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Utilization of Infographics in Teaching, Learning, and Assessment. A Case of Aljamea-Tus-Saifiyah, Nairobi, Kenya

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ABSTRACT
This study attempted to researchthe utilization of infographics in teaching, learning and it's used as a tool for assessment in teaching Biology in Class 3 And 4 of Aljamea-tus-Saifiyah, Nairobi, Kenya. The study also focused on the challenges in the utilization of infographics for effective teaching and learning. The study was guided by five research objectives; to investigate how is infographics utilized in teaching Biology, and the benefits of using infographics to enhance teaching. It also attempted to research in what ways infographics can be utilized in learning. The research also investigated whether infographics can be used as an assessment tool. Moreover, it inquired about the challenges in the utilization of infographics for effective teaching and learning. Solutions for effective utilization of infographics were also sought. This study was based on the theory of the Technology Acceptance Model (TAM) proposed by Fred Davis (1989). The Technology Acceptance Model (TAM) was one of the well-known models use to explain and study the acceptance behavior of the user. This model was chosen over several other models because this model focuses on the practical usage and application of the technology. The TAM theory assisted in establishing the effectiveness of infographics and proving a strong inclination of the users for infographics. This model assumes that when the user comprehend that a kind of technology is useful for them, and also user-friendly, they tend to use it. Hence, the study sought to inquire about the students' and teacher's perceptions of infographics and the challenges and solutions for better usage. The target population of this research was all the teachers and students of Aljamea. Six teachers and ninety-seven students were sampled for this study. Questionnaires were used as instruments of quantitative data to collect data from the respondents. While interview guides were used to collect qualitative data from the faculty members teaching biology in class 3 and 4. Quantitative data analysis was done through SPSS software version 23(2015). Ethical issues were duly met throughout the course of the study.

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I. INTRODUCTION

Effective teaching affects the learning experience of the student. In a survey conducted for 60 students, the student's described characteristics of a good teacher such as; empathy, knowledge for the subject, encouraging nature, eloquent in delivery, enthusiastic and well prepared. The survey could be further analyzed into four key disciplines; rapport, skill, structure, and load (Cross, et al., 1991).

Cross and Patricia (1991) give an analogy of teaching to a farmer. A farmer tries to understand the nature of the corps he is trying to grow and then determines the action plan upon the understanding. It is thus the teacher's responsibility to try to understand the nature of the students and their preferences and plan the teaching and learning experience accordingly.

Ho and Mitchell (1982) discuss the indicators of effective teaching and learning in a classroom. They propose that eye and head movements, smiles, frowns, nods, etc. can be considered as indicators of student receptivity to the learning experience. However, J. Brophy (1978) feels that the feedbacks took upon the visual responses sometimes is not very helpful, "perhaps even misleading"."Students who appear to be attentive may not be, and those who might appear to be inattentive may actually be attending. Mature students may be listening attentively and thinking through a problem even though they might appear to be gazing out the window or staring blankly at the floor"(J. Brophy, 1978).

A teacher should be an exemplar in exhibiting moral dimensions, which is vital for teaching the students. Moral dimensions represent "the real fiber of teaching". As these traits are not easy to measure, we tend to overlook them in the researches regarding effective teaching and learning. Those who are regarded to be "good" or "effective teachers", must show "not only pedagogical expertise but also moral expertise" (Strike, et al., 1992).

An exemplar teacher has a humanistic/moral framework to conduct the teaching. They consider "the meaning of student's lives, as well as their social and psychological development". The teaching is not confined only to goals, content, and skills, rather it concerns values and virtues (Williams, 1985).

Craik and Lockhart (2014) proposed three levels of cognitive processing and the proposed verbal behaviors with each: Level One is limited to the sensory aspects of attending to stimuli. This involves the auditory stimuli or the visual stimuli without differentiating. This serves as a prerequisite but does not ensure the progress towards deeper levels of understanding and processing.

Level Two attempts to relate the incoming stimuli with similar material previously learned. The learner may extract some degree of meaning in spite of the heavy reliance on immediate stimuli of information.

