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Using the Gestalt Principles of Visual Aesthetics in Designing E-Learning Graphical User Interface

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Abstract:
The application of visual aesthetic and instructional design strategy is one of the key factors in creating instructional contents. Aesthetics is seen as a significant feature on student feelings, and attitudes contributing importantly to learning. In online learning, the classroom is the website or Learning Management System (LMS) that delivers the teaching. Research has shown that learners seem more passionate about courses that have paid attention to aesthetic design in their contents delivery. The objective of this study has been to research and create aesthetic visual environments in e-learning through the application of expert standards and to explore the effects of those environments on student satisfaction and motivation. Qualitative research method was used to apply aesthetic criteria within the instructional design model process of Analysis, Design, Development, Implementation, and Evaluation (ADDIE). The study drew upon principles in the fields of usability, graphic design, information architecture, and cognitive psychology to examine learner outcomes and learner experience in order to surface principles for aesthetic considerations that can be incorporated into the instructional design process.
The focus of this research was not upon the technical tools used (e.g., the online delivery mode) but on the discovery of principles that apply to the online learning environment (such as interface, navigation, usability). Practical guidelines are provided through this study that higher education and instructional designers can adopt when designing and developing an online learning environment. With the enormous advancement in technology with the introduction of touch screens, virtual reality and mobile devices, instructional designers have the chance to explore the topic of aesthetics in online education.

Keywords: *Instructional design, Visual aesthetics, Educational content, E-learning, E-learning Graphical User Interface, Gestalt laws.*

1. Introduction

The emergence of information technology tools and new learning paradigms including student-centred learning, communities of practice, distributed cognition, situated cognition, everyday cognition and constructivism in general satisfies the "neo-millennial learning styles" of students (Liu, Cheok, Mei-ling, Thing, 2007). With these new forms of learning and education as well as the competence-oriented education, the continuous education, education at work, the collaborative education and the online education (Dascalu, Moldeoveanu, Dragoi & Balan, 2014), it has become imperative to adopt a system of educational delivery which goes beyond the classroom thus the adoption of online education which is rooted in the usage of technology to enhance teaching and learning which is commonly referred to as E-learning.

Advocators of aesthetics believe it has the ability to help students in their knowledge acquisition process. Levin (1981) points out that aesthetics in instructional materials must relate to at least one of the five visual elements namely decorative, representative, interpretive, organizational and transformative. Drawing from the research in e-commerce, Pelet (2010) talks about how web interface has an important effect on memorization and learning. Studies conducted by Clark and Lyons (2004), Lohr (2008), Mayer (2001) shows that aesthetics facilitates the cognitive process, thus Lohr (2008) recommend that instructional designers take visual aesthetic into consideration to enhance learning by integrating principles, actions and tools.

Research into the role of aesthetics and design plays in user experience of e-learning platforms is growing. These studies point out that quality content and user-friendly technology need to be adopted. Various issues have sprung up with the usage of e-learning platform and the primary concern is the user interface. Chan (1988) proposes that in a learning environment of traditional setting, aesthetics aids in enhancing student achievement. Additionally, aesthetics is seen as a significant feature on student feelings, and attitudes contributing importantly to learning. In online learning, the classroom is the website or Learning Management System (LMS) that delivers the teaching. Research have shown that learners seem more passionate about courses that paid attention to aesthetic design in its contents delivery. These comprise graphics, well-structured layout and creative means in the presentation of content (Hathaway, 1984). These aesthetics and technological features may be linked together to make learning more engaging and motivating. The user interface must therefore avoid such problems and must be deemed credible and trustworthy by the users with information clearly displayed and with no difficulty.

2. Background

2.1 Aesthetics and Instructional Design

The multimodal nature of collaborative technology and demand is discussed by Jenkinson (2009) as providing evaluative tools to help in capturing the learning process that happens when student interrelate with technology. This attentiveness to the learner experience should be studied further and attended to through the instructional design process. With the ever increase in research, new research seeks to understand the aesthetic aspects of human-computer interaction and to provide a balance between usability and aesthetics (Lavie & Tractinsky, 2004, p. 276). When considering the relationship of aesthetics and usability to user experience, it all relates to instructional design of the learner experience.

