

## Screen Design Considerations for Designing an Electronic Brainstorming Software

**Tan Choon Keong**

Faculty of Psychology and Education  
Universiti Malaysia Sabah, Malaysia

**Kang Hwa Choo**

Malaysia Institute of Education (IPG)  
Kent Campus, Sabah, Malaysia.

### ABSTRACT

This paper discusses a study carried out with the purpose of developing and evaluating a prototypical electronic software that captures a brainstorming session. The created brainstorming system, which was part of an integrated system, was tested with a volunteer group of 10 undergraduates of a public university in a computer laboratory. A popular topic on tourism was used as a catalyst to generate ideas for the brainstorming activity. Students' feedback on the efficacy of the system was elicited via structured interviews. Findings revealed that there was a need for creating a good, user-friendly interface for manoeuvring between pages; a clear and easy-to-understand instruction; and a good contrast of displayed text and graphics. Further discussion comparing the improved version with that of the earlier version of the software is presented. Recommendations pertaining to good practices of good screen designs are also discussed.

**KEYWORDS:** brainstorming, morphological analysis, integrated system, screen design principles

### INTRODUCTION

Traditionally, when a company CEO or the manager of an organization needs ideas to solve various current problems or issues, he/she will usually recommend a brainstorming session to be conducted. A venue in a form of a room or even hall (if participants are many) are usually selected and the session being conducted and facilitated by the CEO or his/her representatives to get the needed inputs or ideas. The researchers are investigating the possibility of conducting brainstorming not in the traditional way but rather by taking advantage of the computing power to achieve the objective of brainstorming for ideas. The two main research questions for this study are:

1. Can the computer conduct and manage a brainstorming session?
2. What are the good screen design considerations that can be adhered to produce an attractive, successful and workable integrated computer-based system?

### REVIEW OF LITERATURE

Brainstorming is defined as the generation of as many ideas as possible under 'suspend judgment' (free-wheeling) condition (Rawlinson, 2004; Vidal et al., 2004). It is also a method for stimulating the spontaneous generation of ideas and is based on two principles and four rules (Vidal et al., 2004). Since judgemental thinking often emerges as the dominant force in problem-solving, therefore brainstorming often emphasises the principle of deferred judgement to enable the creative part of the mind to generate more ideas. This is because a

relaxed and judgement-free atmosphere encourages the flow of ideas which would be severely impeded if participants were allowed to convey their judgement on each idea (Majaro, 1988). The second principle states that quantity breeds quality and the possibility of the existence of a big 'solution bank' will definitely solve a problem. In brainstorming, usually the wildest, insane, practical or even impractical ideas are also accepted.

With the growth of online services, the process of exchanging and building upon the ideas of groups of people has occurred spontaneously (Proctor, 1999). Brainstorming activities had gone online with a new term known as brainlining (combines the words 'brainstorming' and 'online'). For example, now online forums are also known as ongoing brainstorming sessions with free flow of ideas exchanging tremendously. One example of this web site is the *CompuServe's* creativity forum where people train to brainstorm to solve specific problems (Proctor, 1999). According to Binder and Binder (2007), there are two types of brainstorming using computers. The synchronous brainstorming is where all team members are connected at the same time while in asynchronous brainstorming, team members brainstorm at different time zones with the possibility of the identity of the participants omitted.

In this study, the researchers created a system that can conduct brainstorming activity. He incorporated the mechanism of enhancing the production of ideas via a creativity method popularly known as "The Morphology Analysis". The original creator was Dr Fritz Zwicky, a researcher from Caltech USA. The Morphological Analysis (MA) method is designed to generate many alternative solutions for any investigated problem (Roy, 2004). It works through breaking down the key investigation points and associated with the suggested components (Roy, 2004). Table 1 shows an illustrated example of the MA method.