Level Three focuses on the progression to a deeper level of understanding. The student can make greater use of learning. The learner differentiates among subtle stimulus, he uses previously learned content or experience to initiate the process of analysis and associate prior learnings and then attempts to apply the expanded combinations of data for a broader meaning on the basis of the deep diversity of insights which have been produced.

The technological developments and advancements in the 21st century have changed the teaching, learning materials as well as forced the change in learning environments. The novel changes and growth of information technology emphasize the improvement of the approaches used by teachers and learners. The methods used in the academic environment need to be reassessed and modern techniques need to be infused in the academic environment(Ozdaml, et al., 2016).

The expectations from instructional methods have also increased such as accessinginformation, configuration knowledge, active participation in class, creative and critical thinking. The selection of content is also very important, the advancements not only require to focus on what to be taught? But also the time and skills involved in acquiring the knowledgeOzdaml et al., (2016).

The New Media Consortium stated that easy access to the internet, especially in higher education has led to an increase in the expectation level of the learners. The immediate access to global society via the internet is modifying the way of communication, information accessibility, peer interactions, and learning. To deliver the promise of affecting teaching and learning, the educational institutions are engaging in encouraging the education of visual literacy (Bicen, et al., 2017).

The society of the 21st Century is rapidly changing; thus the tools of emerging communication are also evolving. The intellectual development of learners through information and communication technologies has increased the challenge of digital literacy (Osterman, Reio, & Thirunarayanan, 2013). The utilization of visuals in all facets of human life is also increasing. As a result, the new generations need to have adequate skills of visual literacy to comprehend the visuals effectively (Hattwig, et al., 2013).

Visual Literacy's concept was given by John Debes in 1969. He defines visual literacy as a set of competencies that "enable a visually literate person to discriminate and interpret the visual actions, objects, and/or symbols, natural or man-made, that are encountered in the environment. Through the creative use of these competencies, we are able to communicate with others" (Welsh, et al., 2010).

Visual literacy training can assist in understanding the visual reading process of information. Dave Gray states that "visual literacy is about having the ability to read and write the visual information, visual learning, speculating and solving problems in a visual environment" (Duchak, et al., 2014). Burmark and Lynell (2002) view visual literacy as the persons' capability to comprehend and use visual symbols to make communication more efficient.

An infographic is a student-centered representation of information to help develop students' higher-order thinking skills, such as analysis and synthesis (Fowler, 2015). It may also be called as data visualization, information design or architecture of information.

The term "Infographics" was first used by Peter Sullivan in the 1970s for The Sunday Times. Later it developed into a more sophisticated field and widely used with the help of Adobe Flash Animation (Bicen & Beheshti 2017). Krauss (2012) Sees infographics as more engaging than the current methods of teaching and learning, and critical thinking as it represents data and ideas visually, in pictures, engaging more parts of the brain to look at a problem (Fowler, 2015).

The nature of the infographics inherent attraction, as people are drawn to visualization, colors and images. It can transfer knowledge about a certain topic more effectively and faster than linear text (Naparin, et al., 2017).

Theoretical Framework

This study is based on the theory of the Technology Acceptance Model (TAM) proposed by Fred Davis (1989). The Technology Acceptance Model (TAM) is one of the well-known models use to explain and study the acceptance behavior of the user. The model is based on social psychology theory as well as the Theory of Reasoned Action (TRA). TRA views that beliefs have an influence over attitudes, leading to intentions,

eventually generating a particular behavior. Davis (1989) introduced some key elements i.e. perceived usefulness (PU), perceived ease of use (PEOU), attitude, and behavioral intention to adapt and use the technology.

According to the theory, PU and PEOU deals with an end-user's perception and beliefs on technology and hence attempt to determine his or her attitude toward the technology, which, therefore, can predict his or her acceptance.