When the learning is viewed as an experience, it widens the area of instructional designers owing to the fact that it necessitates deliberations on the quality of that experience and not just its goals and system (Parrish, 2009, p. 512). As previously mentioned, Hokanson and Miller (2009) propose a new method for instructional design, which attends to the user experience through an "artist" role. This role, pushes for user/viewer experiences and aesthetics, the two areas with massive potential for enhancement in the field of instructional design. In addition, Alben, Lowgren (2006) discuss interaction design, a new field, as a good method of instructional design that is concerned with or attractiveness and emotion, and with the use of user interfaces.

Parrish (2009) sums it up nicely when he states that approaches in aesthetics in instructional design do not make the complications of instruction any easier; but they can support us come to terms to those problems in all their lushness rather than inspiring us to simplify and, possibly, misjudge them. Learning takes place when a change of literacy state happens as a result of some instructional encounters such as expected outcomes, as well as concerns about interface or textual design. Learning is a measurement of affective domain which includes feelings, attitudes, and judgments. From aesthetic sense, learning experiences and instructional materials are able to provoke student' emotions.

2.2 Gestalt Laws

Based on the discussions, ID researchers such as Levin (1981), Lohr (2008), and Parrish (2005, 2009) introduce the notion of visual aesthetics as a potential instructional strategy based on following characters. These characters have been considered as routine principles for designing visual content.

Visibility, affordance, feedback, simplicity, structure, consistency and tolerance constitute another set of the design principles that is presented by Stone et al *(2005)*. The principles proposed correspond to the well-known design guidelines by Nielson and Molich, and Shneiderman and Plaisant:

- The principle of visibility includes the Nielsen-Molich rules of "visibility of system status" and "recognition rather than recall", and the Shneiderman-Plaisant rule to "minimize short-term memory load".
- The principle of affordance corresponds to the Nielsen-Molich rules of "match between system and real world" and "flexibility and efficiency of use".
- The principle of feedback matches the Shneiderman-Plaisant rule to "offer informative feedback" and the Nielsen-Molich rule to "provide online documentation and help".
- The principle of simplicity constitutes the Nielsen-Molich rule of "aesthetic and minimalist design".
- The principle of structure corresponds to the Shneiderman-Plaisant rule to "design task flows to yield closure".
- The principle of consistency constitutes the Nielsen-Molich rule of "consistency and standards" and the Shneiderman-Plaisant rule to "strive for consistency".
- The principle of tolerance includes the Nielsen-Molich rule to "help users recognize, diagnose, and recover from errors" and "error prevention", and the Shneiderman-Plaisant rule to "prevent errors" and "permit easy reversal of actions".

The description of the principles introduced by Stone et al (2007)is comprehensive and clearly structured, which is why it is regarded as the base for further analysis and description. Accessible design is described via four principles: perceptibility, operability, simplicity and forgiveness (Lidwell et al., 2010).

3. Research Design

The research design used for the study was qualitative. The qualitative method was chosen for its ability to build a multifaceted, all-inclusive picture, analyse difference of opinion and conduct the study in a natural setting. Creswell (1998) describes the qualitative method as particularly useful when a topic involves human experience that needs to be explored. Additionally, Strauss & Corbin (1998) refers to qualitative research as a form of research study that findings produced are not arrived at by statistical methods or by means of quantification. The researchers describe qualitative research as being used in research studies as one that seeks to inquire detailed information about respondents' lives, experiences lived, actions, sentiments, and feelings and also about structural functioning, and socio-cultural activities.

Strauss & Corbin again explained that qualitative research provides the best option when the findings are: (a) consistent with the nature of the research problem and preferences of the investigator, (b) matches both the individual experience, and (c) used to explore little known areas. Miles and Huberman (1994) stated an additional view showing that qualitative research is directed to: (a) provide better details about findings that is previously known, (b) check findings of previous study on a topic, (c) to get a new viewpoint, and (d) increase the scope of a previous research. The above mentioned served as basis for the reasons the qualitative method was used for this study.

