New Media Technologies and Students' Creativity: An Analysis of Portfolio Website Concept Generation

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Abstract
This study analyses concept generation for portfolio websites using new media technologies for a third-year Web Design and Development course at the Department of Graphic Design, University of Education, Winneba (UEW). The focus was to examine the effects of technologies used to develop portfolio websites on students' creativity. Using New Heuristic Framework for Creativity Measurement (NHFCM) as a lens, the study analyses the developmental stages of hundred portfolio websites carried out by a hundred third year Graphic Design students at the Department of Graphic Design, UEW. The study from its findings revealed that the technologies used to develop the portfolio websites offered the Graphic Design students the digital platform to plan, record, refine and implement their ideas with no limitation. There was evidence to suggest that the Graphic Design students circumvented some of the concept generation processes for generating portfolio websites with technology. The study recommends the continuous use of new media technology by Graphic Design students to hone their creative skills since it supports concept generation. The study suggests against the circumvention of concept generation processes with technology by Graphic Design students to enable them to gain the total learning outcomes of the process.
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1. Introduction
New media technologies are widely used in every aspect of today's education. In higher education, they are dominant in the Graphic Design discipline. In recent times, Graphic Design educators have supported teaching with digital technologies to interact and inspire students to take a more active role in learning (Appiah & Cronjé, 2014; Adobe, 2009). In a similar vein, it has triggered a change in the way Graphic Design students experience learning. Design students use new media technologies to discover learning topics, solve problems and provide solutions to problems in their learning process (Brush, Glazewski & Hew, 2008, cited in Jo Shan Fu, 2013). Within Graphic Design, digital technology has become a game-changer for students, especially in concept generation. Digital technology avails electronic tools, systems, devices and resources that generate, process and store data. Concept generation in Graphic Design initiates a step-by-step approach for finding a viable solution to a design problem; it's an essential part of the design process which encourages creative thinking through its procedural requirements.

Conversely, Graphic Design students approach concept generation as if they had preconceived the solution itself and instead rendered it digitally. Educators see this approach as worrisome as far as digital technology is concerned (Appiah & Cronjé, 2013). This defeats the learning outcomes of concept generation in the context of graphic design education.

In a practical experience, this study focuses on creating a portfolio website with new media technologies by graphic design students at the Department of Graphic Design, University of Education, Winneba (UEW). The study was purposed to explore how students used new media technologies in the concept generation process that begot the portfolio websites and assess the portfolio websites using the New Heuristic Framework for Creativity Measurement (NHFCM). NHFCM is a taxonomic framework for determining creativity. This suggests a possible use for assessing the creativity of an individual or an organisation through a trait assessment, environmental influence, undertaken process or a product that the individual or organisation has produced using a measurement approach such as self-rating.
In this regard, the following objective was considered for the study:

    To establish the effects of new media technologies on students' creativity through portfolio
    website concept generation for a third-year course (Web Design and Development) at the
    Department of Graphic Design, University of Education, Winneba.

The course does not only consider Web Design and Development. However, it extensively relies on other Computer-Generated Graphic Design (CGGD) courses—such as CGGD (Drawing Software), CGGD (Photo Editing Software) (CGGD) Page Layout and Desktop Publishing students have undertaken. The exposure from these courses has their strengths tied to new media technologies in areas of software and systems whose functions are interrelated. This study is relevant as it justifies new media technologies' impact on creativity

through an empirical study.

2. Literature Review

2.1 New Media Technology

New media technology is defined as the application of skills and sound knowledge to create digital content forms such as image, text, sound and video for exhibition and distribution using computational devices and systems (Manovich, 2001, p. 43). Technology is a core of two primary components: physical and informational components. Physical components comprise equipment/machines, whilst informational components describe knowledge, principles, and skills (Kumar et al., 1999, cited in Wahab, Rose & Osman, 2012). It is impractical to conceive teaching or practicing Graphic Design without the components mentioned above. In the context of graphic design, a perfect example of the physical component is the computer. Most software applications meant for generating graphics runs effectively on the computer, and it helps graphic designers to work with ease. Wacom tablet, digital camera and scanner are additional examples of the physical components. They give graphic design students multiple ways to create and interact with new media content forms (Kelsall, 2001). These digital devices work in tandem with the informational components. Informational components related to graphic design refer to the principles and characteristics of new media technologies, skills for manipulating digital devices, and knowledge of design software applications. Acquisition of these two components aid the management of creative works, enhance creative thinking skills and nurtures artistic abilities of graphic design students through human-computer cooperation during concept generation (Lubart, 1990, cited in Alhajri, 2016).