Perceived usefulness (U) is defined as the degree to which a user believes their performance will be improved by using the program. Perceived ease of use (EOU) is characterized as the extent to which the consumer assumes it will be effortless to use the program. Personal expectations are both U and EOU and are anchored to the system's specific beliefs held by users.According to TAM, U and EOU have a significant impact on the attitude of a consumer towards using the program (A), which is characterized as feelings of system favorability or unfavorability.System (BI) behavioral intent is modeled as a function of A and U. So BI must determine the actual use. Studies have consistently demonstrated that BI is the strongest predictor of actual use(Dillon, et al., 1996).

The TAM provides the basis for determining the effect of the external variable on internal beliefs, intentions, and attitudes. It also indicates that PEOU and PU are the two most important factors for predicting future usage of any system (Olushola, et al., 2017). The TAM establishes the relationship between humans and technology, It predicts the learners' acceptance and utilization of technology to acquire information (Durodolu, 2016).

II. LITERATURE REVIEW

The Utilization of Infographics in Teaching

This subtopic comprehensively deals with previously researched work that has been done on the utilization of infographics in teaching.

Ozdaml et al., (2016) performed a study in Cyprus to research the student's views regarding infographics for an anatomy lesson. They used a qualitative research method as their model. The participants had enrolled for Physical Education and Sports Department (PES) at Near East University. 140 students participated during a six weeks' educational period. The students were informed about the infographics before the study, then the infographics about the digestive anatomy were presented to them under the anatomy course curriculum. At the end of the course, a semi-structured interview form was conducted to get the student's views about infographics and infographic anatomy. 74 students out of 140 in the study stated that they were unaware of the term infographics prior to the study, 84 students stated that they had never seen prior to this study.

The students think that infographics provide more effective visuals than those used in traditional course visuals. They also stated that infographics in more understandable and satisfactory. They also think that infographics are easier to remain in minds, hence it is more effective. They also encouraged that infographics can be used in other subjects as well.

On the basis of this research Ozdaml et al., (2016) claim that the infographics are not only more effective but also have a higher retention rate in minds. This teaching method can transmit the information to increasingly widespread use, and the conventional form of lectures can also be delivered using infographics, thus making it more understandable.

Moreover, Bicen and Beheshti (2017) discuss in his paper titled "The psychological impact of infographics in education"researched in Nicosia, Turkey,that the infographics can be used to present complex information in a compact form. The infographics enable teachers to prepare various learning activities and summarize the units/lessons in order the engage students in better interaction. He proposes that in order to increase the visual communication skills of the students, the infographics can be prepared based on their visual knowledge and skills, such as expression, learning, and intellectual thinking capacities.

The paper argues that infographics can be used as an alternative tool and can also enable the students to illustrate their achievements in education. The instructors are researching ways to integrate the tools and how to satisfy the visual learner's needs, by introducing infographics in the classrooms. The educators are also attempting to utilize the infographic's power as the way of communication, by moving beyond the method of reading text and it's interpretation.

The book "The power of the infographics: Using pictures to communicate and connect with your audiences" written in Indianapolis IN, discusses that the infographics are reinforcing the comprehension speed of information, thus increasing the chance of sharing information via a wide variety of digital channels (Smiciklas, 2012).

The researcher has specified the infographics can be used in the classrooms to carry out discussions and share their studies with their classmates using social media platforms. Additionally, investigations have shown that visual communication also increases collaboration, engagement and the level of understanding of the students (Smiciklas, 2012)(MacQuarrie, 2012).

Infographics in education: Review on infographic Design Naparin et al., (2017)a study conducted in Perek, Malaysia, discussed that one way of handling large amounts of information in through visual. The infographics can transfer information more effectively at a faster rate than transferring information using pure text. However, this depends on the quality and presentation of the infographics.

The researchers investigated four databases from 2004-2016, a total of 55 articles were analyzed. The analysis showed that 30 articles discuss infographics, 18 discussed Infographics in the educational field, and 7 argued about infographics design. The paper specifically integrated two aspects of infographics, i.e. the infographics and the use and effectiveness of infographics in a classroom using a good design aspect.