Phenomenological perspective formed the basis for qualitative approach in this study. As stated by McMillan and Schumacher (1997), the phenomenology perspective is the investigation of peoples' experience with a specific issue. The use of aesthetics in instructional design is a recognised practice that is an essential aspect of the instruction & learning process. Still, a need to explore how aesthetics impact on the online learning environment from a holistic perspective in addition to a development based research viewpoint.

3.1. Research Methodology

The methodology chosen for the study seeks to identify the best theories and principles, integrating these principles and theories in the modification of the Graphical user interface and evaluate the theories and innovation through formative and summative inquiry for subsequent revision and refinement.

Developmental research method used was a highly interactive and iterative process, each interaction sequence affording a reason for refinement, as shown in figure 1.

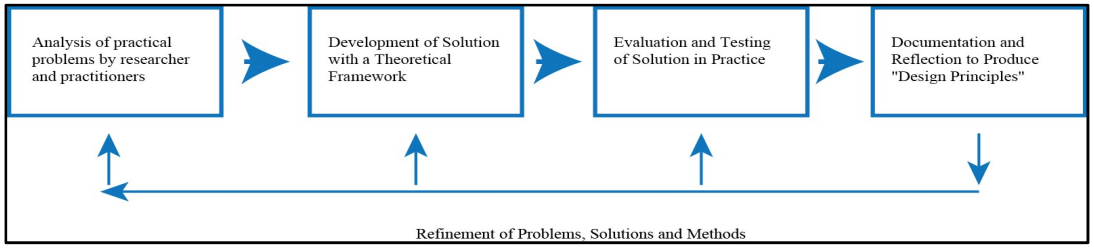

Figure 1: Pictorial representation of the design experiment approach

Four iterative phases were used in this study. This method calls for a variety of evaluation techniques to be utilized during the ADDIE phases. The outcome during the Design experiments method provided a holistic assessment of the Instructional Design process. Figures 2 shows a conceptual model used in the research design. This model built upon Seeto & Herrington's (2006) model. Using the ADDIE model as a framework to direct the research aided in giving the research construct validity.

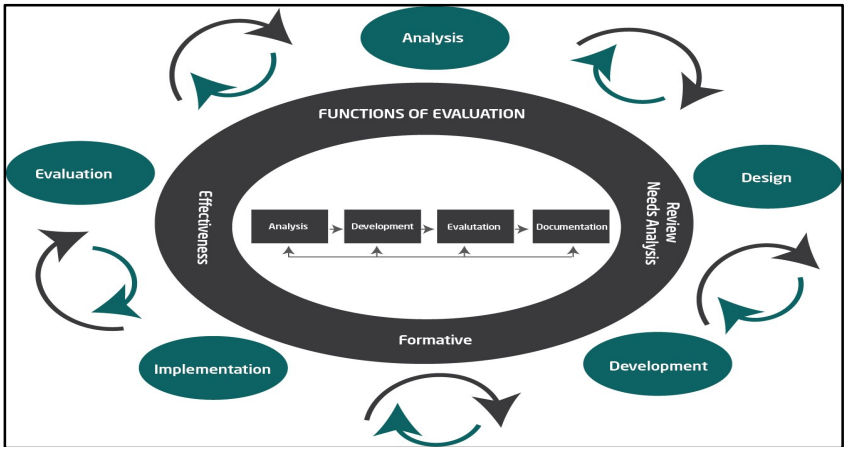

Figure 2: Pictorial representation of construct validity elements included in the research design

3.2. Purposive Sampling

The purposive sampling method a type of non-probability sampling was used in this study to select participant based on convenience of accessibility and proximity to the researcher, it will enable the researcher to answer the research questions that guided the study. Cohen et al. (2000) in describing the above-mentioned methods says the chances of the wider population being included in the sample is unknown, that is, not everyone has an equal chance of being included in the sample. This study also utilized an investigative, inductive qualitative method. This method did not have pre-determined guidelines or scope set for the course of this research (Trochim, 2001).

