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Measuring user emotional responses using Geneva Emotion Wheel towards learning management systems

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ABSTRACT

The learning management system (LMS) has been used widely in higher learning institutions for blended learning; this interaction involves user cognition and may induce emotional experience. Therefore, the user has to sustain a positive emotional experience towards using LMS to avoid difficulty in the learning process. However, the user emotions and the design elements that induced the emotions are yet to discover. This study aims to analyse user emotional responses to a learning management design and examine the emotional design features of a learning management system. Two versions of a higher learning institution LMS were used and investigated using Geneva Emotion Wheel (GEW). The findings show that both LMS versions lack-in activate the positive emotions, but prove the LMS designs reduce the activation of negative emotions. Furthermore, the emotional design elements that concern an LMS is explained.

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1. INTRODUCTION

Educational technologies such as intelligent tutoring systems (ITSs) and massive open online courses (MOOCs) such as learning management systems are becoming more popular and gradually replacing traditional face-to-face learning environments. As a result, these technologies may induce emotional experiences in learners. While there are design elements to ensure a workable learning management system, one aspect of the learning process that has received less attention from designers and researchers is the affective aspect. Since emotional design is found to engage and improve learning outcomes [1], it is important to investigate the user's emotional responses towards the design of a learning management system. learning management system (LMS) is a learning platform that students regularly visit; hence, the system's design should provide the students with a positive experience. This is because emotions act as a mood and feeling of a person during the learning process [2]. Emotions are delicate and often influenced by the circumstances in which they occur or their experiences while going through a process. As a result, emotions are sensitive, and they stimulate conditions that are intended to last just a brief time due to a certain circumstance, action, or object [3]. Thus, when people's needs and expectations are met, emotion is triggered.

Using the previous learning experience as an example, in face-to-face classes, the lecturers can always visualise the students' body language to identify their under-standing based on the lecture. For example, the student's body language can represent the confidence to answer a question, such as a nodding head. However, as LMS is an asynchronous learning platform, the lecturers cannot identify the students

under-standing. Hence, the learning process for the students in LMS will be difficult and affected if they are in a negative mood [2]. Therefore, the LMS, which applies the appropriate emotional design, can evoke positive emotions and lead to positive learning outcomes. Many studies have investigated emotional design in multimedia learning [4]-[11], website design [12], [13] and most of them focusing on specific emotional design elements such as colours [4]-[10], [12], [13], shapes [4]-[7], [10], [11], layout [4], [5], [12], font [7], [13] and image [8], [11]-[13]. However, in this present study, we take a different path from previous research by investigating the emotional design elements from the user perspective. This move is derived from the [14] study, which discovered other design elements that also induced emotion in users through persuasive technology.

The concept of emotional design has been introduced by Norman [15] which has classified the attractive design may affect users in three levels of cognition; visceral, behavioural and reflective. The visceral level concerns the perceptible qualities of the products that determine their look and feel to the user. The visceral level can directly and unconsciously affect emotion, and the response is not different from having acquired factors like education and culture [16]. The behavioural level refers to the user's experience with the product, whereas the reflective level is determined by how the product relates to the user. The implementation of emotional design can create positive interaction [5] that promotes cognitive processing [9] through the redesigning of essential multimedia elements becoming more appealing such as colour or images of the learning tool [17].

Um *et al.* [4] discovered that creating a multimedia learning environment (MLE) to elicit pleasant emotion enhanced understanding and information transfer. Their study contrasted two design approaches: positive and neutral, from the perspectives of visual design elements such as shapes, design layout, colour and sound. Pleasant designs are those that elicit positive emotions like pleasure and joy. Conversely, unpleasant designs depict negative feelings, whereas neutral designs do not elicit positive or negative emotions.

Heidig *et al*. [5] also mentioned the investigated design features in multimedia learning environments towards user emotional states and learning. The study found that positive emotions can lead to positive learning outcomes by using design elements. They proved outcomes by changing the design elements of the colour, layout and round shape. Furthermore, they demonstrated that positive emotions are the factors that can bring provide users with motivation, creativity, and problem-solving skill. In this study, they focused on three design elements, abilities. The study compared positive design with warm colour, layout and round shapes, which represent positive emotions. Then, comparing with the and neutral design by using grey colour and no face-like shapes. The findings showed that the participants could have positive emotions using the positive design compared to the neutral design [5].

Plass and Kaplan [6] also found that using a range of design elements can evoke user emotions and enhance a student learning progress. They believed that design elements could support students in various activities such as decision-making, creative problem-solving, and negotiating in a particular situation. They experimented by using two types of elements, colour: colour and shapes, to confirm whether these elements can affect a person's emotions. They used bright colours as positive emotions and darker colours as negative emotions. Shapes will be used in information representation. The study exposed that round face-like shapes, and warm colours bring positive emotions such as feeling inspired, interested and enthusiastic. However, positive emotions cannot produce if these two elements come alone [6].

Stark *et al*. [7] mentioned that the interaction between the contents and the users, especially in multimedia learning, emotions play an important role. The authors found that positive emotions are produced by the warm and bright colour, face-like shape and text. Furthermore, Mayer and Estrella [9] also redesign the graphics in a lesson using colour and shapes. These studies concluded that the emotional elements could increase the learners' motivation towards their study and improve the learning outcomes. Positive design could lead to a superior learning outcome when imposing neutral design, rectangular shapes and grey-scale colour [7]. The text elements also help the learners stay focused, improve cognitive processing, and lead to better learning outcomes [7], [9].

Kumar *et al*. [8] found that emotions have a relationship with multimedia design. The different designs will deliver different emotions to a person. The study investigated three types of design that can induce emotions in users, which were positive (PosD), neutral (NeuD), and negative (NegD) design which may impact positive learning progress. They used three elements which are colour, font and graphics. At the end of the experiment, they concluded that positive emotions increased comprehension and can transfer knowledge and reduce learning difficulty. However, most users prefer negative designs as personality will decide which emotions will be the best for an individual [8].