(Baglama, Yucesoy, Uzunboylu and Özcan, 2017) conducted research in Turkey, they dissertate that the visualization of data has gained great importance in education. The infographics present information in a clear and abstract method, thus, it is regarded as an important tool in teaching mathematics. They argue that the use of infographics in teaching mathematics has become an important research question. Baglama et al., (2017) performed a study to provide an overview of the effectiveness of infographics in teaching the subject of mathematics to students facing mathematical learning difficulties. A qualitative study provided information about the facilitative role of infographics in enhancing the learning of students having dyscalculia, mathematical learning difficulties.

Whereas, Mohammadi (2017) performed a study investigating the effectiveness of infographics to teach the programming fundamentals on developing analytical thinking skills necessary for high school students. The study was conducted in the city of Makkah in Saudi Arabia. The researcher used a two-group quasi-experimental design for her research. 64 girls participated at the 1st Secondary School in Makkah. They were divided into 2 groups; 32 students in the experimental group and 32 students in the control group.

The educational infographics strategy was used to teach programming units to the experimental group, while the control group was taught the same unit using the traditional way of instruction. The researcher designed the analytical test to measure several of the analytical skills. The study results indicated the effectiveness of using infographics to teach the programming fundamentals on developing analytical thinking skills.

Krauss (2012) based his research in the USA, which Debates that the K-12 curriculum has traditionally skewed towards enhancement of student's sense-making. Infographics are an effective way to perform this task. Infographics represent data and ideas visually, engaging more parts of the brain to look at the problem from multiple angles and its relation to various elements. Infographics ask for an active response from the students, asking questions such as, "What am I seeing?" and "What does it mean?" as the old saying says, a picture speaks more than 1000 words.

However, Kamila et al., (2016) confers that infographics is a type of information visualization that uses graphic design to increase an individual's ability to identify patterns and trends. Kamila et al., (2016) researched in Ithaca NY, a case study was performed where 27 undergraduate students were randomly assigned to witness infographics. The finding concluded that there is a significant and positive correlation between the answers and the positive self-assessment of pleasure and enjoyment. The retention level of information was also significantly high, indicating that infographics can better support robust learning.

Utilization of Infographics in Learning

This subtopic comprehensively deals with previously researched work that has been done on the utilization of infographics in learning.

Harland (2011) researched in his paper *The Dimensions of Graphic Design and it's spheres of influence*, a study performedin Massachusetts USA, that diagrammatic models are visual representations of the information are essential to the thinking and teaching of a subject. Infographics are a combination of multiple visual elements, out of those elements are the diagrams. It has an organizing function, it makes ambiguous or complicated information clear, so the student is guided to the key points of a process, may it be structural i.e. diagrammatic or functional i.e. relational, enhancing his educational standard.

Design is thought to be the "in-between" realm that acts as a bridge between the knowledge and expression, keeping its own core values non-detractive. Design is also considered to be the "third way", incorporating and encompassing artistic as well as scientific thinking (Harland, 2011).

The researcher argues that the practitioners who have artistic inclinations place a high value on imagination and subjectivity and concern for "justice", whereas those who are motivated by the acquisition of "knowledge" seek objectivity, neutrality, and rationality.

Zande (2017) has researched in her paper Design, Form, and Function in Art Education, a study based in Ohio, she sees designing as a built-in skill in human beings. It allows one to organize, arrange, manage and discipline an unorganized or a chaotic environment. People are by nature inclined towards order and harmony to make sense and meaning or to control the surroundings. The study of design principles and processes could expand the students' ability to create and appreciate the elements of good functional design. The students can

also get an insight into the fact that our behavior is influenced through the visual stimulus which surrounds us daily.

She argues that designing is a multidimensional field of study. A designer i.e. the student in this scenario follows three stages in designing infographics for any subject; the problem stage, the creative stage, the solution. In the first stage, the designer identifies the situation and the parameters, analyzing the problems and objectives. The researches information regarding the problem.

In the second stage, the designer brainstorms and visualizes possible solutions. In the final development stage, the designer seeks the best solution Through evaluation, comparison and testing (Hubel, et al., 2017). After all the steps are completed the designer may be required to go to a previous step for further refinement of the solution (Todd, et al., 1996).