2.2. Graphic Design with New Media Technologies

Contemporary Graphic design conflates design theories—such as design elements, design principles and concept generation techniques—with digital technology when it concerns resolving design problems. In Graphic Design, design theories and digital technology are interdependent (Porrit & Miller, 2004). This kind of synergy puts design students in a position to generate their design concepts, manipulate them quickly and refine them into a solution. Again, it creates an environment that promotes effective learning and creativity since digital media has little to no limitation. With the right application software, students' concept generation and editing capabilities are limited only by their capacity for thinking (Linda & Hershey, 2008). Now, design students are served with digital tools that blur some design limitations with automated processes and open routes to new ways and techniques for creating design works. Still, the need to explore the tools to give desirable results constantly lies on them (Ambrose & Harris, 2009, p.33). According to Saxena (2013), when an individual can explore the possibilities of digital tools, the more creative the person becomes. Alhajri (2016) affirmed that new media technologies enhance creative thinking skills and develop graphic design students' artistic abilities.

Contextually, Alhajri (2016) argued that technology only affects the speed at which a design solution is produced; it does not ensure its correctness. Without understanding the basics of design theories, especially concept generation, mastering design software applications neither makes a student a competent graphic designer nor produces good designs. Therefore, equipping students with design theories is necessary as it enhances creative problem-solving. Also, in tackling a design problem, Porrit and Miller (2004) suggest that design knowledge must be used, the designer must design, and digital technology is not the designer. Porrit and Miller found that students often treat design and technology as separate entities. Most students assume that digital technology is the goal. The more you know, the better designer you are (Alkholy, 2007, cited in Alhajri, 2016).

2.3 Concept Generation

Concept generation is a systematic process of developing ideas or concepts to solve an identified design problem. In this sense, concepts serve as a primary raw material for manufacturing visual solutions. In Graphic Design, design concepts are developed in phases, from formless ideas to a clear, compelling message in an appropriate form with supportive visuals and content (Hass, 2015).

For this study, the portfolio website project executed by the third year Graphic Design students of UEW was premised on the five-stage traditional concept generation method of the design process in Graphic Design. As shown in fig.1, this conventional concept generation method is a protocol for refining design concepts into a viable visual solution to solve a design problem.

Figure 1. Traditional Concept Generation Method **Source:** (Appiah & Cronje, 2013)

2.3.1 Problem Identification

The Problem Identification phase requires Graphic designers (design students) to identify the design problem from the design brief once it has been defined and accepted. Design students collect detailed information to understand better the problem presented to them. They begin to search for information that could be fed into the subsequent stages of the design process (Ambrose & Harris, 2015)

2.3.2 Brainstorming/Thumbnail Sketches

Rendering concepts into visuals start with thumbnail sketches. Simple drawings are made on the computer using a mouse or digital pen and graphic tablet. Drawing is one of the most expressive forms of creativity, acting as an extension of working memory, support for mental imagery, and mental synthesis (Buchal, 2002, p. 113, cited in Brown, 2009). This helps to record fresh concepts in mind more quickly often only meaningful to the designer (Saw, 2002).

2.3.3 Preparation of Roughs

Concepts screened from the pool of sketches/images during the brainstorming/thumbnail sketches stage are first composed to scale using Adobe Photoshop software application. This is called rough. If the result is not working after careful examination, re-composition may be required, or the process loops back to the thumbnail sketches stage for ideas to be reconsidered. It is very crucial to the success of the visual solution because if a design concept does not work as rough, it would certainly not work as a solution. It pays to have many feasible concepts at the outset so that if the process must loop back, there would be backup (Landa, 2014, p. 86).

2.3.4 Execution of Finished Roughs

Every element in the work is critically analysed for possible gaps and errors (Saw, 2002). This examination contributes to corroborating the visual solution through sealing detected gaps and correcting errors. More details are injected into the work once set to scale. Finish rough appear like the final design solution, but it is not (Saw, 2002). Using CAD (Computer-Aided Design) systems, designers can develop precise and aesthetically appealing representations of the solution they are aimed at (Bonnardel & Zenasni, 2010).

2.3.5 Final Design Execution

Design students and their instructor agrees on the format of the final product. It could either be rendered in digital or print form. After this agreement, the final product is produced, then the solution to a design problem comes alive (Saw, 2002).