In order to get fair representation of the student population, proportional stratified sampling method was employed. The method employed constitutes a population with definite strata; each stratum is uniquely different which makes the strata heterogeneous in nature. Consequently, each category in the population is treated as a stratum, that is, it is important to identify a satisfactory sample size for a good representation of the population for study. Barton Essel (2011) opines that, the larger the sample, the better it is. He presented the following strategies for choosing a sample size:

- For a fewer population less than 100, review the entire population.
- For a population size is around 500, 50% should be sampled.
- If the population size is about 1500, 20% should be sampled.

Based on the population, the researcher selected 34 students, representing 100%, as the accessible population which is supported by Annku (2006) who stated that, the minimum percentage for any major research for a fewer population less than 100, consideration is 100%. This statement assertively authenticated the sampling and sample size.

3.3. Population

Participants for the study were picked based on the ADDIE instructional design model phases and the type of evaluation required, that is, each phase and the specific type of instrument and participant chosen, for example, in order to gain insight into the perception, the usage, design and aesthetics and test the usability of the final project throughout the ADDIE process, expert opinions and reactions of specific individuals' perspective were sought which included students, two instructional design technicians, an instructional designer and an Web design expert. It should be pointed out that the Researcher also performed the roles of Instructional Designer and a programmer in this research.

4. Presentation and Discussion of Findings

4.1. Analysis Phase

The analysis phase employed a questionnaire and interviews as instruments with the aim of identifying the needs for a modified Graphical user interface of the Virtual Classroom and understand the aesthetics and design gaps that exists. Dick et al, (2005) support this by saying it helps instructional designers to understand the reasons for the design and development of instructional material. The first instrument was an interview with the Web Design Expert, then a semi-structured interview with two technicians of the institute of distance learning KNUST, Kumasi. The following analysis were conducted during this Phase, which included;

- Analysis of needs
- Audience analysis
- Content Analysis
- Learner analysis

4.2. Design Phase

At this point, an open-ended interview "Design Module Discussion" was created for the Web Design Expert, Programmer 1 and instructional designer (as Principal Investigator). The interview was conducted before the prototype was completely developed. The purpose of the interview was to:

- Familiarise the Web Design Expert and Programmer 1,
- Approve the design approach,
- Instructional strategy approach confirmation,
- Determination technical approaches, and
- Study any foreseeable problems and limitations.

Design information from the Analysis phase and above-mentioned information led to the development of the prototype. The intention at this stage was to approve instructional objectives, assessments identification and instructional approaches, and in designing the final product. The development of the Prototype also forms part of this phase.

4.3. Development Phase

The Development phase was completed in ten consecutive weeks. Adobe Photoshop together with java phpstorm as the programming text editor which was used to develop the web based graphical user interface. At this stage programmer 2 (as Principle Investigator) used the prototype as a guiding principle in the development of a web-based Graphical user interface. However, during development some changes were made which increase the usability that were not completely explored in the

prototype. These opportunities offered an improved level of usability that helped to align the user interface nearer to the needs of the Web Design Expert and the KNUST IDL technicians. Knowles' four principles of andragogy in Instructional Strategies were adopted in the development of the web base graphical user interface which included; Knowles in 1984 proposed four guidelines that are useful to adult learning:

- Involvement of learners in the planning and assessment of their instruction.
- Learner Experience (including errors) give the basis for the learning activities.
- Learners are most involved in courses that have immediate importance and effect to their personal life.
- Adult learning is problem-centred activity rather than content-oriented. (Knowles 1984)

Formative evaluations provided information on how the user interface should be created and what modifications were needed before it was implemented at this phase. Feedback from the formative instruments provided the first iteration of "design-evaluate refine" cycle at the development phase. Formative evaluation was conducted after the user interface was developed, the formative evaluations were conducted. The reason was to collect information to create and improve the user interface before it is implemented.