**Table 1: An example of a morphology matrix**

Material	Powered by	Income Groups (USD)	Transportation Type
Metal	Gas	2000	Air
Glass	Electricity	3000	Water
Wood	Solar	4000	Land
Paper	Nuclear	5000	Space

Imagine you want to chart solutions for "future transportation". Table shows a 4 x 4 x 4 x 4 morphological matrix with 256 possible ideas or solutions. Although 256 ideas can be sought but impractical or illogical ones can be ignored. For example, the highlighted components in Table 1 can be combined to come out a new solution named "Flying Glass Cubicle". Manufacturers who will take up this ideas will see production as soon as R&D is completed.

The system for brainstorming created by the researchers is considered to be the asynchronous type under definitions suggested by Binder and Binder (2007). Besides the brainstorming software in this system, the researchers also created another system for the measurement of divergent thinking or creative thinking [as recognised by Guilford (1967; 1977)]. It measures the variable, *fluency*, which is the total number of ideas generated in a sample (Torrance et al., 1992). In this case study, the morphology matrix employed in the brainstorming software supplies ideas to this system to calculate the fluency variable. Other creativity variables are also computed by the system according to definitions by Torrance et al. (1992). In addition to these systems, the researchers also developed multimedia modules for training creativity for a complete creativity study.

All the systems were tested in this case study. As a combined, single system that is complex and integrated (brainstorming, creativity measurement and training) with multiple functions, the

screen and data flow design issues have to be carefully considered and planned. It is easy to create and programmed computer software that that can perform many functions but it is not easy to come up with electronic pages that contain graphics, raw data or information that are presented in an orderly, efficient and easy-to-understand way. The key lies with the application of good design principles for the graphics as well as data flow. Good design principles were found to reduce decision-making time by about 40 percent (Galitz, 1993).

The principles of multimedia designs for electronic pages can be traced back to three important theories. According to the Classic Graphic Design Theory, generally all the text and graphics that are designed must be based on five elements of line, shape, texture, value and colour and space and must be in accordance with the principles of movement, balance, emphasis and unity (Mills and Smith, 1985).

The design of graphical elements on an electronic page can also refer to Gestalt's theory, The Gestalt Principles of Perception. It states that our mind perceives the whole of the picture out of incomplete elements and things are better described as "more than the sum of their parts" (Behrens, 1984; Mullet & Sano, 1995). Graphics put on a page in accordance with The Gestalt Principles are closely associated with the principles of figure and ground, similarity, proximity or contiguity and continuity and closure, area and symmetry.

On the other hand, the popular use of computers beginning 1980's also intensified the careful and effective design of pages that are user-friendly in term of human-computer interactions. The Human-Computer Interface Design Theory states that only electronic messages that can be clearly understood be designed and displayed efficiently (Norman, 1988; Shneiderman, 1998). This theory calls for the proper design of menus, icons, forms, as well as data display and entry screens to facilitate data and information flow.

Later studies on principles of graphics design were mainly based on the variants of the three important theories. For example, Hannafin and Hooper (1989) suggest that good screen design should fulfill the following expectations:

- focus attention on important information
- attract and maintain interest
- promote the integration of new information with previous knowledge
- easy navigation through the information

They also suggest that the screen design for graphics, text and icons must be in accordance with screen grid and layout, line length, screen density, font selection and leading, positioning of icons, buttons and menus and colour. Interface design principles need to be carefully adhered to when designing electronic pages. According to Horswill (2000), by all means, screens must be made easy to understand. He suggests on designing screen layout with uncluttered appearance, columnar structure, so that the reader's eye can move easily from item to item. He further recommends that a screen must be given title and consistency from screen to screen must be maintained for all titles, subtitles, messages, buttons and etc in term of location and with good text-background contrast. Horswill (2000) also reminds on the need to save user's time and patience in using the system. For example, we must make the user change screens as little as possible.

This paper will explore and discuss the design of electronic pages in the computer systems created by the researchers in term of whether they conform to standard screen design principles. Any flaws in the designs will be analysed and presented in coming discussions.