3. Theoretical Framework

3.1 New Heuristic Framework for Creativity Measurement

Creativity is an esteemed construct in both Design practice and education. In Graphic Design, creativity is about developing a solution (design product) that could be regarded as 'new and useful'. If a design student creates a solution with the previous characteristics, that individual will be deemed creative (Batey, 2012). Determination of a designer's creativity in Graphic Design tends to focus on assessing their brainchild (product-oriented approach). However, aspects of creativity such as process, person and place are worthy of consideration as they are critical to creative development (La Harpe et al., 2009, cited in Allen & Coleman, 2011). For this study, considering not only 'design process' (concept generation) but also 'design product' (portfolio website) New Heuristic Framework for Creativity Measurement (NHFCM) was used as a lens to analyse concept generation with digital technology and assessment of students' portfolio websites in Graphic Design. Mark Batey propounded NHFCM in 2012 to integrate some diverse interpretations of the field of creativity into a taxonomic framework to assess creativity considering different dimensions. The framework analyses creativity from three primary perspectives: level, facet, and measurement. The framework takes the form of a three-dimensional matrix; upon one axis lies the level at which creativity may be measured. Upon another axis lies the facet of creativity that may be assessed. The last axis concerns the measurement approach.
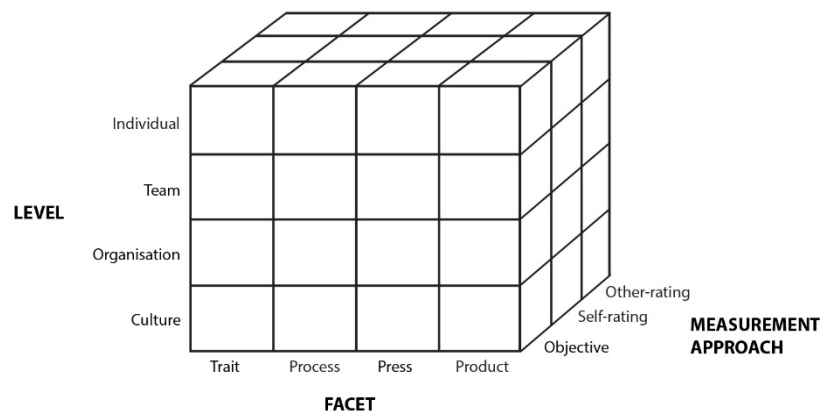
Figure 2. New Heuristic Framework for Creativity Measurement (NHFCM) **Source:** Batey (2012)
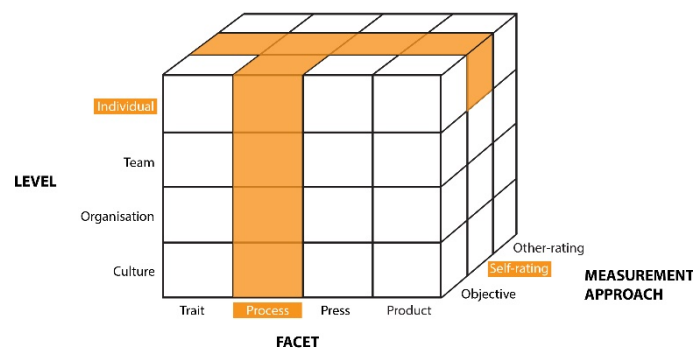

Figure 3. Analysis of portfolio website design (***Process)*** with NHFCM
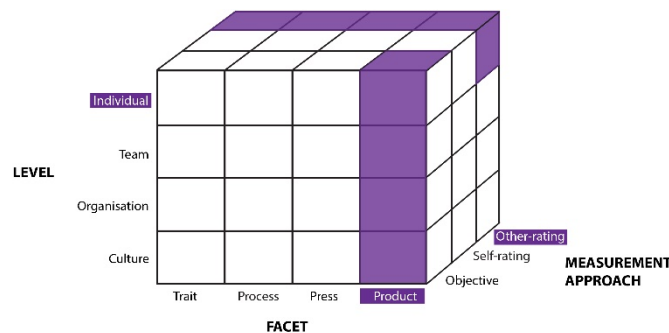

Figure 4. Assessment of portfolio website (***Product)*** with NHFCM

3.1.1 Level
The Level stage outlines the four focal points of creativity analyses and measurement. The focal points are individual, team, organisation and culture (Batey, 2012). Fig. 3 and fig. 4 highlights' ***individual'*** as the focal point of creativity measurement of the study. Individual refers to the '***individual students'*** who undertook the third-year course, namely Web Design and Development at the Department of Graphic Design, UEW and as a result, owns a personal portfolio website.
3.1.2 Facet
The facet stage shows creativity facets of the focal points in the level stage. The creativity facets are trait, process, press and product; these are measured to determine the creativity of the focal points (Batey, 2012). Fig. 3 and fig. 4 highlights' ***process'*** and ***'product'*** respectively as the creativity facet analysed in this study. Portfolio websites developed individually by third-year students under the Web Design and Development course at the Department of Graphic Design, UEW represents a facet of creativity and, therefore, fell under process and product. A portfolio website as a facet of creativity in this study is a student's website that gives information about them and showcases their creative works (Jani, 2017).
3.1.3 Measurement Approach
The measurement approach shows the means of assessing the creativity facets of the focal points in the level stage. The means of assessment are objective, self-rating and other rating. Within NHFCM, the methods of

assessment that might be employed within each box are effective predictors or proxy measures of creativity (Batey, 2012). For this study, each of the third-year students of the Department of Graphic Design used a self-rating measurement approach to analyse the process employed to create the portfolio website. According to Batey (2012), the *self-rating* process captures the means and the extent to which the individual perceives and combine diverse ideas. In assessing the portfolio websites as a *product* of creativity, the study used *other-rating* measurement approach. Moustakis et al. (2004) website quality assessment criteria were adopted for the third-year students at a jury section to assess all the portfolio websites under the auspices of the lecturer who taught the course—Web Design and Development. The lecturer, together with the students, were involved in the evaluation process since, in the view of Batey, other-rating measurement of creativity takes the form of person or persons who are conversant with the creative product and/or the creator (peers, team members, teachers, managers etc.). The other-rating measurement approach was employed because it is the basis of most creative product assessments. This approach gives other people the opportunity to appreciate and critique the product. If creativity involves the social recognition of a novel and valuable idea or product, then society must be asked its opinion of the creation (Batey, 2012).

