded in both teacher education programs and government policy in Kenya. The Kenyan government has encouraged its teachers across the curriculum levels to improvise the teaching and learning resources. This has

made universities and other tertiary institutions which offer teacher education courses to emphasize this in their curriculum.

In Kenyan universities, improvisation of instructional resources is a vital component of a course offered on use of technology in teacher education programs.Varieties of technologies are covered in the course. All Kenyan universities which offer teacher education consider the course a core one in their programs.

Student teachers from time to time in their preparation for teaching make charts. Two courses, explicitly concentrate on this------------------ one is the general course on technology in teaching and the other is a course on media resources and micro teaching. These courses and other two more in the student teachers teaching subjects' education areas are covered before the student teachers proceed for the practicum. This makes the student teachers to be equipped with the requisite knowledge and skills to prepare and use a variety of technologies during the practicum and later in their teaching profession.

Charts, whether improvised or not, should possess certain qualities. Scholars concur on what should constitute a good chart. These include; bear a title , have a central idea standing out , contain accurate and authentic content, be simple and clear, be attractive to the learner, cater for learner individual differences and be large enough to enjoy ease of view by the learner (Nasibi and Kioo, 2005,Thungu., Wandera, Gachie&Alumande,2008 ; Rao,2011 and Agumba, Kipsoi, Misigo,Simiyu&Ongek, 2016)

These qualities should go towards any chart that is planned for use in the classroom. Aside from these, other considerations are of essence. Various scholars concur on the following in improvised charts; use of a suitable paper, framing the material, sketching the outline using a pencil, writing in pencil the details before adding ink, keeping the chart in good condition before and after use, selecting the information or idea to put in the chart, ensuring a good symmetry for the title and use of colours that bring out the idea behind choice of the chart clearly. (Nasibi& Kioo,2005; Thungu, Wandera, Gachie&Alumande,2008 and Agumba,Mwola,Mbiere&Akinyi, 2015).Ideally these should be irreducible minimums in any chart prepared for use in the classroom.

We incorporated these considerations in assessing the charts which were prepared by student teachers for use during the teaching practicum. The charts covered different topics, classes and subjects across the Kenyan school curriculum. The next section covers the methodology we adopted in the study.

II. Research context and methodology

This study arose out of the need to establish the link between theory and practice in teacher education programmes in the light of the Kenyan government policy on improvisation in teacher use of instructional resources in schools. Having gone through various courses on instructional resources in theory, an evaluation needed to be made on student teacher use of what he or she had learnt in preparation of charts. The resources as we have alluded to earlier, are commonly used by teachers in Kenyan schools. The focus of this study was not just to come up with what constitutes a good chart, but to provide a window into learning opportunities that fostered contemporary competency skills and knowledge that addresses the requirements of the 21[st]century such as creative and critical thinking, flexibility, emotional intelligence, adaptability and problem solving.

The researchers developed a tool which they used to evaluate charts that had been prepared by the pre-service student teachers across the curriculum areas during the practicum. Of interest were; layout, content, use of color, title and forms. Various aspects of these areas were explored in an effort to establish the quality of the improvised materials.

This study fills gaps on three fronts: theoretical, empirical and methodological. On the theoretical, it undertakes a step into a critical and contentious subject in the curriculum implementation process. Most empirical studies have dwelt on use of charts in the curriculum implementation process in schools and tertiary learning institutions; revealing a dearth of literature in teacher improvisation skills in the instructional resources. Finally on the methodological front, the study delved into the qualitative approach yet many studies in resource preparation and use have concentrated on quantitative and mixed approaches.

 A case study design was deemed appropriate in eliciting detailed investigation on critical issues on teacher improvisation of the graphic material. Casestudies have been noted to be effective in offering participants with a voice and exposing specific details (Tellis ,1997).Creswell (2013), opine that the case study approach best suits a within –site single program .Berg and Lune (2012) add that it enables a researcher to uncover the manifest interactions of significant factors characteristic of what is being studied. They add that it enables a researcher to capture various nuances, patterns and more latent elements which may be overlooked by other designs. An almost similar position is held by Mugenda&Mugenda(2012) who assert that a case study provides a systematic way of employing rigour in observing a broad range of factors within the selected case. Data collection was made through document analysis. The tool was developed by the researchers. In this study, the researchers were interested in evaluating student teacher improvisation knowledge and skills in charts which are a common feature in most Kenyan classrooms.Cresswell (2002) observes that charts have an advantage of being in the language and words of the participants who have given thoughtful attention to them. This study

was thus able to get more on teacher improvisation skills in the material. The choice of the document was based on the four criteria developed by Scott (1990) and reported by Flick (2009) which judges a document against authenticity, credibility, representativeness and meaning.