Fowler (2015) conducted a project in Washington on the basis of the student's exam results and their weaknesses in certain areas. The project required students, to identify and organism structure and behavioral adaptations, they had to explain how the animals survive in the environment and how animals have evolved over generations. The project involved the students in creating an infographic to explain the topic.

She confers that the infographics provided the students a vehicle for learning skills about how to filter the information, communicate using visual aids and develop creative presentations using technology.

Mini-lessons were conducted to assist the students to prepare the infographics, such as:

- Searching and evaluation of dependable sources;
- Features of a good infographic design;
- critical analysis;
- tips and tricks for using the software, which included lessons on Page size, background color, how to add shapes and photos and formatting;
- how a professional infographic presentation looks;

Fowler (2015) observed that a high percentage of the students demonstrated better results and proficiency than previous results. Likewise, the critical-thinking questions were also attempted with exceeding proficiency. She concluded that "the outcomes of the project are powerful because of their active role in learning".

Moreover, Krauss (2012) has done extensive research in the USA on the infographics and has listed infographic resources to assist students in preparing infographic, in her paper *More than words can say*, such as:

- Cool Infographics: www.coolinfographics.com
- Floating Sheep: www.floatingsheep.com
- Flowing Data: http://flowingdata.com
- GapMinder: www.gapminder.org
- GOOD/Transparency: www.good.is
- Infographics Showcase: www.infographicsshowcase.com
- Information Aesthetics: http://infosthetics.com
- Information Is Beautiful:www.informationisbeautiful.net
- The New York Times Learning Network:http://learning.blogs.nytimes.com
- Adobe Illustrator: www.adobe.com/products/illustrator.html
- Adobe InDesign: www.adobe.com/products/indesign.html
- Adobe Photoshop: www.adobe.com/products/photoshop.html
- Lucid Chart: www.lucidchart.com
- Google Spreadsheets: www.google.com/googled-s/spreadsheets
- Inkscape: http://inkscape.org
- Many Eyes: www-958.ibm.com/software/data/cognos/manyeyes
- Rhino 3D: www.rhino3d.com
- Science Pipes: http://sciencepipes.org/beta/home
- Tableau Public: www.tableausoftware.com/public
- Visual.ly: http://visual.ly/labs

The following can be referred to get tips in designing the infographics Krauss (2012);

- Edward Tufte (www.edwardtufte.com)
- Nathan Yau (http://nathanyau.com)
- David McCandless (www.davidmccandless.com)
- Hans Rosling (www.gapminder.org)

Klein (2014) based her research in Kansas, argues that the extended information and visual manufacturing calls for new approaches of information Presentation. Fry (2007), McCandless (2009) and Tufte (1987, 1990, 1997) have each advanced the knowledge and the need for growing visually compelling, lovely statistics. Statistics visualization is now a growing exercise amongst designers, artists, network scientists, mathematicians, cartographers, qualitative researchers, journalists, visualization architects, and educators. A google search of the term "Information Visualization" revealed forty million possible research answers.

Data visualization can include charts, diagrams, timelines, maps, *Word Clouds* and *infographics*. Word Clouds can be created with open online sources such as Wordle and Tag Crowd. The student has to copy and paste the textual content in a word cloud internet site, and the web site creates numerous arrangements of words, according to the frequency of those words. The presentation resembles a cloud-Scape. The greater the frequency of a word, the darker the font and larger the phrase. Word clouds have been used in multiple books as a tool for organizing visuals. *Textexture* is another open-source utility that creates word networks similar to Wordle and Tag crowd (Klein, 2014).

The student can explore a topic using compelling visuals and organizing data in order to educate and discuss the topic. Infographics include data represented in tree charts, scatter plots, tables, bubble matrixes, cluster bars, maps, stacked bars, pie charts, timelines (McCandless, 2009). Descriptive data also appear frequently, as well as quotes, bulleted text, and icons. The students can use the open-source websites given above, as well as the websites *Piktochart&Easel.ly. Visual.ly* is another good source to study and modify the multitudes of posted infographics.