4. Methodology

The study employed the mixed-methods research approach, using qualitative and quantitative approaches respectively. The qualitative phase employed a case study method to understand how the third-year Graphic Design students at UEW captured and combined diverse ideas in compliance with self-rating measurement of the NHFCM for developing their portfolio website with the aid of a technology-mediated concept generation process. Qualitative data was garnered through observation of the activities at the Multimedia Laboratory, where Web Design and Development lessons were held at the Department of Graphic Design, UEW. Qualitative case study enables researchers to generate an in-depth, multi-faceted understanding of a complex issue within a specific context in a real-life setting (Rashid et al., 2019).

The quantitative phase employed an evaluative research approach. According to Stern (2004), evaluative research provides a means to judge actions and activities based on values, criteria, and standards. In this study, an evaluative research approach was used to establish the functionality of the portfolio websites and the extent to which the portfolio websites satisfy the project's design brief in compliance with other-rating measurement of the product of the NHFCM. In Graphic Design, a design brief is a document that outlines the requirements and scope of a design project (Busche, 2021).

In evaluating the portfolio websites, a questionnaire was scored using a five-point Likert scale. The questionnaire's content spanned three dimensions of Moustakis et al. (2004) website quality assessment criteria. The dimensions included purpose and content appropriateness of the portfolio websites, presentation of the portfolio websites' graphics and usability of the portfolio websites.

The third-year students at the Department of Graphic Design, UEW numbered 100, and each student produced a portfolio website for themselves. As a result, 100 portfolio websites were assessed using Moustakis et al. (2004) website quality assessment criteria against the project's design brief. The third-year students (participants) were purposively chosen based on their completion of all CGGD courses captured in the Graphic Design curriculum at the Department of Graphic Design, UEW. The CGGD courses expose students to five application software, namely Adobe Illustrator, Adobe Photoshop, Adobe InDesign, Adobe Dreamweaver and Adobe Premiere Pro; these application software were relevant to their portfolio website design project. Moreover, the third-year students were chosen owing to the rich store of knowledge and experiences they had accrued from addressing several elementary to complex design problems on digital platforms with concept generation processes and techniques. Participants were selected based on criterion sampling, a purposive sampling technique.

Analysing qualitative data focused on technologies used in the generation of portfolio websites. In addition, the concept generation process adopted for the development of the portfolio websites was considered. The analysis was premised on the self-rating measurement approach based on the number of processes carved for developing 100 portfolio websites with digital technologies by third-year Graphic design students at UEW. Following the concept generation process put forward by Appiah and Cronje (2013), findings were thematically positioned to reflect stages identified. Quantitative data garnered were analysed using SPSS.

5. Data Presentation and Analysis

5.1 Analysis of Portfolio Website Design Process with Self-Rating Measurement Approach

An account of processes carried out for the development of 100 portfolio websites with digital technologies by third-year Graphic Design students, UEW at each phase of the five-stage traditional concept generation method of the design process in Graphic Design are delineated below:

5.1.1 Problem Identification

Appiah and Cronje (2013) indicated that the first stage of the concept generation process is problem

identification. Data after analysis showed that before the portfolio website design project, the students did not have a properly structured online portfolio with their creative works, skills, experiences and other essential attributes that gave them an excellent online presence. Therefore, a genuine design problem (lack of online portfolio) required a visual solution (production of portfolio website).

After perusing the design brief, the students identified the design problem presented to them and determined the project's specifications and scope. The design brief had the following instructions:

Design a dynamic personal portfolio website.

1. The website should contain only five pages and not less or more. Thus, Home, About Me, Portfolio, Video and Contact.
2. The footer of your pages should have your full name, index number, course code and copyright year.
3. The website should be responsive.
4. Create an educational video for the Video page.
5. All videos must be uploaded on YouTube and then linked to your website
6. Your portfolio page should be designed in a flash, showcasing only personal projects as students of the Department of Graphic Design, UEW.
7. Your contact form should be linked to a valid email address. Add your phone numbers as well as your social networks to the contact page

Knowing the above-listed requirements of the project, the students resorted to the internet to study elements that go into the development of portfolio websites. Again, the students translated knowledge gained from studying materials on web design and already existing websites into planning the development of their portfolio website project. At this stage, they prepped the write up for the web content and resorted to the internet to garner ready-made materials, which encompassed educational videos, the colour scheme of existing websites, website templates and images of relevance to the project for use in the subsequent stages of the process.

5.1.2 Brainstorming/Thumbnail Sketches

Having understood the design problem, the students made visual representations of design concepts which covered some components of their portfolio website project using Adobe Illustrator (Ai) and Adobe Photoshop (Ps). With the aid of Ai and Ps, each student created several brand names and logos to give their portfolio website a unique identity. At this stage, the students went beyond creating brand names and logos to make some thumbnail sketches of webpages layout and improved upon the sketches on their computer using Ai and Ps. Also, the students augmented the concepts they generated themselves with some of the website templates and refined design concepts they had downloaded from the internet at the problem identification stage and modified them with Ps and Ai. Collecting advanced design resources from the internet allowed students to circumvent the rigorous brainstorming process and record some of the concepts they needed for the portfolio website project themselves.