The participants included thirty student teachers who were attending a pre-service teacher education program at a Kenyan university. All the participants had gone through courses which prepared them for development and use of instructional resources in teaching. They thus had knowledge on what is required in the preparation of instructional resources in general and at the secondary school in particular. They were in a three-month teaching practicum in public and private secondary schools across the country. The participants were thus purposively selected because of being information-rich (Patton 2002; Berg and Lune 2012; Mertens,2015 and Cresswell,2013). This study was driven by the Kenyan government policy for improvisation of resources in the classroom across the curriculum levels.

A thematic analysis was adopted in data analysis. These themes were based on the critical areas that had been identified by the researchers in the tool used for data collection. The sub-themes were also based on the same. Cohen, Manion and Morrison(2013) observe that content analysis should proceed from the following steps:

- Sampling of texts
- Definition of the units of analysis (e.g. words, sentences) and the categories to be used for analysis.
- Reviewing the texts in order to code them
- Placing the codes into categories.
- Counting and logging the occurrences of words, codes and categories
- Application of analysis, and
- Interpretation of results.

During the analysis, a recursive process was adopted to bring deeper engagement and understanding of the data. Inaddition, being a qualitative study, the analysis was both simultaneous and iterative. Five main themes were identified;

i)Layout
ii)Content
iii)Title
iv)Forms(variety)
v)Color

From the five themes, sub-themes also emerged as is reported in the following section.

III. Results

Results for this study has been presented on the basis of the student teacher pedagogical content knowledgeon the graphic material on layout, colour, content, title, and forms (variety). They will be done through a combination of narrative style discourse and tables.

Findings have indicated that a majority of student teachers have gaps in their technological pedagogical and content knowledge of the graphic materials of interest to the study.

Lay-out.

Assessment of the student teacher technological pedagogical and technological pedagogical content knowledge revealed some gaps on lettering, drawing and pictures. Most charts had grammatical errors and poorly constructed sentences. This was noted in the title and body of the materials. Below are some of the examples

C1-He need a spokesperson where Moses escaped from Egypt.Hebecame a Jethro's shepherd and later married one of his daughters (Zipporah). God called Moses when he was looking after his father-in-law sheep.
C2- God promises of Abraham
C3-Formation of a rift Valley

A further assessment revealed other aspects of grammatical errors in the documents. There were many cases of wrongly spelt words and failure to adhere to use of capital and small letters in sentences. A few examples will suffice

C4-Vegetable(vegetation)
C5-Decending(descending)
C9-Compression forces(compression forces)
C16-The Atlantic slave trade

There was also poor use of prepositions e. g C16- a trans-Atlantic slave trade

On legibility, most of the documents had words which could be read with ease by the learners. The letters were large, bold and were mostly of the same font. Spacing between words and letters was also even. The sentences equally began well from the top left as they moved horizontally.

Assessment of the layout also concentrated on the design of the document. We found out that most of the documents were poorly designed. They were of poor symmetry. The content was not centred.Nonetheless, most of the documents adhered to consistency and style. This made them to make the learner get 'a feel' in how they were presentedin a simple, interesting and attractive approach. Most of the documents were also large enough to be observed with ease by the learners from all parts of the classroom.

Provision of margins in the document is another element of layout that is crucial. We sought to establish this in the documents from the student teachers. Most of the documents catered for this element.As a result, vital information stood out. The margins were adequate, well drawn and adequately covered the content of interest. The opposite margins were also identical in size.