Li *et al.* [10] also proved the positive emotional design, face-like shapes, bright and warm colours are able the users to learn better, improved cognitive processing during learning and lead to improving learning outcomes compared to the neutral design grey-scale colour and neutral shapes. However, there is no

significant result to prove the users' emotions. The study concluded that even though the positive design cannot produce the students' emotions, it helps a lot in their learning process.

Emotional design elements can elicit different emotions and be able to develop in users' remembering. [11] proved this hypothesis in an experiment by using two sets of designs. The first design using the emotional design elements, face-like shapes, warm colour and graphics related to the learning content, while another design without the emotional design elements. The study proved that the emotional design elements could enhance recall by serving as an effective retrieval cue for long-term memory [11].

Besides that, emotional design is not only used to affect learners but also another type of user. In a different study, Pengnate and Sarathy [12] explained how the website characteristics influence a customer's trust in the unfamiliar website. Different design elements will bring a different experience to a customer when they are browsing the website. The study emphasised that if the elements, visual appeal, colour, layout and images are design appropriately, it brings confidence to the user about the brand's reputation. It can bring them confidence in an unfamiliar website and bring others' emotions like pleasure and joy [12]. In addition, Jiang *et al.* [13] studied the design elements such as colour, images and font. The study found that human sensitivity to colour will affect emotions as we will see the colour first compared to the other elements. Neutral colours scheme provides harmony and a cultural atmosphere suitable for education and different societies. In contrast, images help convey the information more effectively and create the users' emotions, while the font will directly affect the quality of the web page. The study believed that positive emotions could be evoked if the design elements were developed properly.

In summary, emotional design refers to the design elements that can deliver different emotions to the users. The elements of emotional design are colour, design layout, shape, font and graphics. Colours have three categories which are bright, warm/dark and neutral. Colour and shapes normally work together to produce positive emotions. For example, a good design layout with navigation indicates positive emotions. Font with proper size and graphics with bright colour can bring positive emotions as well. However, personality will affect people to pick a negative or neutral design that they think is suitable and easier to use. Sometimes, there might be no emotions detected from the users, but the positive design proved that the users' learning outcome is better than the negative design and neutral design. All previous studies have measured user emotional responses towards the identified elements they wanted to investigate. However, this present study will identify the elements that triggered user emotional responses towards using a learning management system which could have led to a discovery of more factors than what has been investigated by past studies.

The Geneva Emotion Wheel (GEW) is an instrument used in psychology to measure the users' emotional reactions. The GEW is used extensively to identify the users' emotions toward objects, virtual learning environment and more by selecting the appropriate emotions and the intensity for each emotion [18]. There are three versions of the GEW. The first version of the GEW only containing 16 emotions; four emotions are presented per quadrant. Then, the second version is produced to emphasis the option represented on emotion family rather than individual emotion; it makes the emotions more accurate than the first version. However, problems assist in both versions. The intensity for version 1.0 did not precisely reflect the users' emotions, while the arrangements of the emotions in version 2.0 did not arrange according to the respective rim on the wheel. Therefore, the third version of the GEW (Figure 1) is produced, allocating the major emotional terms in their respective rim on the wheel and making the intensity of the emotions more accurate than the first two versions [19].

The GEW 3.0 has positive emotions and negative emotions. The wheel contains 20 emotional terms labelled with the simplest English words, which ease the users' understanding. Each emotion contains ten emotional terms and indicates the intensity of the emotions by using different sizes of circles. The higher the intensity, the larger the circle, which is aligned towards the edge of the wheel. GEW 3.0 also provided the users with "no emotion" and "other emotions" as the subjective options. The users can provide accurate emotional states and intensity through this setting as it provides a wide range of choices.

GEW has many advantages. Sacharin *et ali.* [20] provided evidence that GEW is a useful measurement tool under time pressure, especially for repeated measurements on a similar topic. Michl *et al.* [21], GEW including the basic emotions that people always experience. For example, joy, love, fear, anger, sadness, surprise and disgust. Due to the simplicity of the setting and the language used, GEW is recognised as an enjoyable instrument to record emotions [18], [22], [23]. As Reader and McMahon [24] emphasised, GEW is the self-report method that can assess reflective, visceral and behavioural levels of emotional processing. Feidakis *et al.* [25] explained that self-reporting is an action for the users to measure their subjective feelings in a shorter time than other tools.

The GEW tool has been utilised in various field studies to investigate users' emotions concerning processes [26], products [27], [28], and technology [14]. Zhang *et a*. [26] focused on design-based learning (DBL). The study stated that DBL is a tool that allows learners to learn from mistakes, think out of the box, work in a team, and support ideas. The version 1.0 GEW were used to identify the children emotions based on their DBL learning process. The study showed that the emotions produce by the children is different when

they are performing different tasks. For example, during the DBL process, the children felt pride and elation, while joy was only experienced during the initial talk with their partner. Turumugon *et al*. [27] used GEW to examine the users' emotions towards Kansei-based standards where the participants were required to evaluate the web design of a higher learning institution. The study indicated that the Kansei-based web design standard did produce positive emotions to the users, where they found seven positive emotions induced high intensity while all ten negative emotions were induced at the lowest intensity. Next, Mahachandra *et al.* [28] identifies the users' emotions in their shopping experience using a smartphone. The study investigated what emotions can the users evoke based on the content and factors in their shopping experience. The findings discovered that navigation is the most important factor for the shopping experience, while the product is the most important factor for the shopping outcome. The navigation and content elicit similar emotions and are important for completing a shopping task. Furthermore, Wan Ahmad, Ali and Rodzuan [14] stated that the channel for users to understand how they feel about using technology, emotions are one of the reasons, especially the persuasive strategy is applied. Therefore, the study focused on the users' emotions towards persuasive applications through three stages of experiments. The stages are pre-interaction, during-interaction and post-interaction. The participants of the experiments are required to give comments based on the emotions they experienced for each stage. The results for this experiment in three stages were different. However, their findings showed that the positive emotions were dominated by high-control positive emotions, especially joy, pleasure and interest, whereas disappointment was the negative emotion usually triggered in users.