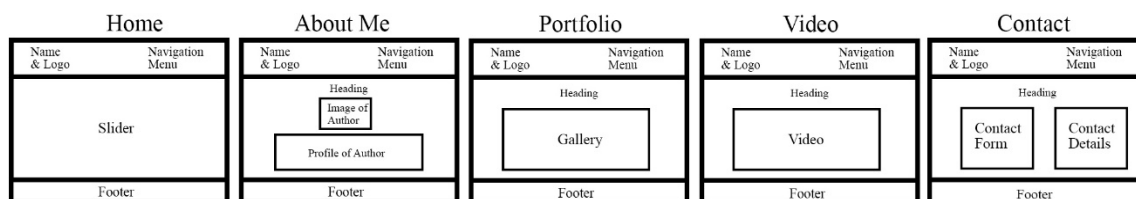Figure 5. Names and logos of some students' portfolio website

Figure 6. Thumbnails of webpages layout of a student's portfolio website

5.1.3 Preparation of Roughs

A collection of self-generated and adopted design resources made up of logos, colour scheme, refined images, text, webpages layout and website templates at this stage were screened by students for competing ones. Students tried out qualified concepts in different compositions styles using Ps and Ai for the five web pages (Home, About Me, Portfolio, Video and contact). Also, website templates expedited the composition of many web pages. Concepts in the created compositions were substituted. Concepts were transferred from one composition to the other to enhance and resolve flaws detected in the compositions assigned to each web page. This was crucial to the success of the portfolio websites because if the graphical user interface concepts did not work as rough, Landa (2014) emphasised that it would certainly not work for the website.

Whilst they had many compositions for each of the five web pages, the students needed one composition. For this reason, compositions were screened for the one that stood out in terms of suitability, workability and

attractiveness. Those selected became the blueprint for the graphical user interfaces of the web pages.

5.1.4 Execution of Finished Roughs

At this point, graphical user interfaces of the webpages took their actual dimension, colour scheme, font, and details, which appeared like an actual website either in Ps or Ai. Students put the finishing touches to the web page's graphical user interface, which included slicing the five web pages into sections using the 'slice tool' in Ps for easy assemblage with Adobe Dreamweaver (Dw). Advancing to this stage, each student had developed a prototype for their portfolio website.
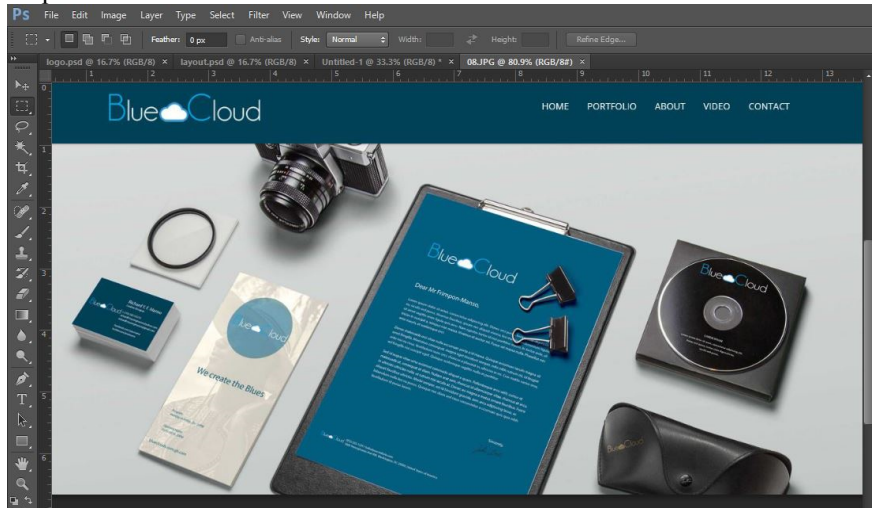