4.4. Implementation Phase

One week was used to finish this stage. The period of time involved updating the web based Graphical user interface and moving files to the internet server after each of the alterations. It was basically involved of the Programmer 2 (as Principle Investigator) copying the Graphical user interface php files over to a web server. A web based user interface was created and a hyperlink was added to give participant access interface. Three technical considerations guided implementation of the web based graphical user interface, which included;

- *Who are the students?*

An important consideration during this phase was creating an interface that had the user in mind. Knowing this aided in answering all the questions and doubts that were encountered during the other phases and development of the final product. Various things were also taken into consideration including; the students' gender, academic level, distance, social and economic position, that influence them in their everyday life, positively and negatively.

- *The various stakeholders who use the system?*

Another major consideration was the role other users in assisting the final user (Student). Effective lesson planning and delivery of content onto the system was a major consideration, the system was developed to support ongoing communication between the stakeholders of the system.

- *The use of passive vs. active content?*

Two important types of content delivery were considered. The widely used one, passive content, which comes in the form of non-interactive media: videos, documents, slideshow presentation, images, and others. This content delivery method is essential in the learning experience, when internet access is a problem. Additionally, the use of active content was also taken into consideration, such as quizzes, the theory of gamification to help effective content delivery. Once implemented, content will be uploaded using a content management system that will enable facilitators to upload and administer their own content. Any coding is replaced with a user-friendly, point-and-click interface.

4.5. Evaluation Phase

Summative Usability Evaluation was conducted at this phase which comprised of heuristic evaluation and a survey for student, was administered to a group of students and the IDL technicians. The presence of aesthetics is subjective. Aesthetic appearance as a matter of fact is of a personal opinion and extent. Nevertheless, in such a way as to find some measure to evaluate if the application aesthetics for the creation of user interface was effective in this project, an informal test was conducted to obtain the opinions of potential student. This information gathering was essential since it afforded the chance for the student to make an assessment between the initial KNUST Virtual Classroom Graphical Interface and the modified Graphical User interface with aesthetics considerations. Responses from the student were varied but majority considered the modified Graphical user interface had a higher level of visual appearance. This view was reinforced when an assessment of the control Graphical user interface was conducted.

5. Element Distribution Using the Gestalt Law

5.1. Law of Similarity and Proximity

The usage of the same font and colours throughout the prototype adhered to the law of similarity. According to Lidwell et al., (2010, p. 226) the similarity law, the same elements are viewed as a single set, and are understood as being more connected than different elements; resemblance can be based on dissimilar features (i.e. form or size and colour). The proximity law means that elements near each other are viewed as a single set, and are understood as being more linked than elements that are far away (Lidwell et al., 2010, p.196)

Menu and navigations designed following the law of similarity, this same style showed proximity as elements looked similar together and performed the same functions. The laws of proximity and similarity are applied to indicate hierarchy among the items. Content items are of the same size and shape whilst titles are placed above and bigger, this is to distinguish

title text from the body texts. As a result, the intended content can be viewed faster by looking through items grouped according to their kind by the user.

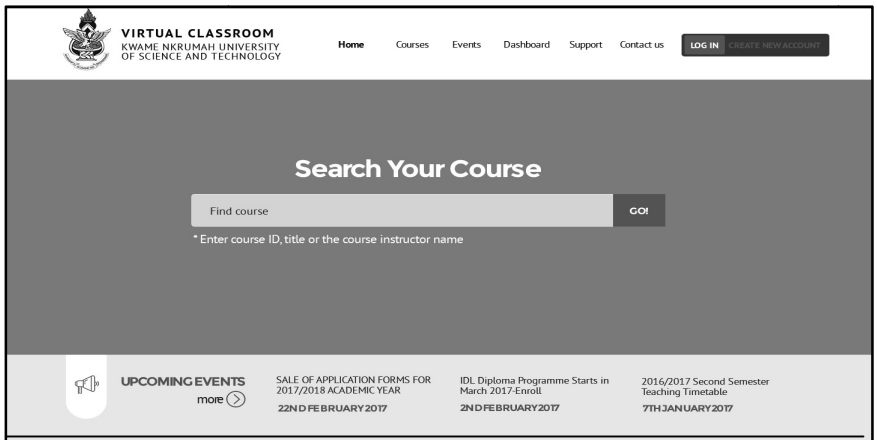

Figure 3: Proximity and similarity used for creating menu and navigation. Source: Developed by Researcher