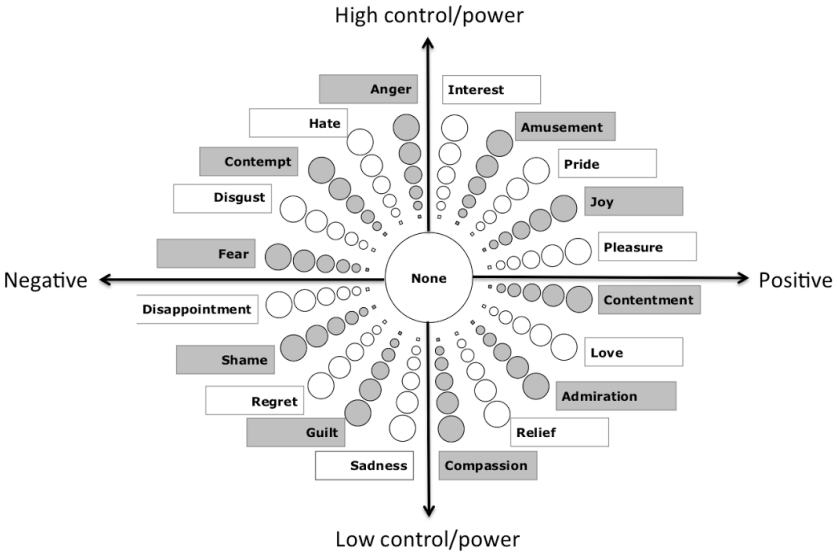


Figure 1. Geneva Emotion Wheel (GEW) version 3

In summary, GEW can be used to identify the users' emotions, whether positive or negative. Moreover, the GEW provides the simplest English terms, making it easy for the users to access the emotions based on different intensities. It is an emotional measurement tool recommended to measure an object, event or situation because it can be used to test theoretically and empirically [19].

Hence, this present study aims to develop an emotional design framework for LMS by answering the following research question; i) what are the emotional design elements for LMS? and ii) how do we know whether LMS design affects user emotions? The objectives are addressed in two parts; i) to investigate the emotional design elements of a learning management system and ii) to analyse users' emotional responses to a learning management design. The contributions of this paper are:

- Discovery of new emotional design categories and elements which should become the concerns in emotional design studies.
- Development of emotional design framework for LMS through the mapping of users' emotional response.

The rest of the paper is followed by section 2 that explains the comprehensive method, material and procedure for data collection and analysis. In Section 3, result and discussion are presented to explain the discovered scenario. Finally, there is a conclusion to the study.

2. METHOD

This section describes the methodology processes in conducting the study. The method explains i) the selection of participants and procedures, ii) material, iii) measures and task, and iv) analysis. The method consists of quantitative and qualitative approach. We present the subsections as follow:

2.1. Participants and procedures

The research subjects for this study were the students in higher learning institutions that used learning management systems in blended learning. The participants were recruited through advertisements on Facebook and WhatsApp. The research took three weeks to complete, with 50 respondents participated in the survey. They are comprised of thirty-one males and nineteen females. The distribution percentage on the year of study of the respondents from Year 1 is 16%, followed by 12% Year 2, 64% Year 3, and Year 4 is 8%. The year of study defined the experience and exposure of the respondents towards the learning management system. An online survey is distributed through social media such as Facebook and WhatsApp. The survey was open for three weeks and may be completed at any time. Participants were asked to examine the selected interface design of both system versions supplied in the survey before answering the questions.

2.2. Material

The learning management system of Universiti Malaysia Sabah (UMS) is used for evaluation. Two versions of the learning management system, SMART2 and SMARTv3, currently being used in UMS, are investigated. The SMART2 refers to the old version, while SMARTv3 is the latest version of the LMS. Both system versions have similar functionality, but a slight improvement on the interface design has been made towards the SMARTv3. Six specific interfaces were selected from each version, the homepage before login, course page, assignment view, assignment submit view, forum and quiz. Those interfaces are chosen because they are the interfaces the students always visited and used compared to other interfaces. Figure 2 shows both of the system versions. Figure 2(a) illustrates the SMART2 LMS and Figure 2(b) shows the SMARTv3 LMS.