## METHODOLOGY, SAMPLING AND INSTRUMENT

This is a case study used purposive sampling methodology because only convenient subjects who can volunteer to participate were selected for the project. The researcher chose a sample of 10 undergraduates from a public university in Sabah, East Malaysia. These undergraduates were not randomly selected and therefore, no generalisation of the findings is intended in any part of the discussions. The sample size is 10 and consists of 4 male and 6 female subjects.

The computer software created by the researcher that is named as “Ideas Generator” is an integrated system for brainstorming, measuring and training creativity. Certain screens from the system will be discussed in the coming sections in term of its designs. The instrument for this study is the interview. Ten participants who tested on the system were interviewed. The 5 questions that were asked were:

- Are there any graphics that are not relevant to the theme of the software, “Creativity”?
- Are instructions clear and easily understood?
- Name three activities in the software that are too long to complete (start with the longest one first)
- Is the navigation of page to page slow in any part of the software?
- How fast is data or information processed (Ex: save data, display video)? Choose an answer: Fast, Medium or Slow

## FINDINGS AND DISCUSSIONS

### The Electronic Brainstorming Software

This part discusses the possibility of the computer conducting brainstorming activity via the system named “The Ideas Generator”. In answering the first research question of whether a computer is capable of conducting brainstorming, the answer is an absolute “YES”. The result was in agreement with what stated by Binder and Binder (2007) where online brainstorming via the asynchronous method can be done successfully. In this pilot testing of the software, (unlike traditional brainstorming environment) the computer environment did not require any participant to be in contact with other participants. All a participant did was to understand the given problem “Future Transportation in Malaysia” (in 2 brainstorming practices, the pre and post practices) and then posted the ideas via the interfaces of the computer (refer Figure 1).

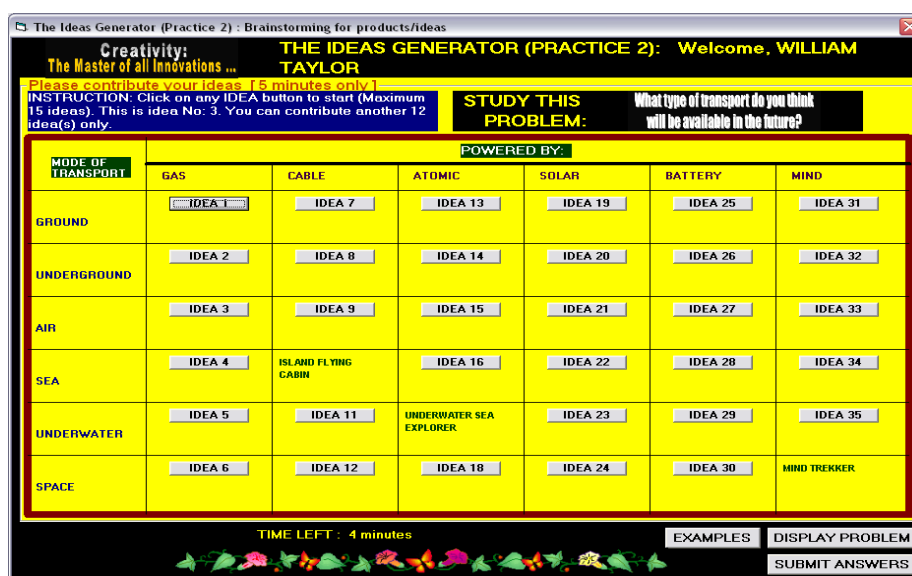


Figure 1: The interfaces for keying in ideas in a brainstorming session

Theoretically, participants can contribute unlimited number of ideas but in real-world environment, everyone is constrained by factors such as time, number of participants, place of brainstorming if numbers is big and etc. The same goes to the computer environment too. For example, everyone is too busy to brainstorm. Therefore, the researchers limited the brainstorming time to five minutes only. This was to allow the participant to make full productive use of the limited time given. Traditionally, ideas of each participant are written and displayed on paper and hang on the surrounding walls of the brainstorming venue. For this computer program, the ideas for each participant were displayed on screen via the click of a button as shown on Figure 2.