Where the writing board is to be used, and this is what obtains in mostKenyan schools, provision for display of the chart on the board is essential. We assessed the document against this. Most of the documents did not explicitly provide for this. Many students, from the observation of the researchers during the practicum, always stick the documents on the board using celotape. However, this is an approach that is usually wrought with challenges as at times, the celotape does not stick the document thus forcing the student teacher to resort to use of unorthodox means such as holding the chart as he/she takes the learners through the content or asking a learner to help hold the material as he/she takes the class through the content. These desperate approaches have a negative bearing on learning.

Graphic materials should be attractive to the learner. This is the essence behind framing. We sought to find out whether the documents were framed. Most of the documents were framed thus enhancing their appeal to the eye.

The other issue of interest to us was the use of symbols. Weassessed the documents against this item. It emerged that most of the charts did not require the use of symbols. Those where the item was necessary, had it. A few examples will suffice.

C2-Had symbols showing the different language groups in Kenya. Each language group had a symbol to enable the reader interpret the information in the document with utmost ease.

C4-It had symbols which were in the form of numbers from 1 to 6 standing for the different language groups in Kenya.

However, there were some documents where symbols were necessary but this was not provided as our notes below reveal.

C-6The document had content on towns,routes, human settlements and territories.

C-21-Content was based on trade goods during the Trans-Atlantic Trade. These should have been well represented through symbols.

Keys are essential in charts. However, not all charts require keys. We assessed the documents against this item. Most of the documents assessed did not require a key. Nonetheless, those that did require it, had the item provided. This was true for example of C2 which had the key but had a symbol provided for two different information on language groups in Kenya. This was quite confusing to the observer.

C4 had a key but only concentrated on some aspects of the content and not others. e.g. ,although it provides a key for the language groups in Kenya, it leaves out large water bodies represented in the map such as Lakes Victoria and Turkana.There is also no uniformity on where to indicate the details in the key and the side to write the numbers given in the key.

However there were a few cases of the documents which should have had the element but lacked it.

C6 had content on the type of climate in Africa. This should have been catered for in the key but was not.

C21 On the Trans-Atlantic slave trade should have also been well addressedby a key to show the trade goods and routes. This was not provided.

Lastly on layout in the material, we assessed the element againstcreativity and innovation. Most of the documentslacked evidence of the element. Many had just been copied from textbooks in the respective subjects. A sample of our comments during the evaluation will suffice

C1-There is no element of creativity and innovation at all. Thecandidateappears to have just copied the content from a textbook in Christian Religious Education.

C1O-The chart is on office practice in Business Studies. No creativity and innovation noted. Student teacher has merely summarizedkey points from the textbook.

C11-No element of creativity and innovation. Student teacher has just transferred the diagram from achemistry textbook.

C22-No element of creativity and innovation. Student teacher has merely summarized what is physics and its branches. What is so creative in writing the meaning of physics on a chart?

Content

We assessed the presentation of the content in the documents. We looked at various parameters on this item. Evaluation was made on the nature, preciseness and friendliness to learner characteristics, simplicity, relevance to specific objectives, accuracy and brevity.

On nature of the content, we established that in most of the documents, the content wasneither attractive nor neat. The content was not also well illustrated as is recommended. Afew notes will suffice.

C4- The material is congested withcontent. This makes it clumsy hence not attractive or appealing to the eye. Even the illustrations are confusing. There is a line of dots running from Lake Turkana dividing Kenya into almost two halves yet no reason or attempt is made to let the observer interpret it with ease.

C6-Material is not attractive. It does not appeal to the eye atall. Some work is even written in pencil. How can a learner read this in a classroom?

We further sought to establish the preciseness and friendliness of the materialto learner characteristics. Most of the documents were precise and friendly to the learner. The assessment revealed that they were direct and to the point, friendly to the learner characteristics, within learner interest and ability and were neither offensive nor immoral to the learner.

C1-The content directly touches on the call of Moses thus direct and to the point as it is based on the specific objective. It is also friendly to learner characteristics and not immoral or offensive to the learner's social-cultural background.

The next area of content we evaluated in the documents was simplicity. Being a visual material and considering the element of instructional time, the material should enjoy a high level of simplicity for the learner to make meaning from it. On simplicity, we were interested on whether what is addressedhas been put in a simple and easy way for the learner to understand, whether it is illustrated, begins from simple to complex and is made in a simple and easy to understand language to the learner. Ourevaluation, from the sample of our notes below, revealed that most of the documents enjoyed high levels of simplicity.