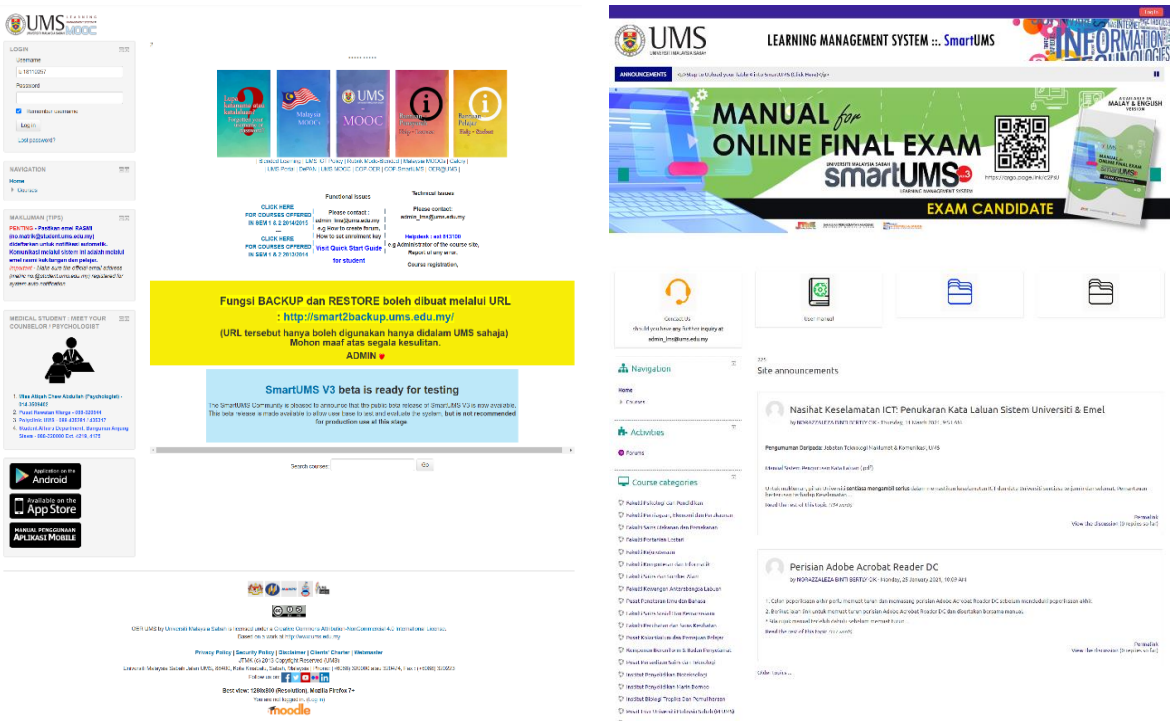
2.3. Measures and task

An online GEW survey is developed to identify the respondents' emotions based on the provided interfaces for each LMS version. The online survey is divided into two sections; Section A: Demographic and Section B: Emotional User Responses. Section A collects the participant's demographic information, while Section B is designed to identify the participants' emotions based on the provided interfaces for each version of the LMS. Section B is then divided into two subsections representing selected interfaces of the two system versions. The selected interfaces, together with the 20 emotional terms from the GEW, is given. Emotional terms are arranged following the GEW order. The five-point scale ranging from 1 to 5 is used, with 1- refers to the lowest intensity and five refers to the highest intensity is provided. The option, "I do not feel this emotion", is prepared for the participants if the respondents cannot feel the particular emotion towards the interface. The respondents must also specify reasons that make them like the interface's design the most among the two system versions. The online GEW survey is presented by using Google Form (https://forms.gle/22jMnDaQiZ1QgoFn8).

2.4. Analysis

Both quantitative and qualitative approach were used for data collection and analysis. Descriptive statistics is used to analyse the survey data. As the emotional data is measured using the five-point scale, which indicating the different intensity levels of the emotions, and the additional option, "I do not feel this emotion", is implemented with a scale of "no emotion" or "0". We applied the analysis mechanism from [27], where the intensity range of each of the intensity levels, the range size for each level of intensity is calculated using the formula [(n-1) / n]. The five-point scale, including an extra scale, the "0" for the option, "I do not feel this emotion", is added too. Hence, the range size was [(6-1)/6]. The answer 0.8333 is obtained and used by adding the range size to each intensity level. Table 1 shows the range of the intensity level.

A six-phase guide of a framework for conducting thematic analysis [29] is adopted to analyse qualitative data on the specific reasons given by the respondents related to the selected interface designs they preferred. The six steps of procedures for doing the thematic analysis involved; Phase 1: Familiarising with the Data; Phase 2: Generating Initial Codes; Phase 3: Searching for Themes; Phase 4: Reviewing Themes; Phase 5: Defining Themes; and Phase 6: Producing the Report. The study extracted the survey transcripts with the respondents' answers on their emotional justifications towards the interfaces. The procedure of each step is explained in the following subtopic:



(a) (b)

Figure 2. Two versions of the learning management system: (a) SMART2 and (b) SMARTv3

Table 1. Range of intensities level

Intensity Level	Intensity Range	State of Emotion
5	4.16–5.00	Highest Intensity
4	3.33–4.15	High Intensity
3	2.50–3.32	Neutral
2	1.67–2.49	Low Intensity
1	0.84–1.66	Lowest Intensity
0	0.00–0.83	No Emotion Felt

2.4.1. Phase 1: Familiarising with the data

This phase required reading and re-reading the survey transcripts. The repeated process involved in reading the respondents' emotional justifications towards the LMS interfaces. The respondents' positive and negative feelings towards the selected LMS interfaces identified the perceived effect elements.

2.4.2. Phase 2: Generating initial codes

In this phase, the study coded the respondents' emotional justifications using two columns table to separate and coded the respondents' positive and negative justification towards the interfaces. Different colours were used to highlight similar coding. Then, based on the research objectives, the study started to develop the codes during the coding process. This part of the method concluded after data was coded and the data pertinent to each code was compiled.

2.4.3. Phase 3: Searching for themes

This phase entailed the fundamental process of producing themes and subthemes, which are subcomponents of a theme. Following that, the research evaluated the produced codes and organised them into topics. In addition, the study began to investigate the crucial components include interaction between themes and how those themes work together to form a story of the data.

2.4.4. Phase 4: Reviewing themes

This phase involved a repeated process in reviewing the developed themes related to the coded data and the entire data set. Therefore, this step involved a final re-reading of all the data in reviewing the themes

with the entire data set. This process will determine whether the developed themes would semantically capture the entire dataset or only those aspects. This involved the process of splitting, combining, and discarding a theme. A new theme may also be generated to ensure accuracy.

2.4.5. Phase 5: Defining themes

In this phase, we define a name for the final list of themes. The process of defining themes involves precisely formulating the meaning of each theme and understanding how that data aids in the understanding of its data. A concise and meaningful name was given for each topic. The list of emotional design elements and the types of emotional design mentioned in the literature review were used for cross-checking when naming themes. Two names, elements and categories were used to group the similar elements and aspects.

2.4.6. Phase 6: Writing the report

This phase required the study to write a report that summarises all of the findings from the thematic analysis. As a result, a thematic map is developed. The map depicted the flow analysis and complete results obtained from all of the preceding phases of the study is exhibited.

3. RESULTS AND DISCUSSION

3.1. Emotional states

Figure 3 respectively presented the emotional states for SMART2 and SMARTv3 LMS. The evaluation of the respondents' emotional experience suggests that both LMS elicits positive emotions. Furthermore, the responses showed that the LMSs develop positive emotions. Therefore, the report illustrates that the LMSs induced all ten positive emotions but in a neutral state. As a result, this study indicates that the LMSs produced all ten positive emotions, but only in a neutral state. These results show that positive emotions were felt to some extent, but not to a large degree.

In contrast, the ten negative emotions were induced with the lowest intensity. The data showed that the respondents did not experience any negative emotions with high intensity, implying that most of the respondents experienced the negative emotions at a very low intensity. Overall, the results suggest that the SMARTv3 interfaces evoke a little stronger emotional experience than SMART2 interfaces with an increment in positive emotions and a decrement in the intensity of negative emotions, hence indicate that the SMARTv3 interface design improvement is heading towards emotional design even the emotions state are not that significant.