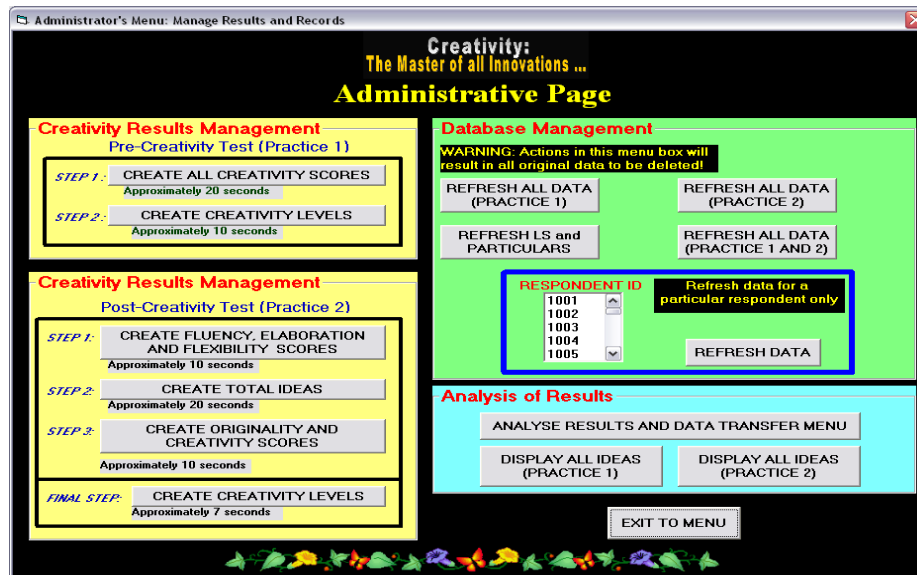


Figure 2: The button for displaying all ideas (bottom right)

The result of the click was shown in Figure 3. For example in the display, the participant named Rita, gave and elaborated on 9 ideas on the brainstorming topic “Future Transportation in Malaysia”. However, in the five minutes given, she was only able to provide 9 out of 15 ideas allocated. In this way, all the participants’ ideas in the sample could be displayed on screen in a single click which was quite organised and fast (less than 5 seconds). However, if we compare this action to the traditional method, it would be very chaotic and tedious to write and paste everyone’s ideas on the board. In this study, the computer was proven to be effective in reducing human copying errors (rewrite ideas to be pasted) and also easily retrieve ideas via saved files whereas the pasted papers, once taken down are difficult to be assembled again back to its original form or format.

