USING HYBRID LEARNING MODEL TO EHANCE PUBLIC'S SCIENTIFIC LITERACY

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Abstract

Informing public's scientific literacy via the World Wide Web is increasingly emerging. As such, this paper provides insights on a hybrid learning model for multimedia design conceptualized from the Piagetian science learning cycle model and the Kolb's experiential learning cycle model. This hybrid learning model represents learning as a cognitive process and is intended to address both conceptual understanding and learning styles inclinations. The inquiry-based pupil-centred science learning cycle represents an inductive application of information processing models of teaching and learning. Indeed, results from cognitive studies have revealed that the model that is closest to the way we learn is that of the science learning cycle. For the experiential learning cycle model, the central idea is that learning requires both a grasp or figurative representation of experiences and some transformation of that representation. Research studies on multimedia design have found this experiential learning cycle model to be a useful framework for organizing interactive multimedia activities to address learning styles. Global warming as an example is used to illustrate the application of this hybrid learning model to develop an e-learning product to enhance public's scientific literacy. Instructional storyboarding is provided to illustrate some of the processes elicited such as thinking skills, self-questioning as well as the science of instruction in multimedia learning design principles.

Keywords: Multimedia learning, Science learning cycle, Experiential learning cycle

1. Introduction

The process of design and development of multimedia learning materials to be delivered in the World Wide Web often need to be guided by sound educational theories [1, 2]. Although developers of multimedia learning environments often have enormous amount of information, proven instructional methods and powerful multimedia systems, it is still a difficult task to create and produce effective multimedia materials. This is more so especially due to lack of effective yet practical design model for organizing and designing multimedia materials [3, 4].With this in mind, the following sections provide an insight on a conceptualized hybrid learning model for interactive multimedia learning and its pedagogical application using global warming as a example to enhance public's scientific literacy and the public is viewed as the learner.

2. Hybrid Learning Model Framework

The hybrid learning model [5] is different from the traditional model of "Transmit-Receive' which when applied to multimedia learning, has so far failed to engage learners in meaningful learning [6]. As such, this hybrid learning model for the design of multimedia aims to enhance concept learning as well as to cater to different learning styles. The theoretical basis of this hybrid learning model is derived from the Piagetian science learning cycle model and the Kolb's experiential learning cycle model. Results from cognitive studies have revealed that the model that is closest to the way we learn is that of the Piagetian learning cycle model. This inquiry-based student-centered science learning cycle represents an inductive application of information processing models of teaching and learning. It has three phases in a cycle: exploration, concept invention and concept application [7, 8, 9]. The exploration phase focuses on "what did you do?" while the concept invention phase centers on "What did you find out". In other words, "Is there any pattern to the data acquired?" and "What does it mean?" The third phase is for the concept application.

The Kolb's experiential learning cycle [10] represents learning as a process of translating experiences into concepts, in a cycle of four stages, namely, concrete experience, reflective observation, abstract conceptualization and active experimentation. The concrete experience stage focuses on "doing". The next stage, reflective observation is about the "understanding the doing". The abstract conceptualization stage focuses on the "understanding" part while the stage of active experimentation is about "doing the understanding". This stage allows application and links theory and practice. Indeed, Kolb's research has led to four learning style inclinations: accommodator, diverger, assimilator and converger. A learning style inventory has also been developed by Kolb [10] to help learners know their strengths and weaknesses. It measures the learner's preferences in the four stages of learning cycle. A preferred learning style is indicated by preference of one or more stages over others. Learning styles are also concluded as an important factor in computer-based training and learning [11].

Hence, a synthesis of both the Piagetian science learning cycle model and Kolb's experiential learning cycle model has evolved a hybrid learning model. This hybrid learning model termed the TSOI© model represents learning as a cognitive process in a cycle of four phases: **T**ranslating, **S**culpting, **O**perationalizing, and **I**ntegrating. This model is intended to address both concept learning and learning style inclinations. Figure 1.show the four phases of the TSOI© model of learning.