Figure 7. A student's Home (Index) webpage prototype in Adobe Photoshop

5.1.5 Final Design Execution

A prototype of the graphical user interface for the five web pages was ready. Students used the prototypes as a guide to develop the actual portfolio website using Adobe Dreamweaver. This was followed by website compatibility test with different web browsers— Internet Explorer, Firefox Mozilla, Google Chrome and Opera. Finally, all the 100 websites were hosted. Students as users browsed each other's websites and registered their level of satisfaction concerning its usability and overall outlook using Moustakis et al. (2004) website quality assessment criteria at a jury session.
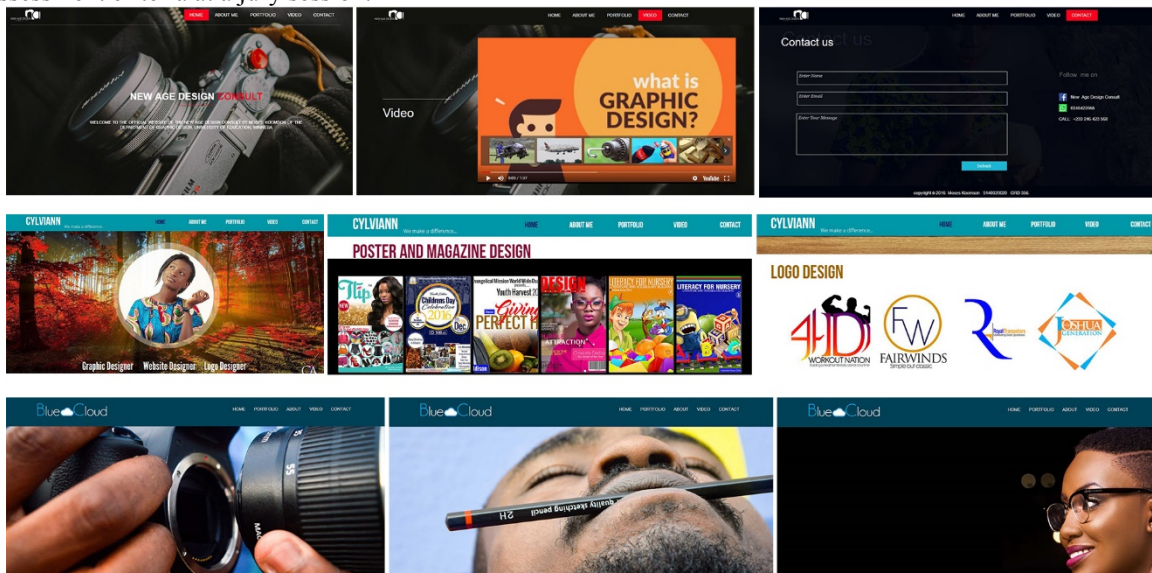

Figure 8. Some students' webpages

5.2 Results: Portfolio Website (Product) Assessment

As a slice of the mixed-method approach adopted for this study, the quantitative approach yielded quantitative data. The data was analysed using the other-rating measurement approach put forward by Moustakis et al. (2004) for assessing the quality of a website. The assessment focused on the following:

- Purpose and Content Appropriateness of the Portfolio Websites

- Presentation of the Portfolio Websites' Graphics
- Usability of the Portfolio Websites

The quality of the assessment criteria used in the study is its measure of central tendency.

Table 1. Purpose and Content Appropriateness of the Portfolio Websites (m = 4.17)

Construct	Definition of Construct	No. of websites	Very Poor 1 (%)	Poor 2 (%)	Good 3 (%)	Very Good 4 (%)	Excellent 5 (%)	Mean (m)
Clarity of purpose and precision of website scope	It reflects the degree at which the website content communicates the website purpose at a glance and range of themes captured for users.	100	—	5	16	28	51	**4.2**
Orderly organization of website content	It reflects the consistency and neatness in the placement of text, images and videos that represents the website content.	100	3	4	16	34	43	**4.1**
Accuracy and usefulness of website content	It reflects the degree of correctness and essence of information provided in the website.	100	3	2	11	37	47	**4.2**

As shown in table 1, after analysing the constructs of Purpose and Content Appropriateness of the Portfolio Websites, the mean of means was 4.17. This connotes that users' overall satisfaction with the Purpose and Content Appropriateness of the Portfolio Websites were high. The mean (m) of the constructs of Purpose and Content Appropriateness of the Portfolio Websites are as follows: clarity of purpose and precision of website scope (m = 4.2), orderly organisation of website content (m = 4.1) and accuracy and usefulness of website content (m = 4.2)

Table 2. Presentation of the Portfolio Websites' Graphics (m = 4.4)

Construct	Definition of Construct	No. of websites	Very Poor 1 (%)	Poor 2 (%)	Good 3 (%)	Very Good 4 (%)	Excellent 5 (%)	Mean (m)
Appealingness of webpages layout	It shows the aesthetic value of the overall appearance of the website and its ability to capture the attention of users.	100	2	4	12	33	49	**4.2**
Legibility and appropriateness of font used for the website	It reflects the suitability of chosen font in the website and the extent it makes reading easy for users.	100	—	2	7	21	70	**4.6**
Quality and pertinence of images in the website	It shows the correlation between images and its accompanying text in the website. Again it shows image quality in terms of resolution and the clarity of message it communicates to users.	100	1	4	5	30	60	**4.4**
Workability of website colour scheme	It captures how the colour scheme projects the website purpose, distinguishes the website parts and aids navigation.	100	—	4	10	30	56	**4.4**

In table 2, Presentation of the Portfolio Websites' Graphics recorded a mean of means of 4.4 considering its constructs. The average score of 4.4 indicates that users appreciated the presentation of graphics in the portfolio

websites, and they were delighted with its corresponding constructs. The mean (m) of the constructs of Presentation of the Portfolio Websites' Graphics are as follows: appealingness of webpages layout ($m = 4.2$), legibility and appropriateness of font used for the website ($m = 4.6$), quality and pertinence of images in the website ($m = 4.4$) and workability of website colour scheme ($m = 4.4$)