5.2. Element Distribution Using the Gestalt Law of visibility

The law of visibility is grounded on the premise that individuals have a better way of recognizing solutions when choosing from a range of options than remembering results from memory (Lidwell et al., 2010, p. 250). Gestalt laws of visibility, is adopted with the use of submenu, instead of creating individual pages, the submenu makes it possible to view all the different pages on a single page.

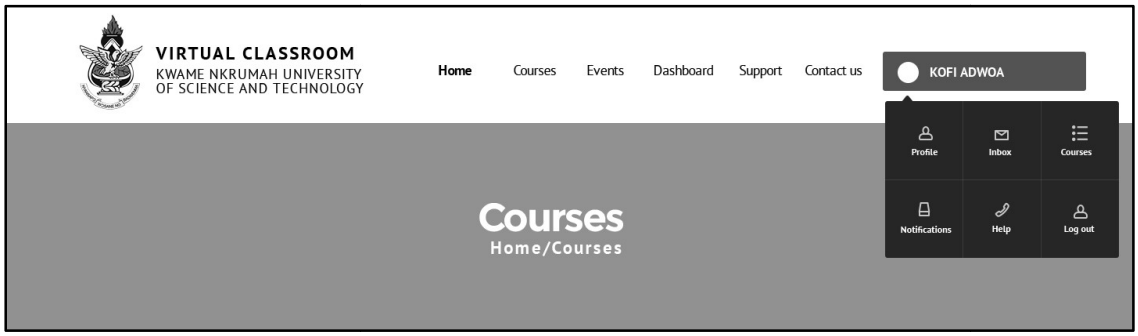

Figure 4: Law of Visibility used for creating submenu. Source: Developed by Researcher

Figure 5: Law of Visibility used for creating hyperlinks. Source: Developed by Researcher

5.3. Element Distribution Using the Gestalt Law of structure

Stone et al. (2005) propose that the layout of the user interface should satisfy the user's hopes and mirror their understanding of the layout. Structure needs are linked with principles of being simple, uniform, visible and accessibly. Visibility is enhanced by placing text and icons on attractive and contrasting background colours that lead to corresponding pages where users can easily access. This leads to a simplistic design with structure that create less obstacles for the user; buttons, body, headings of sections are legible and understandable.

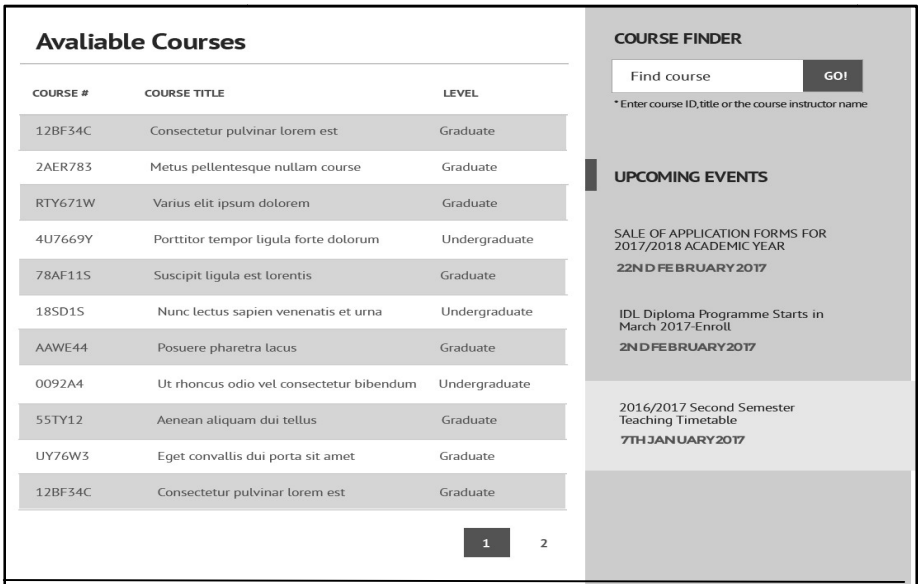

Figure 6: Law of Structure linked with the principle of being visible, simple, consistent and accessible
Source: Developed by Researcher