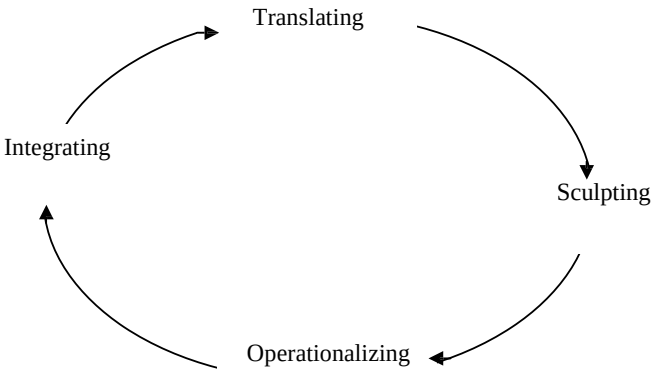

Figure 1. TSOI© model of learning

3. Pedagogical Application

For illustration, global warming in the context of public's scientific literacy is used. In the Translating phase, the activity explores the consequences of an increase in global warming through a video clip. The video experiences are translated into a beginning idea or concept of global warming as shown in Figure 2 as part of instructional storyboarding.

S/N	Animation	Narration	Text on Screen
1.1b	End of activity, video clip showing the scenario of what happens during an increase in global warming remains. Next, narrate. End of this narration, the option button for learner to view & pause the video clip is displayed. Next, narrate. End of narration, a Pop-up response box (Your Observations) for selection of responses / Enter. Pop-up response box as in diagram B. Pop-up feedback box (Our Observations) as in diagram C. For each response selected within the response box, cue learner to click to next line which is displayed within the feedback box for learner to compare. After which, cue learner to click to proceed to check one's response selected earlier. Provide positive strokes, e.g 'good try' for incorrect answer, 'well done' for correct answer. Diagrams, response box and feedback box are to be on the same fixed screen.	Seems like our atmosphere has been taken for granted. What has happened? Can these unfortunate events be avoided? Is a there a part for you to play in keeping our atmosphere clean and healthy? You can view and pause the video at any time. You are to select your appropriate response after watching the video.	**Global Warming** *What has happened?*

Figure 2. Instructional storyboard for translating phase

These multimedia experiences are then further engaged in the Sculpting phase. This takes place in the form of a series of logical events of content sequencing, learner reflecting and guiding as shown in Figure 3 as part of instructional storyboarding.

S/N	Animation	Narration	Text on Screen
1.2b	End of activity, both pictures remain showing the scenario of damaged ozone layer and burning of fossil fuels and the respective rise in temperature (diagram H and diagram I). Next, narrate the 1st line of narration. 2s pause before narrating the next narration. Again, 2s pause before narrating the last narration End of narration, a Pop-up response box (Your Observations) for input of responses / Enter. Pop-up response box as in diagram J. Pop-up feedback box (Our Observations) as in diagram K. For each response within the response box, cue learner to click to next line which is displayed within the feedback box for learner to compare. Narrate each feedback clicked to by the learner as in diagram K. End of each narrated feedback, cue learner to proceed to the next response to be keyed in. Diagrams, response box and feedback box are to be on the same fixed screen.	Compare the two scenarios. What have you observed in terms of the rise in temperature? How are the observations in this activity alike?	**Global Warming** *Physical Meaning*

Figure 3. Instructional storyboard for sculpting phase

The activity in Figure 3 provides a path for infusing thinking skills and consolidating the understanding of the physical meaning of global warming and its relationship to carbon dioxide as the root cause of global warming. The scenario of a damaged ozone layer due to release of CFCs to the atmosphere reacting with the ozone layer serve to inform that it is a misconception that a damaged ozone layer which allows more UV rays to enter is the root cause of global warming although it does contribute to some extent. Basically, the greenhouse gases such as carbon dioxide and methane contribute to the so called greenhouse effect in which the heat is trapped within the earth's atmosphere leading to global warming. This is an essential observation that will emerge from the activities designed in the Sculpting phase. Besides, the learner has the opportunity to check the observations made to the feedback given.

In this Sculpting phase, the idea or concept still in its beginning or raw form is sculpted or shaped by various meaningful and relevant activities to give rise to a form that is more concrete conceptually. Besides, self-questioning is embedded and the use of conversational style as in the personalization principle [2] is also applied. Generic questions such as "How are the observations in this activity alike?", "How do you do it?, are provided for self-questioning.

Information of the idea or concept is discovered through the learner's own observations by participating in these activities. The thinking process is focused by questions that inform the learner about the specific thinking skill the learner will use in acquiring and processing the content. For example, questions infused with the thinking skills such as observe, compare, predict, hypothesize, etc are provided. Conceptually, one of the key points to be observed is the trapping of the heat rays within the earth's atmosphere by the greenhouse gases.

This is essential to understanding the different variables & various sources involved in the activity of the third phase, the Operationalizing phase. This entails meaningful functionality whereby the idea or concept is operationalized. Relevant quantitative data or information is provided for a more meaningful formation of the concept as shown in Figure 4 as part of instructional storyboarding.