Figure 4 shows the six selected interfaces of both LMS system. Figure 4(a) illustrates the SMART2 interfaces. Figure 4(b) shows the SMARTv3 interfaces. The evaluation of emotional states for the selected interfaces from both LMS versions shows that all interfaces induced positive emotions in users. These results suggest that positive emotions were felt to some intensity, although not to a significant extent, implying that both LMS can elicit positive emotion in users. However, there is a slight difference in the result for the SMART2 system, where the interface of assignment submission captured one negative emotion in a neutral state. A similar case also happens to the forum's interface for the SMART2 system, where the interface evokes only eight positive emotions in a neutral state while another two emotions: relief and compassion, is experienced with low intensity. Thus, although the intensity of positive emotions is not significant, still the results suggest that the interfaces evoke positive emotions.

Meanwhile, the ten negative emotions were elicited with the least intensity. According to the statistics, respondents did not feel any negative emotions with high intensity, suggesting that the majority of respondents had negative emotions with relatively low intensity except for the assignment submission interface in the SMART2 system where respondents experienced guilt emotion in a neutral state, indicating that the guilt emotion is experienced but with not a significant intensity.

From this finding, we can conclude that the design of a learning management system does not affect user emotions. The intensity value shows the level of arousal that the respondents experienced. Although the respondents felt positive emotions, the intensities are not strong and dominant. This result, however, implies that respondents were not quite sure whether they felt those positive emotions. Meanwhile, the low intensity of the negative emotions shows that respondents generally perceived that the learning management systems have no major design flaws and are mostly perceived based on their expectations towards the LMS in facilitating the respondents' interest or motivation in learning.

The primary aim of this study is to examine the emotional states experienced towards the design of a learning management system affect the learning process. This goal refers to a contemporary debate in multimedia learning research where emotional states may influence working memory processes and information retrieval, for example [4]. Furthermore, while the positive and negative emotions represent the emotion valence, the intensity value defines the activation of the emotion. Thus, the neutral activation from the positive emotions experienced by the respondents shows that the design of both LMS lack-in activates the

user emotions. Our study provides further evidence that different designs of the LMS affect the respondents' emotional states expectedly as there was a slight increment in the mean values of the SMARTv3 design. In addition, both LMS designs managed to capture all positive emotions, marginally reducing the negative activation. However, this discovery may be affected by the similar tone colour and layout used in both LMS designs. The differences in both designs are mainly on the navigation and content design. We expected both designs to have different positive and negative emotions with high or low activation, but our expectation is proven wrong. On another hand, the results of more positive emotional states suggested that both designs enhanced understanding and informational transfer. Previous research has also suggested that positive emotional states foster information transfer and comprehension as the learning outcomes in multimedia learning [4]. However, other research has found that user emotional states impact their motivation to keep working with the material [5].

Emotions	Mean	Intensity Range	Intensity Level	Emotion State
Interest	2.86	2.50 – 3.32	3	Neutral
Amusement	2.84	2.50 – 3.32	3	Neutral
Pride	2.93	2.50 – 3.32	3	Neutral
Joy	2.76	2.50 – 3.32	3	Neutral
Pleasure	2.9	2.50 – 3.32	3	Neutral
Contentment	2.95	2.50 – 3.32	3	Neutral
Love	2.79	2.50 – 3.32	3	Neutral
Admiration	2.92	2.50 – 3.32	3	Neutral
Relief	2.81	2.50 – 3.32	3	Neutral
Compassion	2.69	2.50 – 3.32	3	Neutral
Sadness	2.14	1.67 – 2.49	2	Low intensity
Guilt	2.26	1.67 – 2.49	2	Low intensity
Regret	2.11	1.67 – 2.49	2	Low intensity
Shame	2.18	1.67 – 2.49	2	Low intensity
Disappointment	2.1	1.67 – 2.49	2	Low intensity
Fear	2.32	1.67 – 2.49	2	Low intensity
Disgust	2.12	1.67 – 2.49	2	Low intensity
Contempt	2.02	1.67 – 2.49	2	Low intensity
Hate	2.05	1.67 – 2.49	2	Low intensity
Anger	2.01	1.67 – 2.49	2	Low intensity

(a)

Emotions	Mean	Intensity Range	Intensity Level	Emotion State
Interest	3.02	2.50 – 3.32	3	Neutral
Amusement	3.13	2.50 – 3.32	3	Neutral
Pride	3.09	2.50 – 3.32	3	Neutral
Joy	3.01	2.50 – 3.32	3	Neutral
Pleasure	3.1	2.50 – 3.32	3	Neutral
Contentment	3.16	2.50 – 3.32	3	Neutral
Love	2.91	2.50 – 3.32	3	Neutral
Admiration	3.15	2.50 – 3.32	3	Neutral
Relief	3.04	2.50 – 3.32	3	Neutral
Compassion	2.85	2.50 – 3.32	3	Neutral
Sadness	2.04	1.67 – 2.49	2	Low intensity
Guilt	2.01	1.67 – 2.49	2	Low intensity
Regret	1.99	1.67 – 2.49	2	Low intensity
Shame	2.06	1.67 – 2.49	2	Low intensity
Disappointment	2.04	1.67 – 2.49	2	Low intensity
Fear	2.15	1.67 – 2.49	2	Low intensity
Disgust	2.1	1.67 – 2.49	2	Low intensity
Contempt	2.13	1.67 – 2.49	2	Low intensity
Hate	2.1	1.67 – 2.49	2	Low intensity
Anger	2.13	1.67 – 2.49	2	Low intensity

(b)