Table 3. Usability of the Portfolio Websites ($m = 4.23$)

Construct	Definition of Construct	No. of websites	Very Poor 1 (%)	Poor 2 (%)	Good 3 (%)	Very Good 4 (%)	Excellent 5 (%)	Mean (m)
Functionality of hyperlinks in the website	It captures the extent at which hyperlinks available connects users to information within the website and other websites or data repositories.	100	2	3	4	17	74	4.6
Convenience of website navigation	It shows how the navigation system in the website guides the movement of users.	100	2	4	9	17	68	4.6
Website compatibility with different web browsers.	It reflects the degree at which the website functions exactly on multi-browser platform.	100	1	2	15	19	63	4.4
Website display on mobile devices	It shows the ability of the website to resize and reformat its content to fit on the screen of all mobile devices such as smartphone.	100	18	12	24	18	28	3.3

As shown in table 3, after analysis of the Usability constructs of the Portfolio Websites, the mean of means was 4.23. This suggests that users' satisfaction with the portfolio websites' usability features was high. The mean (m) of the constructs of Usability of the Portfolio Websites are as follows: functionality of hyperlinks on the website ($m = 4.6$), the convenience of website navigation ($m = 4.6$), website compatibility with different web browsers ($m = 4.4$) and Website display on mobile devices ($m = 3.3$). However, a mean of 3.3 for website display on mobile devices indicates that the portfolio websites were fairly responsive.

6. Discussion of Findings
6.1 Internet Usage and Concept Generation Process
It was found from the study that the third year Graphic Design students at UEW derived a road map for the development of their portfolio website by studying the makeup of existing portfolio websites available online. Studying existing design solutions, as done by the third year Graphic Design students with the internet, gives detailed information about the makeup of the solution (Ambrose & Harris, 2015). Again, studying the makeup of existing portfolio websites gave the third year Graphic Design students at UEW insight into web content creation which culminated in the development of portfolio websites, on average, that communicated their purpose to users with appropriate content. The finding further implies that the internet serves as a vehicle for design students in studying design problems and existing design solutions concerning concept generation in Graphic Design education.

6.2 Concept Generation Process Circumvention on Refined Design Concepts
The study revealed that the third year Graphic Design students at UEW modified advanced design concepts they downloaded from the internet with Ps and Ai at the brainstorming stage of the concept generation process. On the contrary, according to Ionos (2018), the brainstorming stage requires design students to develop an array of

new and raw ideas to find potential solutions to a design problem. Modifying existing design concepts in their refined state by Graphic Design students at the brainstorming stage give credence to the notion put forward by Toffah, Appiah and Boamah (2021). They put forward that design students are now using technology to circumvent the design process concerning concept generation. Again, when design students brainstorm ideas themselves, Ionos (2018) postulates that it trains their brain to trigger a storm of ideas. In addition, developing a website with refined design concepts, themes and templates are timesaving, and it expedites the concept generation process. However, if a design student values uniqueness, refined design concepts, themes and templates are an abysmal choice (Noupe, 2017).

6.3 New Technologies Proofing Supportive in Concept Generation
The study revealed that using Ps, Ai and Dw in the concept generation process for portfolio website by the third year Graphic Design students at UEW offered them the digital platform to record and implement the ideas they brainstormed themselves. Capturing design concepts on digital platforms promotes creativity since digital platforms have little to no limitation (Linda & Hershey, 2008). The third-year Graphic Design at UEW were not stifled in generating their concepts with Ps, Ai and Dw. This proves the assertion made by Linda and Hershey (2008) that students' concept generation and editing capabilities with the proper application software are limited only by their capacity for thinking. Technology-supported concept generation, in this study, yielded portfolio websites that were satisfactory to users in the light of purpose and content appropriateness of the portfolio websites, presentation of the portfolio websites' graphics and usability of the portfolio websites.

7. Conclusions and Recommendations
The findings on the portfolio website concept generation (process) and assessment of the portfolio websites (product) with NHFCM concluded that the third year Graphic Design students of UEW maximised the usage of the internet, Ps, Ai and Ai Dw. They demonstrated that they were taught through CGGD courses to unleash their creative capabilities for the portfolio website project.

The findings again suggest that the third year Graphic Design students at UEW misapplied digital technology at the brainstorming stage of the portfolio website concept generation. It was evident in modifying refined design concepts instead of brainstorming and recording their ideas with digital technology. This led to the circumvention of some concept generation processes for portfolio websites.

The study from its findings recommend that Graphic Design students continuously support concept generation with new media technologies to hone their creative prowess through design problem-solving.

Again, the study recommends that Graphic Design students should not circumvent concept generation processes with new media technologies to gain the total learning outcomes of technology-mediated concept generation processes in Graphic Design.