C14-The chat is on the teaching of Kiswahili Linguistics. It begins well from simple to complex eg.Mazungumuzo(dialogue),Hadithi(story), ushairi(poem), Semi(proverbs), and then Maigizo(dramatisation). The language used is simple and within the learner level. Content is also simple in the way it is presented.

C12-The chart is on internal landforms in Geography. It has a simple content which learners can easily understand, begins well from simple(how the internal process begins) to the complex (how eventually the Rift Valley is formed) .The language used is within learner level and ability.

We further sought to establish the relationship between the content and specific objectives. Being related to the content of interest, the chart should facilitate the realization of specific objectives. It must thus be developed with this in mind. On this item, we were interested in how the content relates to the specific objectives, whether it helps in their achievement and whether the content covered a single (specific aspect of the content) or the whole content of interest to the learners. Most of the documents were relevant to the specific objectives. We subsequently present some comments we made on this item.

C2-The chart is on the topic emergence of Kenyan communities by the 19[th]century in History and Government. Content is relevant to specific objectives and can help in the realization of the objectives with ease. The content covers a single aspect of the topic- route showing entry of Kenyan communities by the 19[th]century.

In addition to relevance to specific objectives, we also investigated the accuracy and adequacy of the material. From our evaluation, we established that most of the documents were accurate and adequately addressed the content of interest. Most were also current hence up to date as the following comments made during our analysis shows:

C10-The document was on filing system in Business Studies. The content was accurate. It addresses adequately the aspect of content of interest- advantages of a filling system in the office. The content is equally up-to-date hence quite current.

C14-Content is accurate-it is in harmony with what obtains in the syllabus, addresses the sub-topic adequately as it is able to take the learners through the five branches of FasihiSimulizi (Oral Literature) in Lughaya Kiswahili. The content is equally up-to-date.

We further investigated the issue of brevity of content in the document. Our evaluation established that information in most of the documents failed the test of brevity. The information was crowded, covered a lot of content and failed to address only key or basic ideas on the content as some of our notes show.

C6-The information is crowded as lots of irrelevant content is found in the material. This makes the content to be detailed thus failing to address only key issues.-The routes taken by Abraham during his call by God from Ur to Canaan.

C4-The information is crowded. It is too detailed and veers into issues not directly related to the sub-topic. All communities in Kenya by the 19thCentury have been lumped in the material yet one community at time is what should constitute the sub-topic.

Colour

Colouring is vital in charts where its useis applicable. It adds beauty to the material thus making it attractive to the eye. We sought to establish how colour was used in the documents. A total of fourteen charts out of the thirty investigated lent themselves to the use of colour. Evaluation of the documents revealed that most had poor colouring.One was even shaded in pencil thus making it clumsy and less appealing to the eye. Many were over- crowded, colouring was not used with discretion and where adherence to conventional colour use rules was to be observed, it was disregarded. There were also cases of colour clash in most of the documents. A sample of our notes revealed these.

C2-In this chart in History and Government, colour has been used. However, the document is over coloured.Use of the colour blue has not been employed with discretion as the same colour has been used to show modern countries, routes of migration of Nilotes,Cushites and Semites. This is confusing the observer. Some parts have been shaded in pencil while the rest are in ink.