Figure 3. The user emotional responses as for (a) SMART2 LMS and (b) SMARTv3 LMS

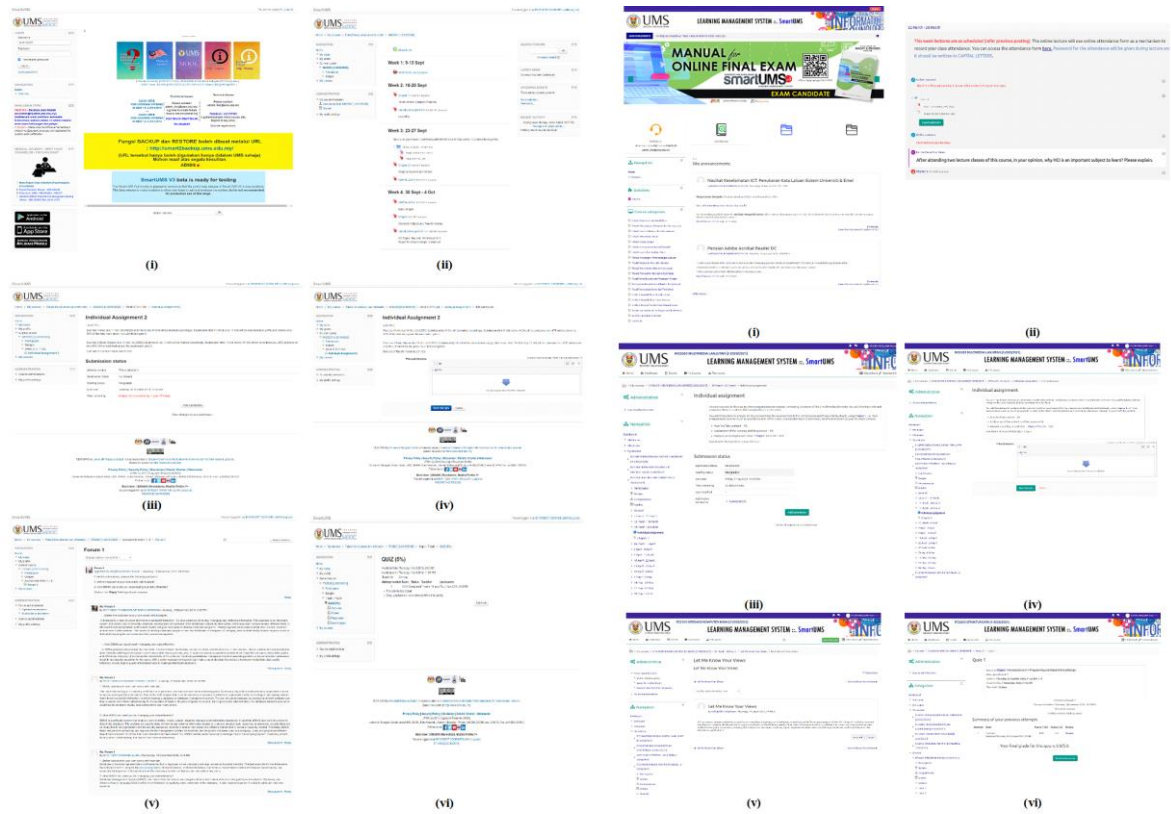


Figure 4. Selected interfaces for LMS of (a) SMART2 and (b) SMARTv3. The interfaces consist of (i) homepage; (ii) course page; (iii) assignment view; (iv) assignment submission; (v) forum; (vi) quiz

3.2. Emotional design factors

Survey transcripts were extracted from the 50 responses of higher learning institutions. Based on the analysis, the thematic map depicts the persuasive flow of data on the subject. For example, the thematic map in Figure 5 shows that the respondents must analyse the selected LMS interfaces state their justifications or comments towards interfaces. Then, this study had to get familiar with all the data received, generate the initial codes of the data, search for the specific themes, review, and define the themes to identify and develop categories and elements of LMS emotional design. The developed categories and elements were then mapped with the types of emotional design by [15] from the literature, hence illustrated the concept of emotional design for LMS.

This study reviewed the generated codes and organised them into themes. A positive justification theme was created from a collection of coded phrases that visualised the respondents' liking for the interfaces. The code examples such as:

- "…I feel happy because of the interface is little bit colourful and many information there.." [R2,S1I1].
- "…It is very detailed and arranged show every week assessments. Easy to look.." [R42,S1I2]
- "…able to know whether succed to submit the assignments…" [R8,S2I4]
- "…like a community to share idea and information.."[R45,S2I6]

While various coded lines from data relating to respondents' dislike of interfaces were grouped into another theme called negative justification. For instance, the code stated as the following:

- "…timeline of due date is not obvious…" [R1,S1I3]
- "…no appropriate title for the forum, and presenting the comment in full is somehow stress…" [R22,S1I5]
- "…lack of colours and…less interesting.." [R40,S2I1]
- "…I sad if i late submit my work.." [R4,S2I4]

As a result, this study identified 21 elements and 11 categories mapped to three themes of emotional design. Table 2 shows the framework of emotional design for LMS. The framework consists of emotional design types, categories and elements.

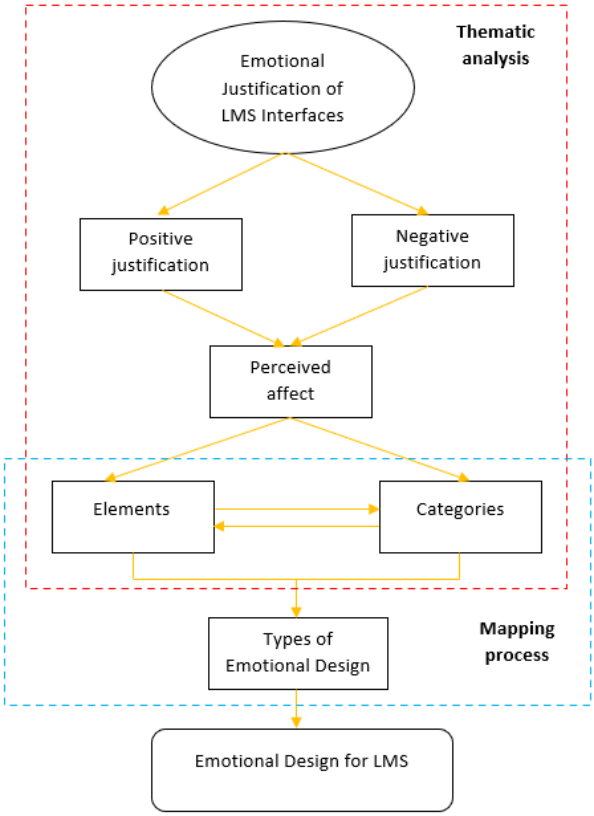


Figure 5. The thematic map on respondents emotional justifications of LMS interfaces