References
Adobe (2009). *Technology in Education*. [Online] Available: https://www.adobe.com/content/dam/Adobe/en/education/pdfs/adobewp-tech-education- 03062009.pdf. (January 9, 2022)
Appiah, E. & Cronjé, J. (2014). The influence of information and communication technology on graphic design: reflections on pedagogy. *Journal of Science and Technology-Ghana*, *34*(1), 85.
Appiah, E. & Cronjé, J. (2014). Information Communication and Technology (ICT) and the Challenges of Ideation in Graphic Design: An Activity Theory Focus. *International Journal of Computer Applications, 63*(6), 0975 – 8887.
Alhajri, S. (2016). The Effectiveness of Teaching Methods Used in Graphic Design Pedagogy in Both Analogue and Digital Education Systems. *Universal Journal of Educational Research*, *4*(2), 422-425.
Allen, B., & Coleman, K. (2011). *The creative graduate: cultivating and assessing creativity with eportfolios.* [Online] Available: http://www.ascilite.org/conferences/hobart11/downloads/papers/Allenfull.pdf (January 9, 2022)
Ambrose, G. & Harris, P. (2015). *Design Thinking for Visual Communication (2ⁿᵈ Ed.)*. Bloomsbury
Ambrose, G. & Harris, P. (2009). *The Fundamentals of Graphic Design*. Lausannes 6: AVA Publishing SA
Batey, M. (2012). The Measurement of Creativity: From Definitional Consensus to the Introduction of a New Heuristic Framework. *Creativity Research Journal*, 24(1), 55-65.
Bonnardel, N. & Zenasni, F. (2010). The Impact of Technology on Creativity in Design: An Enhancement?. *Creativity and Innovation Management*, 19(2), 180-191.
Brown, P., (2009). CAD: Do Computers Aid the Design Process After All?. *Intersect: The Stanford Journal of Science, Technology, and Society*, 2(1).
Busche, L. (2021) *What is Graphic Design Brief?*. [Online] Available: https://creativemarket.com/blog/what-is-a-graphic-design-brief (January 5, 2022)

Hass, A. (2015) *Graphic Design and Print Production Fundamentals*. [Online] Available: https://opentextbc.ca/graphicdesign/chapter/2-5-concept-development/ (January,7, 2022)

Ionos (2018). *brainstorming*. [Online] Available: https://www.ionos.com/startupguide/productivity/brainstorming (January 7, 2022)

Jani (2017). *Portfolio website vs. portfolio book: which is preferred now?* [Online] Available: https://blog.flipsnack.com/portfolio-website-vs-portfolio-book-which-is-preferred-now/ (July 15, 2021)

Jo Shan Fu (2013). ICT in Education: A Critical Literature Review and Its Implications. *International Journal of Education and Development using Information and Communication Technology (IJEDICT), 9*(1), 112-125.

Kelsall, A. (2001). *The Impact of New Digital Technology on the nature of Graphic Design: The Digital Designer*. [Online] Available: http://www.andrewkelsall.com/the-impact-of-new-digital- technology- onthe-nature-of-graphic-design-the-digital-designer/ (January 7, 2022)

Landa, R. (2014). *Essential Graphic Design Solutions*. 5th ed. Boston: Clark Baxter

Linda W., F, & Hershey H., F. (2008). *The New Media Technologies: Overview and Research Framework*. Retrieved: July, 15, 2021 from http://people.stern.nyu.edu/aghose/msi_4.pdf

Manovich, L., 2001. *The language of new media*. Cambridge: MIT Press.

Moustakis, V., Litos, C., Dalivigas, A. & Tsironis, L. (2004). *Website quality assessment criteria*. [Online] Available: http://ssmvm030.mit.edu/ICIQ/Documents/IQConference2004/Papers/WebsiteQualityAssessmentCriteria.pdf (J annuary 20, 2021)

Noupe (2017). *Pros and Cons: Design with Templates*. [Online] Available: https://www.noupe.com/design/pros-and-cons-design-with-templates.html (January 7, 2022)

Porritt, D., & Miller, B. (2004). *Integrated learning: design theory versus technology in graphic design*. [Online] Available:http://acuads.com.au/wp-content/uploads/2014/12/porrit_miller.pdf (February 10, 2021)

Rashid, Y., Rashid, A., Warraich, M. A., Sabir, S. S., & Waseem, A. (2019). Case Study Method: A Step-by-Step Guide for Business Researchers. *International Journal of Qualitative Methods*. https://doi.org/10.1177/1609406919862424

Saw, J. T. (2002). *Design and Composition*. [Online] Available: http://daphne.palomar.edu/design/form.html (February 10, 2021)

Saxena, S. (2013). *How can technology enhance student creativity?*. [Online] Available: http://edtechreview.in/trends-insights/insights/750-how-cantechnology-enhance-student-creativity (February 10, 2021)

Stern, E. (2004). *Evaluation Research Methods*. [Online] Available: https://uk.sagepub.com/en-gb/eur/evaluation-research-methods/book226796 (January 7, 2022)

Toffah, A., A., Appiah, E., & Boamah, A. (2021). To Use or Not to Use: Analysis of ICT in the Ideation Process of Graphic Design in the Senior High Schools. *Arts and Design Studies, 90*, 24-29

Wahab, S., Rose, R. & Osman, S. (2012). Defining the Concepts of Technology and Technology Transfer: A Literature Analysis. *International Business Research*, 5(1), 61-65.