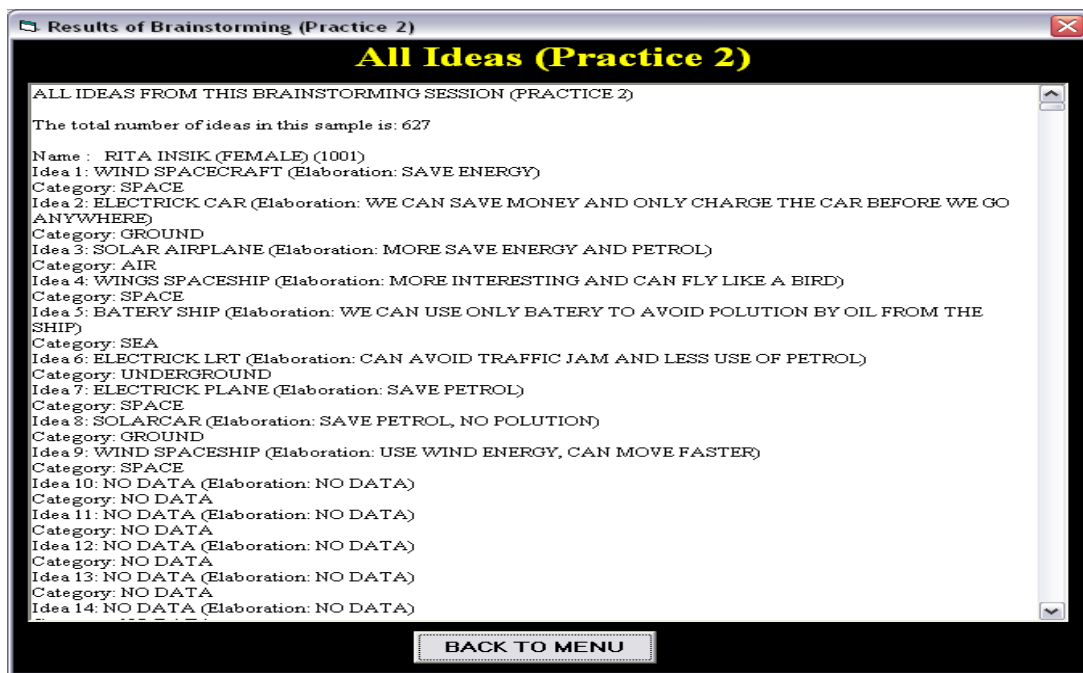


Figure 3: The assembled ideas in a brainstorming session

It is therefore easy, accurate and fast to brainstorm in a computer environment. It saves administrative manpower because no leader is needed to conduct it. As Proctor (1999) puts it, brainlining is a new, effective way to help generate large numbers of ideas. The participants in this study were also in a “self-access and self-directed” environment which conformed to an important multimedia instructions design principle proposed by Schwier and Misanchuk (1993). Contrarily, in the traditional platform, without a leader and someone to record ideas, there can be no brainstorming activity. In a way, this software had its advantages although not absolutely one hundred percent similar to the traditional brainstorming method.

### Screen design flaws and rectifications

All discussions on screen design of the tested system (The Ideas Generator) will be based on evidences collected in the interview with the 10 participants. The full result of the interview is shown in Table 2.

**Table 2: Results of Interview on the use of the system**

	Question	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	In term of graphics and text, do you think there is anything that can be improved on?	Main menu: Your topic is creativity, so what are grass and pineapple for?	Seems okay for me	I think the main menu and other pages must be more attractive, lively with animations	The main menu can have other futuristic graphics such as robot to relate creativity	I don't think grass and pineapple are related to the theme, and the curtain looks ugly	The logo "Are you creative" in Practice 1 should be removed. Not balanced, one-sided	The text-background contrast of the main menu doesn't look attractive enough	Texts are readable, good but, why choose grass and pineapple for menu? Creativity?	I think I like the graphics, looks okay	Text and background contrast can still be improved, graphics look okay for me
2	Are instructions clear, easily understood?	Clear and simple	Clear	Can be understood easily	Clear and simple	Clear	Easy to understand	Clear and easy to understand	Can be understood easily	Easy to understand	Clear and simple
3	Name three activities that are too long to complete (start with the longest one first)	1. LS test very long 2. video 3. intro part	1. video 2. LS test 3. Practices	1. LS test 2. video 3. Practice 1	1. LS test very long 2. video 3. Practice 1 & 2	1. LS test 2. video 3. intro part	1. video 2. LS test quite long 3. intro part	1. LS test very long 2. video 3. Practice 2	1. LS test 2. video 3. the part that shows intro	1. video 2. LS test 3. Practice 1 & 2	1. LS test very long 2. video 3. the practices
4	Is the navigation of page to page slow in any part of the software?	Navigation is smooth except I think video display can be slow sometimes	Entering Practice 1 & 2 is slow, why can't go direct to it instead of giving instructions first?	Navigation is smooth but the instructions between the practices, quite disturbing	I think no need to give instructions between the switching from menu to Practices, others are okay	I think navigation is easy and smooth	I noticed there are instructions given before entering the practices, can be omitted	Navigation is smooth but why need instructions between the practices, make navigation slower	Smooth navigation, but less graphics make accessing speed faster	Navigation is smooth but still can be improved	Why need to read instructions first before entering the practices? Can cut that
5	How fast is data processed (Ex: save data, display video)? Fast, Medium or Slow	Medium	Medium	Fast	Fast	Fast	Medium	Fast	Fast	Fast	Fast