5.4. Element distribution using the Gestalt Law of Affordance

Affordance is described as a property in which the physical features of an item or environment have an effect on its function (Lidwell et al., 2010, p. 22). Affordance is supported in design when elements suggest the manner it is used (Stone et al., 2005). Placing all content on one page at once appears massive and requires a lot of navigation. The principle of affordance is used to design side bars clearly indicating the various sections available for the user to access. These are clearly positioned for users not to face any obstacles while browsing the pages. Course materials are clearly indicated with icons and text.

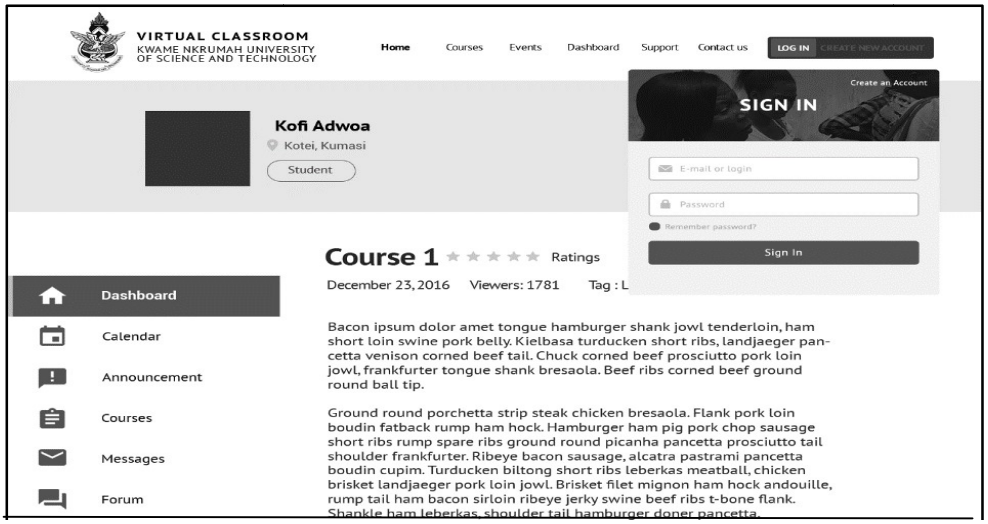

Figure 7: Law of Affordance side bars clearly indicating the various sections available for the user to access
Source: Developed by Researcher

5.5. Element Distribution Using the Gestalt Law of Symmetry

It is suggested by the principle of symmetry that the human eye categorises and interprets the information so as to make it simple and to give it symmetry (Johnson, 2014, p. 20). Evidence of symmetry in the structure of the pages and this helps the user to browse through the pages when searching for a specific information. Consistencies in the pages will aid the user to scan the page content efficiently. As an example, when the background creates context, while the information is added in the figure. Moreover, the figure/ground guideline is used in the projection of information dialog boxes with button, icons and images enhancing system reaction, directing the users' attention on the content.