Title

Titles are important in graphic materials. They tell in a bird's eye view what is represented in the document. We assessed the documents against this item. Specifically, we were interested in its availability, size, attractiveness and design. Each of these areaswas investigated. The results revealed that on availability, most of the documents had a title which was also well spelt as a sample of our notes reveal.
C3-The title "The Bible" was available and well spelt
C9-The title "Significance of vegetation" was available and well spelt.
We also investigated the size of the titles in the document of interest to establish whether they were brief and to the point as is recommended. Our examination revealed that on this item, most of the titles were not brief and to the point. This is supported by a sample of our notes.
C27- Title is long and confusing- both the title for topic and sub-topic have been provided-''Demand and Supply" and " factors that influence demand for the product" The document bears two titles making a reader be at a loss on which is which?
C22-The candidate should have prepared two charts-"The meaning of physics" and "branches of physics". As it is, the title although brief, is not to the point as is recommended.
Instructional resources should be attractive to enable them catch the eye of the learner. The words used in the title should be catchy and beautiful besides being appealing to the eye. We assessed the documents against this item. Through the investigation, we established that most of the titles were not attractive. They lacked catchy and beautiful words that would have made them appealing to an observer's eyes. Our notes attest to this.
C 6-the title "Ancient World" is not catchy and attractive to make them appealing to the eye.
The last item on the title we investigated was design. We were interested to establish whether the title was put above the frame, begins with a capital letter, is written in capital letters, spacing is good, letters are of the same font and whether the title has a rhythm to enable it dance or stand out.
We further sought to establish whether the title grabs attention and if it is centralized. All these parameters made us to be able to judge whether the titles were of good design. From our findings, most of the titles were of good design. A sample of notes attests to this.
C -14-the title is well within the frame. It is written in capital letters and words are good and all the letters are of identical font. The title also stands out quite well, grabs attention and is centralized

Types

There are various types of charts a teacher may use during the instructional process. Various factors underlie teacher choice of type of chart to improvise for use. We sought to establish the types of charts improvised by the student teachers. Of interest to us was variety, dominance and types not made by the student teachers. The charts included pictorial, those having summarized words, diagrams and sketch maps. Out of these, those having a summary of the key points in the sub-topic were dominant. We thus concluded that student teacher improvisation of the material comprised mainly of a summary of the key points written on materials. No attempts were made to make graphs or charts having figures.

The table that follows gives a breakdown of the distribution of the document according to types.

Types	Total
Summary of key points in words	16
Sketch maps	4
Diagrammatic	8

Pictorial	2
Total	30

*Distribution of charts by types

IV.   Discussion and conclusion

In this article we have provided an insight into student teachers' technological knowledge in the development of charts as an instructional material. Varied aspects of their skills have been explored. Of interest to the study has been lay-out, content, colour use, title and forms of charts prepared by the student teachers for use in the practicum. These issues were explored in a multi-dimensional approach to enable them bring out the student teachers' skill in the development of the material.

The findings of this study show that the student teachers' technological pedagogical knowledge on charts as reflected in the skills shown is varied. Some aspects of the knowledge are positive while others are negative and needs improvement.

Charts need to be of a good lay-out. The analysis revealed that overall, the materials' layout was wanting. They had grammatical errors, sentences were poorly constructed, their design was of poor symmetry and content was not centered as is required. The documents also lacked provision for display. A close examination also indicated that, no attempt at creativity and innovation was made towards their preparation. These were notwithstanding the fact that in our analysis, the documents had good margins, were well framed and had both symbols and keys provided where applicable.

The findings on poor lay-out are consistent with studies undertaken in other parts of Africa and the rest of the world where teacher improvisation of instructional resources were found to lack creativity. Such studies include those ofAdu&Adu(2014) and Omosanya et al 2008 cited in Salami &Olotu (2014).

Lack of creativity and innovation in teacher improvisation of instructional resources warrants interest because this is one of the essential 21st century skills that teachers should go to great miles to help nurture in the learner. Moreover, Desailly(2015) observes, that creativity has benefits to both the teacher and learner. She avers that a creative teacher will challenge, engage and motivate learners while also making teaching relevant to the learner. To the learner, she opines that it is crucial in the development of essential academic and intellectual skills.

Our findings equally reinforce those of Salami and Olotu (2014) who found that science teachers in Nigeria had poor improvisation skills. The present study even though covered many subjects was able to bring out element of low quality in the student teachers improvisation of the charts in terms of checking for grammatical mistakes, provision for display and symmetry. Coupled with the issue of creativity, it won't be off the mark to adjudge the student teachers to have taken their work casually; otherwise, most of the weaknesses noted on the layout of the documents would have been mitigated. This made us to conclude that the student teachers improvisation skills were low due to their casual approach to the task. We reached this conclusion because we established that they had undergone through courses which should have made them be able to develop charts with a good layout as this was part of the processes they were taken through during their preparation for the practicum and eventual teaching profession. Having taken their work casually, the finding departs from that of Aina (2013) which found that teachers of physics in Nigerian secondary schools took improvisation of instructional materials seriously. Maybe, this departure may be attributable to the fact that the teachers in the two studies varied due to experience in terms of service in the teaching profession. Those in our study might have taken improvisation as something that was merely aimed at going through the practicum and passing examination hence paid little attention to the contribution of the resource to teaching and learning.