**NOTE: 'P' stands for Participant**

Firstly, the discussion will begin with the design of the main menu page. As shown in Figure 4, there were three graphics at the bottom of the page. The researchers's justification was to make the page colourful to ensure that it did not look too dry or dull so that it could attract user's motivation as in accordance with Keller's ARCS Model of Motivational Design of which the 'A' refers to 'Attention' strategy to arouse and sustain curiosity and interest (Small, 1999). In term of screen layout and density, it adhered to the principles of page design as specified by

Hannafin and Hooper (1989). The result shown on Table 2 on Question 1 revealed that 4 participants questioned the purposes for the two graphics on the left (grass) or the graphic on the right (pineapple). They disagreed that the graphics were related to the theme of the software, creativity. The same question went to the 'hanging curtain' on top of the screen (1 participant commented). However, the flower pattern at the bottom looked acceptable as decorative graphics.

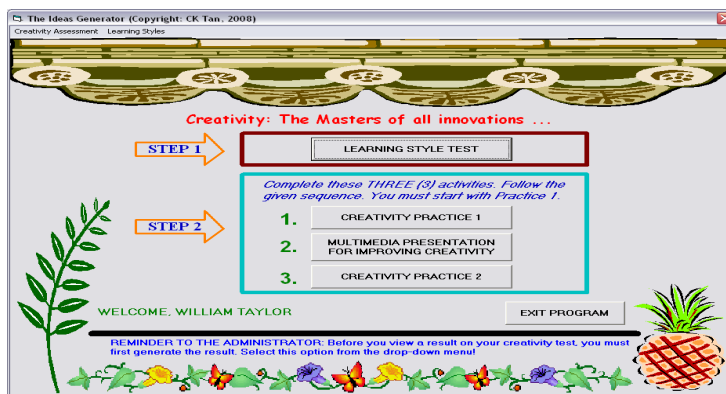


Figure 4: The flawed main menu

After some careful considerations to the principles of page design, the redesigned main menu is shown in Figure 5. The background of the page was blackened to sharpen the contrast of the instructions (text) after taken into considerations comments from 3 participants (Question 1, Table 2). The title of the software on the top and the flowery pattern at the bottom were redeveloped into animated graphics to arouse more attraction because 1 participant commented on that. The arrows for step 1 and 2 were also animated to gain attention of the user (ARCS Model consideration).



Figure 5: The redesigned main menu

To solve the problem of unsuitable graphics, it can also be noted that a futuristic graphic on robot purposely named "Transbot" (Transportation Robot) was loaded to the main menu (1 participant commented, Question 1, Table 2). The welcome section was also repositioned to the upper section of the page to show greater emphasis on the importance of acknowledgment to the user.

On design of instructions, Question 2 in Table 2 reported this. It is good to report that all participants agreed that the instructions on each page were simple, clear and easy to understand. Therefore, the researcher regard this as a non-issue.