Table 2. Framework of emotional design for LMS

Types	Categories	Elements
Visceral	Text	Font style
		Font colour
	Colour scheme	Monochromatic
		Dichromatic
		Colourful
	Image	Attractive image
		Animated picture
	Interface appealingness	Neat look
		Simple interface design
Behavioural	Layout	Flow of control
		Arrangement of elements
	Navigation	Consistent structure
		Clear hierarchical structure
	Learnability	Ease of use
	Functionality	System function
		Notification
	Content design	Information quality
		Information representation style
Reflective	Self-reflection	On-time submission
		Task completion
	Sociality	Communication with others

The elements were mapped based on the analysis of [15] that concluded the visceral level is based on the visual look of a product or system; the behavioural level is based on the satisfaction and usability from interaction with the product or system; reflective level represents the rationalisation of the product and its value to self-image. Thus, four categories; Text, Color scheme, Image and Interface appealingness, were mapped to the visceral level. Those categories are related to the appearance of the LMS. Another five categories, layout, navigation, learnability, functionality, and content design, were mapped to the behavioural level, while the reflective level is associated with Self-reflection and Sociality.

The second aim of this study is to determine the emotional design elements of a learning management system. Since previous research [4]-[7] investigated emotional design through specific elements, this study has taken a different path where the emotional design is extracted from the user feedbacks. As a result, our study discovered several elements which appeared to be different from the mentioned emotional design elements found from the previous studies, such as interface appealingness, navigation, learnability, functionality, content design, self-reflection and sociality. For example, the Interface appealingness refers to the overall look and feel of the LMS design compared to the text, color scheme, and image categories referring to specific items. Navigation provides the structure for the user to interact or navigate through the course content. Therefore, a consistent structure through each interface and a clear hierarchical structure of the navigation menu will influence user performance in the interaction. A Learnability is defined as a system that is easy to learn, which parallels the definition provided by [14], [30]. Thus, for a system to be easy to learn, it should be easy to use, putting the ease-of-use element under the Learnability category. Both learnability and ease of use were also found as the elements that triggered user emotions in the use of persuasive technology [14]. Functionality consists of two elements, i) system function and ii) notification. User emotions were affected by the system function merely because either the user was successful or unsuccessful in using the provided functions. The notification, either for reminding or inform, will initiate the user to behave or interact accordingly with the notified subject. For example, a notification that reminds the assignment due date will initiate the user to upload the assignment into the system by navigating to the assignment submission interface. In addition, previous research in persuasive technology [14] supports the discovery of the content design category that is about serving the user with the information they need. This content design will be affected by the information quality and the information representation style. The information quality determines the information's accuracy and completeness, while the information representation style defines the approach used in delivering the information. The LMS allows for individual and social use. This ability has formed the Sociality and Self-Reflection category, both the reflective level of emotional design. Sociality refers to the elements that allow for interaction with others, such as coursemates or lecturers. This Sociality feature provides the user with a sense of connection with others, making the learning process more effective. Self-reflection provides the value for users to reflect on themselves. Furthermore, both Sociality and Self-Reflection provide the meaning of having LMS as the blended learning tool. Other categories from previous research which appeared in our findings are Text, Colour Scheme, Image and Layout.

As a limitation of the study, we have eliminated nearly 20 per cent of the users' feedback to be analysed due to the respondents' brief answers that were difficult to determine which themes should the data be included and required us to interpret the given answers were trying to refer. However, in a future study, it is recommended to integrate an eye-tracker to capture the elements that trigger user emotions to confirm their feedback.

4. CONCLUSION

Our research is looking into whether the design of a learning management system impacts learners' emotional states and whether emotional design components impact their emotions. Whereas earlier research has effectively demonstrated the efficiency of specific emotional design features in terms of emotion induction and learning, our research aims to present a more differentiated perspective on what other design aspects might be considered to induce user emotion. We thoroughly evaluate the user emotions using GEW, looking at the emotional states' positive and negative (valence) states and the emotional intensity (activation). The results did not meet our expectations when none of the positive and negative emotional states showed a strong activation level. However, somehow it shows that the LMS designs are generally thought to be free of severe design defects, and it facilitates the interest or motivation in learning. In addition, the current study also managed to discover other design features apart from the features investigated in previous research. These features, Navigation, Learnability, Functionality, Content design, Self-reflection and Sociality, are the emotional design features that should be considered when designing a learning management system. In conclusion, this study has contributed to the emotional design concept, further validated through empirical framework study.

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REFERENCES

[1] D. C. Simionescu, "The impact of emotional design on the effectiveness of instructional materials," PhD. Dissertation, Ohio University, 2020.

[2] K.-K. Teoh and S. H. Lau, "Emotion based LMS: an investigation of user perceptions and attitudes," *International Journal of Learning and Teaching*, vol. 1, no. 2, pp. 154–160, 2015, doi: 10.18178/ijlt.1.2.154-160.

[3] K. R. Scherer, "What are emotions? and how can they be measured?," *Social Science Information*, vol. 44, no. 4, pp. 695–729, Dec. 2005, doi: 10.1177/0539018405058216.

[4] E. R. Um, J. L. Plass, E. O. Hayward, and B. D. Homer, "Emotional design in multimedia learning," *Journal of Educational Psychology*, vol. 104, no. 2, pp. 485–498, May 2012, doi: 10.1037/a0026609.

[5] S. Heidig, J. Müller, and M. Reichelt, "Emotional design in multimedia learning: Differentiation on relevant design features and their effects on emotions and learning," *Computers in Human Behavior*, vol. 44, pp. 81–95, Mar. 2015, doi: 10.1016/j.chb.2014.11.009.

[6] J. L. Plass and U. Kaplan, "Emotional design in digital media for learning," in *Emotions, Technology, Design, and Learning*, Elsevier, 2016, pp. 131–161.

[7] L. Stark, R. Brünken, and B. Park, "Emotional text design in multimedia learning: A mixed-methods study using eye tracking," *Computers and Education*, vol. 120, pp. 185–196, May 2018, doi: 10.1016/j.compedu.2018.02.003.