Our investigation revealed that the documents' content were accurate and based on the realization of specific objectives. They were also friendly to learner characteristics, simple and attractive as is recommended. These characteristics made them attract learner attention and be useful in the realization of the specific objectives. These findings contradict those of Abdu-Raheem and Oluwogbohunmi (2015) who found that pre-service teachers of social studies in Ekito state university in Nigeria during the practicum used instructional materials which were irrelevant . It is possible that the resources in the case of the Nigerian university were not improvised. The student teachers may have found this challenging thus resorting to any resource they may have come across. Where improvisation is made, a teacher is forced to critically look at the processes of coming up with the material and is unlikely to come up with an irrelevant resource.

Colour adds beauty to charts. This is why teachers are advised to coluor their charts where applicable. Unfortunately, our investigation revealed that the documents were wanting in as far as this is concerned. Colour clashing, use of colour without discretion, over -colouring and in some instances, shading in pencil, all made us to conclude that the student teachers' use of colour was poor. This made the documents clumsy hence not attractive. Cohen, Manion and Morison (2012) observes that colour in charts should be balanced with content harmoniously and that it should not scream at the observers. It is probable that the student teachers lacked a

variety of colours to choose from due to financial constraint as they are expected to use their money to purchase any material they use. Most schools in Kenya do not provide the materials either. We also established that the same applied to the universities where the students are trained and that even where they are provided, they are never adequate. This, coupled with lack of technological pedagogical knowledge may be the source of the problem. What makes this probable is the observation of OgbeandOmeka (2017) who found that both skill and training conspired against teacher improvisation of instructional resources in Nigerian secondary schools.

Every chart should have a title. This is what tells at a glance what the material is all about. Our investigation found the charts wanting in different aspects of this item. The titles were not brief and to the point whereas even the words were not catchy and beautiful. This is despite the fact that titles as opined by Sen(2011) should be like a fish bait: juicy, dance slightly and have a hook. She adds that to look juicy, it must contain strong colorful words: to dance, it must have rhythm and to hook your reader, it must grab attention. Unfortunately, the titles could not pass the test of Sen's qualities. Various factors may have informed this. The most probable could have been failure by the student teachers to put a serious thought on their improvisation task. Coupled with the culture of copying directly from textbooks, it is likely that some of the titles had been lifted from textbooks in the respective subjects. Lack of creativity and innovation may have equally had a hand. Otherwise, if the technological pedagogical knowledge and a little bit of creativity and innovation would have been mustered, most of these errors would have been mitigated.

Finally, our assessment of the types of charts improvised by the student teachers revealed a biased towards summarized content in textbooks. No creativity and innovation was put into consideration while improvising the materials. The student teachers seem to have gone for a cheaper option. This is why they gave a wide berth to other types of charts which would have equally enhanced learning. Our finding reinforces that of Bassey (2012) in Makokha (2017) which found that science teachers in Kenyan primary schools mainly relied on textbooks in guiding their learners through the instructional process. It is this tendency that made the student teachers to view everything in the textbook as the be-all- and end-all in the teaching process hence use the same to develop the materials. Otherwise, a critical reflection would have made them to widen the latitude in the variety of charts in their quest to improvise.

To conclude, there is a dearth of studies on student teachers' improvisation skills. Most of the studies have concentrated on use of the improvised resources (Adu&Olotu,2014;Shiganga,2015; Aina,2013;Ogbe&Omenka,2017 and Makokha,2017). We hope that this study will stimulate research in the technological pedagogical aspects of the instructional resources available for teacher improvisation in schools and colleges.

In line with our findings, we recommend that teacher education programmes scale up instruction on improvisation of teaching and learning resources. They should in equal measure, expose the student teachers to consistent practice on the same. This will make the student teachers horn their skills prior to going for the practicum and subsequent practice as professional teachers. On their part, the student teachers should exercise tact and care while improvising charts for use in teaching so that some of the weaknesses witnessed in the improvised resources may be checked.

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