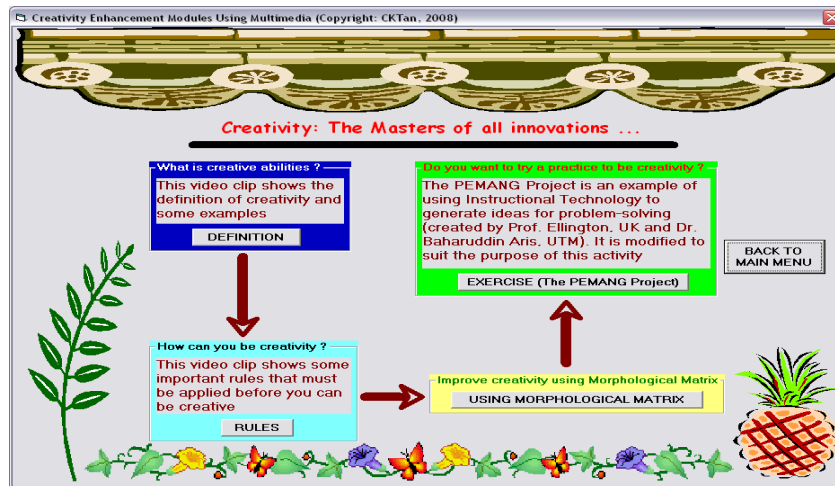


Figure 6: The flawed page on navigation of videos

The respondents also reported that there was a problem with video navigation and the duration of the videos as illustrated in Figure 6. To solve this problem of video clips being too long, the researcher redesigned the flows of video content. The long clip was shortened and redistributed into shorter clips with different sub-section of the theme of the main clip. This solution would help the participants to promote the integration of new information (definition of creativity) with previous knowledge (Hannafin & Hooper, 1989). The new, redesigned page is shown in Figure 7. As we can observe now, the clip on 'definition' had been broken into 6 shorter clips.

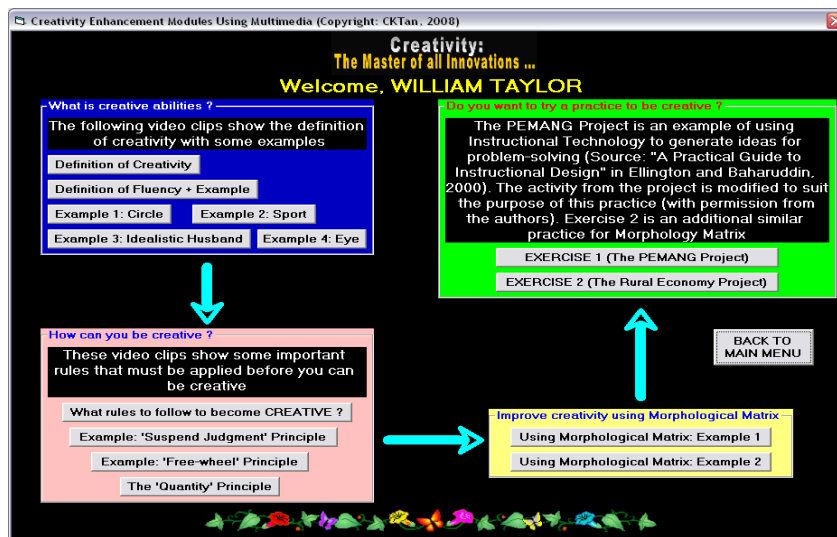


Figure 7: The redesigned page on navigation of videos

According to Question 4 in Table 2, there were 6 participants who questioned on the rationale of putting instructions between main menu and Practice 1 or 2. This issue is illustrated in Figure 8.