[8] J. A. Kumar, M. Balakrishnan, and W. A. J. W. Yahaya, "Emotional design in multimedia learning: how emotional intelligence moderates learning outcomes," *International Journal of Modern Education and Computer Science*, vol. 8, no. 5, pp. 54–63, May 2016, doi: 10.5815/ijmecs.2016.05.07.

[9] R. E. Mayer and G. Estrella, "Benefits of emotional design in multimedia instruction," *Learning and Instruction*, vol. 33, pp. 12–18, Oct. 2014, doi: 10.1016/j.learninstruc.2014.02.004.

[10] J. Li, C. Luo, Q. Zhang, and R. Shadiev, "Can emotional design really evoke emotion in multimedia learning?," *International Journal of Educational Technology in Higher Education*, vol. 17, no. 1, p. 24, Dec. 2020, doi: 10.1186/s41239-020-00198-y.

[11] T. K. F. Chiu, M. S. Y. Jong, and I. A. C. Mok, "Does learner expertise matter when designing emotional multimedia for learners of primary school mathematics?," *Educational Technology Research and Development*, vol. 68, no. 5, pp. 2305–2320, Oct. 2020, doi: 10.1007/s11423-020-09775-4.

[12] S. (Fone) Pengnate and R. Sarathy, "An experimental investigation of the influence of website emotional design features on trust in unfamiliar online vendors," *Computers in Human Behavior*, vol. 67, pp. 49–60, Feb. 2017, doi: 10.1016/j.chb.2016.10.018.

[13] N. Jiang, X. Feng, H. Liu, and J. Liu, "Emotional design of web page," in *9th International Conference on Computer-Aided Industrial Design and Conceptual Design: Multicultural Creation and Design-CAIDCD 2008*, Nov. 2008, pp. 91–95, doi: 10.1109/CAIDCD.2008.4730526.

[14] W. N. W. Ahmad, N. M. Ali, and A. R. A. Rodzuan, "Understanding user emotions through interaction with persuasive technology," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 9, pp. 225–235, 2020, doi: 10.14569/IJACSA.2020.0110926.

[15] D. A. Norman, *Emotional design: Why we love (or hate) everyday things*, 1st ed. New York: NY: Basic Books,.

[16] X. Li, W. Zhao, Y. Zheng, R. Wang, and C. Wang, "Innovative product design based on comprehensive customer requirements of different cognitive levels," *Scientific World Journal*, vol. 2014, pp. 1–11, 2014, doi: 10.1155/2014/627093.

[17] J. A. Kumar, W. A. Jaafar, and W. Yahaya, "Emotional design in multimedia: does gender and academic achievement influence learning outcomes?," *Malaysian Online Journal of Educational Technology*, vol. 4, no. 3, pp. 37–50, 2016.

[18] K. Warpechowski, D. Orzeszek, and R. Nielek, "Tagging emotions using a wheel user interface," in *ACM International Conference Proceeding Series*, 2019, pp. 1–5, doi: 10.1145/3351995.3352056.

[19] K. R. Scherer, V. Shuman, J. R. J. Fontaine, and C. Soriano, "The GRID meets the Wheel: Assessing emotional feeling via self-report1," in *Components of Emotional Meaning*, Oxford University Press, 2013, pp. 281–298.

[20] V. Sacharin, K. Schlegel, and K. R. Scherer, "Geneva Emotion Wheel Rating Study (Report)"," *Geneva*, 2012.

[21] T. Michl, I. M. Welpe, M. Spörrle, and A. Picot, "The role of emotions and cognitions in entrepreneurial decision-making," in *Understanding the Entrepreneurial Mind*, New York, NY: Springer New York, 2009, pp. 167–190.

[22] P. Gendall, J. Hoek, and K. Gendall, "Evaluating the emotional impact of warning images on young adult smokers and susceptible non-smokers," *Journal of Health Communication*, vol. 23, no. 3, pp. 291–298, Mar. 2018, doi: 10.1080/10810730.2018.1440332.

[23] M. Mahachandra, H. Prastawa, N. Susanto, and D. Y. Susilo, "Perception analysis of microsoft windows OS users," *E3S Web of Conferences*, vol. 73, p. 12008, Dec. 2018, doi: 10.1051/e3sconf/20187312008.

[24] L. Reader and C. Mcmahon, "Using online product reviews to assist design for emotion," in *5th International Congress of International Association of Societies of Design Research*, 2013, pp. 2598–2609, [Online]. Available: www.amazon.com.

[25] M. Feidakis, T. Daradoumis, S. Caballé, J. Conesa, and D. Gañán, "A dual-modal system that evaluates user's emotions in virtual learning environments and responds affectively," *Journal of Universal Computer Science*, vol. 19, no. 11, pp. 1638–1660, 2013, doi: 10.3217/jucs-019-11-1638.

[26] F. Zhang, P. Markopoulos, and T. Bekker, "The role of children's emotions during design-based learning activity: A case study at a Dutch high school," in *CSEDU 2018 - Proceedings of the 10th International Conference on Computer Supported Education*, 2018, vol. 2, pp. 198–205, doi: 10.5220/0006667901980205.

[27] P. Turumugon, A. Baharum, N. H. Nazlan, N. A. M. Noh, N. A. M. Noor, and E. A. Rahim, "Users' emotional evaluation towards kansei-based higher learning institution website using geneva emotion wheel," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 16, no. 3, pp. 1547–1554, Dec. 2019, doi: 10.11591/ijeecs.v16.i3.pp1547-1554.

[28] V. Pakarinen, "Mobile shopping experience: the factors and emotions affecting the shopping experience on a smartphone," Master Thesis, Turku, Finland, 2020.

[29] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.

[30] J. Xu, K. Le, A. Deitermann, and E. Montague, "How different types of users develop trust in technology: A qualitative analysis of the antecedents of active and passive user trust in a shared technology," *Applied Ergonomics*, vol. 45, no. 6, pp. 1495–1503, Nov. 2014, doi: 10.1016/j.apergo.2014.04.012.

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