III. METHODOLOGY

Kothari (2013) defines research design as a conceptual structure in which the research is conducted. It is considered a blueprint for the collection, measurement, and analysis of data. Moreover, the research design is a plan and structure of investigation, created to attain information and answers to research questions.

Ogula (2005)describes a research design as a plan, structure, and strategy of investigation to obtain answers to research questions and control variance. Additionally, the study design is the plan of action the researcher adopts for answering the research questions and it sets up the framework for the study(Kerlinger, 1973).

The Mixed Methods Approaches as discussed by Teddlie (1998) emerged in the mid-to-late 1900s, provides an alternative to researchers from the qualitative and quantitative research approaches. By applying the Mixed Methods Approaches, researchers incorporate methods of collecting or analyzing data from the quantitative and qualitative research approaches in a single research study (Creswell, et al., 2014).

A researcher when applying this approach collects and analyzes numerical data; which is a feature of quantitative research, as well as narrative data; a customary for qualitative data, in pursuit to address the research questions for a particular research study Teddlie (1998). The aim of applying the mixed methods approach is to "to draw from the strengths and minimize the weaknesses of the quantitative and qualitative research approaches"(Johnson, et al., 2004).

The study will be conducted using mixed-method research to collect and analyze quantitative data, as well as narrative data to research the utilization of infographics in teaching. Also, in what ways infographics can be utilized in learning, and whether infographics be used as an assessment tool. Furthermore, it will attempt to research the challenges in the utilization of infographics for effective teaching and learning.

IV. FINDINGS AND DISCUSSIONS

Possible Solutions to the Challenges in the Utilization of Infographics

The participants in the study were asked to express their views on the possible solutions they think for better utilization of infographics, via an open-ended question. The feedback received from the teachers and students is categorized and analyzed into themes.

The respondent's feedbacks could be categorized into the following broad themes; the following themes also encompass subthemes; some of the respondents consider giving frequent infographics assignments as a possible solution. While, a few of the respondents consider that proper guidance and awareness towards safe and secure online portals for infographics can be considered as a possible solution.

Furthermore, a number of respondents consider that tutorials regarding usage of online portals for infographics can be considered as a possible solution. Moreover, a few of the respondents consider better access to the ICT resources as a possible solution. The responses were analyzed, summarized and presented in figure 1

Figure 1: Respondents' views on the possible solutions for better utilization of infographics.

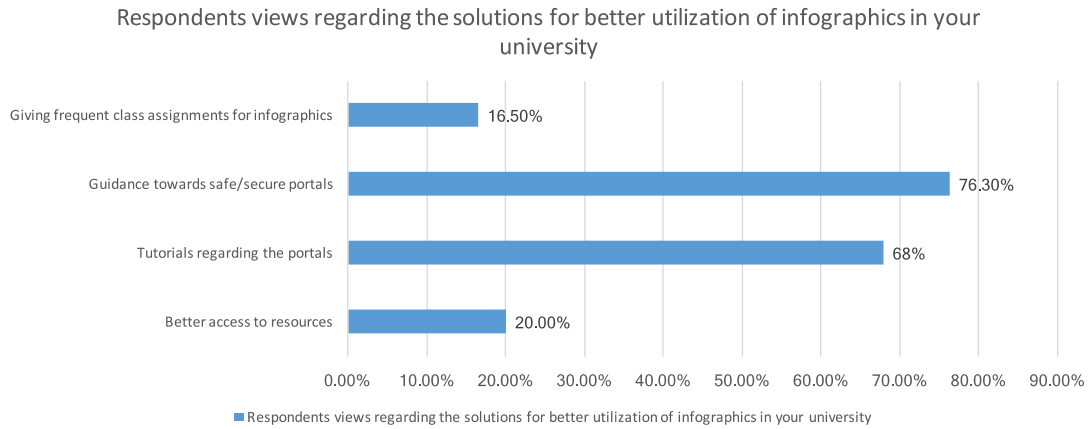

Figure 1 reveals that 76.30% of the respondentsthink that proper guidance and awareness towards safe and secure online portals for infographics can be considered as a possible solution. While 68% of the respondents consider that tutorials regarding usage of online portals for infographics can be considered as a possible solution.