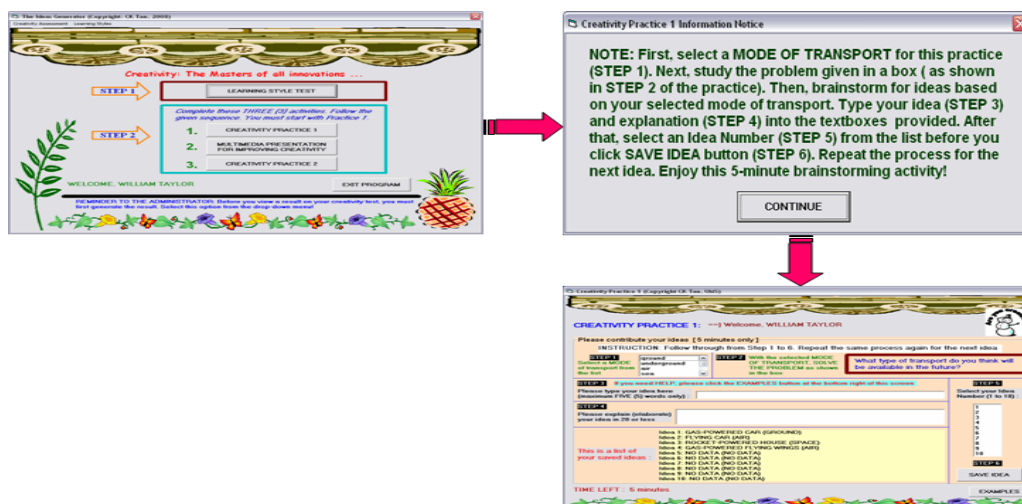


Figure 8: The flawed flows of page that influences navigation

The researcher actually faced problems when using the design tool or the programming tool that produced this software. The researchers used Visual Basic (VB) 6.0 and initially he had technical difficulties in designing the direct link from main menu to Practice 1 due to database technicality. The researcher could not transfer the database data of any selected respondent's ID to a new destination page. This ID was unique for accessing database for direct saving of data. In the flawed design, the researchers broke up the direct link so that the dummy page could be set up to do the 'behind the scene' action of retrieving the user's respondent ID for further data processing purposes which was successful. However, this technical problem was solved after referring to advance programming manual of the VB programming tool. Therefore, the direct link was re-established as shown in Figure 9.



Figure 9: The redesigned direct link from main menu to Practice 1 and 2

Again, the action to maintain direct link from main menu to the required practices was taken in accordance to recommendation by Horswill (2000) who reminded on the need to save user's time and patience in using the system. It was also in consistent with suggestion by Hannafin and Hooper (1989) on the need to maintain easy navigation through the information.

The conclusion for this section is that all good practices of graphics, interfaces and data design recommended by experts were adhered to in the planning and development of the new and redesigned pages for the sake of comfort, effectiveness and user-friendliness of future participants.

## RECOMMENDATIONS

The pilot testing of this integrated prototype system had the following implications:

1. The researcher had proven that a computer was capable and could be programmed to conduct a brainstorming session in an environment different from that of the traditional brainstorming environment. Traditionally, brainstorming in a room packed with participants sometimes tends to restrict or obstruct some creative participants from giving good ideas (Rawlinson, 2004). If the group conductor of the session fails to uphold rules according to 'free-wheeling' and 'no-judgment' principles, then ideas that are original and even illogical or wild are difficult to come by. However, let us assume that the principles are abided with, and then still the traditional session is still a tedious and long one considering the volumes of ideas that need to be compiled and displayed on the board. However in a computer environment as demonstrated in this study, all these problems of compiling and recording ideas were solved via programming with suitable algorithms. Further analysis of ideas was possible with functions such sorting, archiving and even scoring them for specific purposes. One distinctive advantage of using computer for brainstorming was that an individual was able to key in his/her ideas free of feelings of shyness, fear or humiliation for giving foolish ideas in which the boss, conductor or other participants might not like at all during face to face brainstorming (Caverly & MacDonald, 1999).
2. This study also showed that good screen designs were needed to be practised and scrutinised to avoid potential users from abandoning the electronic product. It was also ways to make amendments to mistakes in programming of multimedia instructions and data processing errors that might hamper the achievement of planned objectives of the system being tested (Schwier & Misanchuk, 1993). The researcher recommend that screen design principles are needed to be adhered to at all times as far as the development of computer system is concerned.

## CONCLUSION

This study had proven that a computer could serve as a useful platform for successful and effective brainstorming sessions. In fact, many online programs such as online forums or even blogs are believed to variants of electronic brainstorming programs (Binder & Binder, 2007). These sites compile opinions rather than ideas for specific purposes but the operating modulus are almost similar to what this present system did that was to get ideas and then organised and displayed them. However, brainstorming also has its limitations because it relies heavily on random association and therefore does not always produce original solutions (Proctor, 1999). Nevertheless, the researchers recommended that in the future, more cyber venues on specific online brainstorming should be developed and used for brainstorming activities. This would surely benefit the industries and societies at large.

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