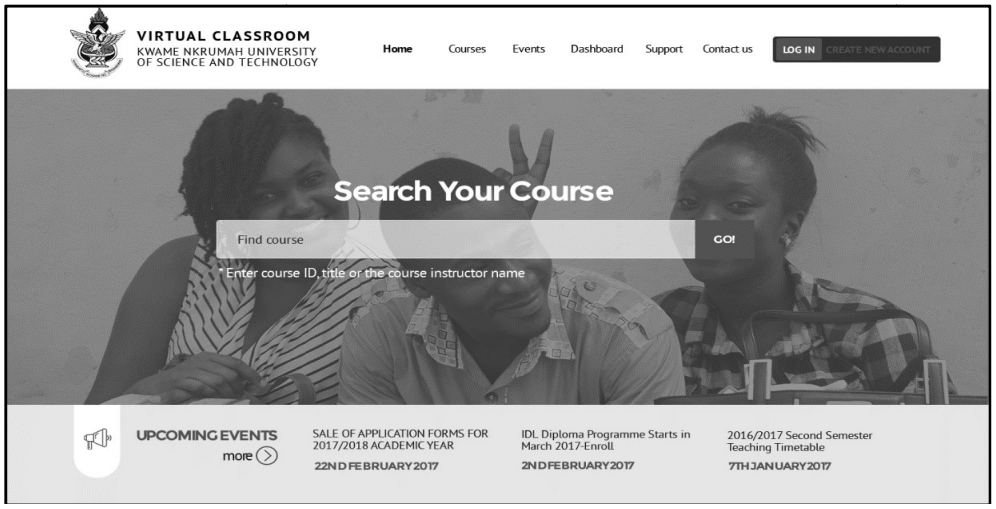

Figure 8: Creating with the background context, while information is added in the image. Source: Researcher

6. Discussion

The development of the user interface has been successfully implemented using the guidelines presented in chapter 2. The visibility law has been used in the planning of the navigational position of the menu and the element structures of the user interface so as to make them visible and available. How the user interface responsive matches the feedback law which has been ensured by differentiating between used, non-used, visited links and menu items.

Moreover, the pages' bear only essential features, by not including some audio-visual and heavy graphical content in order to reduce the response time of the interface. Affordance law has been applied to save space on layout design. The side bar menu, which is familiar for student, and arrows carry concepts that helps usability between the interface and users. The law of simplicity has been guaranteed through the use of the following features: using of a legible font style, a clear background that enables student to easily comprehend content irrespective of their hardware. The navigation menu titles are easy to understand, this enable each page to offer one activity at a time, allowing the student to focus on an activity at a time. The total layout of the interface is used to the student; thus, student can interact at ease.

The user interface is properly-arranged. The Structure of the interface is ensured by use of the figure-ground relationship and principles of proximity, similarity, symmetry on a graphical level. Furthermore, there is similarity in the colour, typography style and form. The structure of the pages is balanced from the perspective of symmetry and the elements are distinct from their settings forming context for the user interface.

7. Conclusion

Issues of aesthetics and design made instructional delivery and overall appeal of the LMS difficult. The golden ratio and section help create the layout for the entire user interface bringing together design elements thereby increasing the visual appeal. The distribution and arrangement of the design element was done using the gestalt laws which provided neat and well-planned user interface. Colour theories used ensured colour harmony, creating a better visual appeal to users. Users admitted spending less time on the control as compared to test Graphical user interface.

Users found it easier to identify information and perform tasks assigned to them and admitted spending less time on the control as compared to test Graphical user interface. Practical guidelines are provided through this study that higher education and instructional designers can adopt when designing and developing online learning environment. With the enormous advancement in technology with the introduction of touch screens, virtual reality and mobile devices, designers have the chance to explore the topic of aesthetics in online education.

The distribution and arrangement of the design element was done using the gestalt laws which provided neat and well-planned user interface. Users found it easier to identify information and perform tasks assigned to them. Colour theories used ensured colour harmony, creating a better visual appeal to users. Users admitted spending less time on the control as compared to test Graphical user interface.

Although it is possible to design a basic looking, easy to navigate user interface, visual cues are provided by using aesthetic principles. The role of aesthetics provides not how things appear but instead it is part of a bigger conversation on usability; the provision of an enjoyable experience devoid of mishaps and constant search for information. Credibility; the study suggested a higher aesthetic treatment of the content of a user interface indicated that a higher treatment of the content did suggest to the users of a higher credibility. Aesthetics provides a much better and improved learning experience.

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