Moreover, 20% of the respondents consider better access to ICT resources as a possible solution. Whereas, 15% of the respondents consider giving frequent infographics assignments as a possible solution.

One of the themes regarding possible solutions for the better utilization of infographics was that students can be given frequent assignments for preparing infographics, this way they will get better by practicing it. Also, the teacher should make sure to increase the student's awareness regarding visual communication skills. The teacher must attempt to giving them tasks to prepare infographics based on their visual knowledge and skills, expression, learning, and intellectual thinking capacities must be calculated.

One of the faculty members suggested that the teacher himself/herself can use the smart board in class and prepare a model infographic, this way the student will understand exactly what to do and how to do. The respondents also expressed their concern in regard to the instructions given by teachers, some of the students mentioned that they are unable to understand exactly what the teacher requires when he gives an assignment for infographics. Hence, if the teacher himself/herself prepares a sample, the instructions will be very clear.

Moreover, the teacher can also ask the student to carry out discussions and share their studies in the classroom with a classmate using infographics. This way, the visual communication also increases collaboration, engagement, and level of understanding of the students.

The collective teamwork will be very vital for better and effective utilization of infographics. This way, the students' ability to identify patterns and trends will also increase. The ability of positive self-assessment of pleasure and enjoyment will also enhance. It will also significantly increase the students' retention level.

Another theme that came forward was the suggestion of using diagrammatic models and asking students to combine multiple visual elements and structure the content by organizing the information and making ambiguous or complicated information more clear. The students could also be asked to identify key points and relationships among various elements.

The faculty members also pointed out the importance of maintaining quality when giving examples to the students. The level of the students must also be considered. The

Another theme that emerged was giving tutorials for better usage of the online portals. One of the faculty members recommended that workshops can be conducted by the IT department to guide the students and faculty respectively for better utilization of infographics. The IT team can increase the students' awareness of the importance of privacy and confidentiality, also guiding them towards safe and secure platforms for infographics.

Furthermore, the students also insisted that if they are provided adequate workshops regarding the usage of online portals, it may be very beneficial for them. Moreover, they suggested if tutorials can be prepared for each and every step and kept on their common drive in the computer lab, it will be easy for them to learn and do the practical application at their own pace.

The responses also revealed an appeal from the students and teachers to the IT department for assistance in this regard. They suggested if the IT department could assist students while they are working on the infographics in the computer lab, this way their problems and queries will be resolved immediately and it will be much more effective.

The faculty members also pointed out the fact that there are some queries that even they are not able to resolve themselves, hence, they desperately require the IT team's support in resolving those queries.

The students also recommended that as infographics also relates to the field of graphic designing, they suggest that if the Department of Arts in the university could be requested to do some workshops on the fundamentals of arts and design, discussing the key elements such as: maintaining balance, hierarchy, harmony, unity, font size, continuity, contrast, and alignment.

Some of the faculty members also suggested that the Department of Arts could also take workshops or tutorials for graphic design software, such as Adobe Photoshop, Adobe Illustrator, Adobe Indesign, Corel Draw. They recommended that if the students know how to use this software, they will not be required to rely heavily on the online portals to prepare an infographic, instead, they will be able to create their own infographics from scratch, using the tools already available in the software, also keeping in mind the design principles.

Another theme that was significantly common in the responses was to familiarize students with charts, diagrams, timelines, maps, word clouds, tree charts, scatter plots, tables, bubble matrixes, cluster bars, stacked bars, pie charts, etc. This way their creativity level will get enhanced and they will be able to easily convert content/information into an organized infographic.

Another theme which emerged was the necessity of utilization of infographics in both summative and formative assessment. The faculty members recommended that the students must be encouraged to use infographics in tests and exams. Moreover, they recommended that a student can be given more marks if he duly incorporated infographics in his/her answers. As infographics involve multiple cognitive skills, the usage of infographics in tests/exams could assist in determining the academic level of the student in a holistic manner.

A theme that commonly featured among the responses was the inability to judge the time consumed in preparing infographics assignments. The shaping of the assessment task, its purpose, timing have a very critical impact on the ability of learners. Hence, the time consumed in preparing infographics must be kept in mind when giving the assignment to prepare infographics.

Another theme that was evident in the responses was regarding adequate ICT facilities. The faculty members as well as the students, all had a very positive attitude towards ICT and endorsed its integration. The ICT facilities in the university are state of the art and of its kind. All the classes have been equipped with a computer, projector, and smartboard. Moreover, the specification of all computers is also very high. Furthermore, there are 2 computer labs for males and females respectively, also equipped with all the required equipment.

The responses of the faculty members and students revealed a common theme, they are facing difficulty in their timings for using the computer lab, they have trouble getting enough time to complete their work in the computer lab. The students recommend whether if the computer lab can add some flexibility to their schedule. Secondly, the students face queries while working on the computer.

One of the possible solutions which the faculty member suggested was if the administration for the computer lab can fix timings for the lab class-wise, that will be helpful to the students. Secondly, they affirmed that the IT team is very proactive and prompt in resolving the queries, if the IT department can designate one of their technicians in the computer lab, who could be present at all times in the lab, it would prove very beneficial and time-saving for all students.

Some of the faculty members' also suggested a certified teacher training program for ICT. They insisted that such training sessions will enable the faculty members for better integration of ICT in the classroom, as well as the effective adoption of infographics. The faculty members admitted that ICT raises the quality of their teaching and eventually student learning.

Moreover, the teachers suggested that if there is an ease of the booking process for the computer lab, it will be very beneficial for them and time-saving. This will allow the teacher to examine and assist each student personally.

V. RECOMMENDATIONS:

On the basis of the research conducted regarding the utilization of infographics in teaching, learning and assessment for the subject of biology in class 3 and class 4 of Aljamea-tus-Saifiyah, Nairobi, Kenya, the study proposes several recommendations which if acted upon, would lead to effective teaching and learning. Furthermore, it will help the students to score better in exams/tests and can be helpful for the faculty members for holistic assessments for students' cognitive, affective and psychomotor development.

The faculty members, teaching biology should ensure classroom activities for students regarding the preparation of infographics and also by giving group assignments as well as individual tasks. The teachers themselves must take the responsibility of guiding the students in each and every step required to prepare infographics, most importantly in identifying key points and organization of information.

The teachers must also use the smart board in class and prepare a model infographic, this way the student will understand exactly what to do and how to do. The respondents had expressed their concerns regarding their inability to comprehend exactly what the teacher requires when he/she gives an assignment for

infographics. Hence, if the teacher himself/herself prepares a sample, the instructions will be very clear and will act as a beneficial guideline.

The IT department must also ensure workshops regarding student and faculty awareness regarding privacy and confidentiality while using the online portals. Furthermore, the IT department must ensure the presence of technical teams in the computer labs at all times to assist the students in resolving their queries in time.

The IT department and the faculty members must also undertake the responsibility of preparing tutorials regarding the usage of inline portals, to ensure ease of access and maximum utilization by the students.

Moreover, the teachers must also seek the assistance of the Department of Art to conduct sessions regarding the fundamentals of art and design, this way the infographics prepared by the students can meet professional design standards.

Furthermore, the Administration of the computer lab must also adapt flexibility in their timings for the computer lab usage. The administration can either increase the number of computers or plan a fixed schedule for computer lab usage, class-wise.

The assessment board must also undertake the responsibility for the promotion of infographics by asking the students to prepare infographics in their exam; directly and indirectly. Also, the environment of encouraging the students towards infographics must be entertained. The teachers can use positive reinforcement techniques to encourage the students who exhibit their infographics, as thorough practice will enable them to enhance their skills.

Certified teacher training programs must also be endorsed by the university; this will enable better integration of ICT resources in the classroom. It will also lead to the effective adoption of infographics in teaching, learning, and assessment. The administration must arrange certified programs for the teachers to boost the teacher's positive attitude towards ICT.

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