S/N	Animation	Narration	Text on Screen
1.3c	Narrate. End of narration, display scenario diagram B for global warming simulation. Next, cue learner to manipulate the 6 variables (a) the amount of carbon dioxide gas to be emitted, (b) the amount of methane gas to be emitted, (c) the amount of chlorofluorocarbons to be released, (d) the number of plots of forests to be burnt for agricultural purpose, (e) the number of plots of mangrove swamps to be destroyed, (f) the amount of certain pollutants, for example, carbon monoxide, nitrogen oxides and sulphur dioxide to be present To each variable, try to have a source or sources. For example, provide sources such as burning of fossil fuels in power plants and as well as in heavy industry, household products containing chlorofluorocarbons, parts of the earth more prone to man-made forest fires, parts of the earth more prone to mangrove swamps being destroyed, incomplete combustion of carbon-containing substances, for example, in motor vehicles' internal combustion engines; lightning activity; volcanoes and combustion of fossil fuels for the learner to select accordingly i.e. variable and source(s) to correspond. For each variable manipulation e.g increasing or decreasing the amount of substance; and increasing or decreasing the number of plots burnt or destroyed; there should be a corresponding match to the events happening i.e. the consequences as in diagram B1(i), B1(d) to B6 (i), B6 (d) where (i) is for increasing and (d) is for decreasing. Note the many possible combinations arising from manipulating the variables. Also, *narrate accordingly to diagram B1(i), B1(d) to B6 (i), B6 (d) with the corresponding variable manipulated. Diagrams, response box and feedback box are to be on the same fixed screen.	You are to simulate your global warming. *(Narrate text accordingly to displayed diagram B1(i), B1(d) to B6 (i), B6 (d) as in narrated text B1.1(i), B1.2(d) to B6.1 (i), B6.2 (d).)	**Global Warming** *Understanding: A Simulation*

Figure 4. Instructional storyboard for operationalizing phase

The activity in Figure 4 emphasizes an awareness of the different sources major or minor that may or may not contribute to global warming and the possible health and environmental consequences of an increase in global warming. The different variables provided as part of the simulation of global warming are manipulated by the learner.

For example, variables provided in a quantitative form such as the amount of carbon dioxide gas as well as the amount of methane gas to be emitted, the amount of chlorine containing compounds, chlorofluorocarbons released, the number of plots of forests burnt for agricultural purpose, number of plots of mangrove swamps destroyed, the amount of certain pollutants, for example, carbon monoxide, nitrogen oxides and sulphur dioxide are used.

For example, various sources such as burning of fossil fuels in power plants and as well as in heavy industry, household products containing chlorofluorocarbons, parts of the earth more prone to man-made forest fires, parts of the earth more prone to mangrove swamps being destroyed, incomplete combustion of carbon-containing substances, for example, in motor vehicles' internal combustion engines; lightning activity; volcanoes and combustion of fossil fuels are provided for the learner to select accordingly. Another possible scenario is the carbon cycle in which the level of carbon dioxide is regulated and how the upset of the carbon cycle may affect global warmimg.

With these concrete and visual multimedia experiences, the learner will be able to construct a more scientific as well as a holistic view of what global warming is all about including the root cause, the contributing sources as well as the consequences arising from an increase in global warming. This will be furthered strengthened in the Integrating phase as shown in Figure 5 as part of instructional storyboarding.

S/N	Animation	Narration	Text on Screen
1.4b	Narrate and display Diagram B. Titled Global warming: Carbon dioxide levels highest in 650,000 years. (Acknowledged from the source, the channelnewsaia.com dated 25 Nov 2006) Provide learner a scroll button if article does not fit screen. Font size must be reasonable for reading.	A story for you.	**Global Warming** *Carbon dioxide level: 27% higher!*
	5 mins before narrating. End of narration, provide a 'Proceed' button. Animate the 'Proceed' button.	Are you ready to proceed?	
	When learner clicks the 'Proceed' button, narrate.	Is a there a part for you to play in keeping our atmosphere clean and healthy?	
	End of narration, 2 min pause before narrating. End of narration, a Pop-up response box (What can I as a citizen of the Earth do to keep our atmosphere clean and healthy? and narrate. Pop-up response box as in diagram C.	What can you do? What can I as a citizen of the Earth do to keep our atmosphere clean and healthy?	**Global Warming** *What can I do?*
	When learner has finished the above input, narrate and provide some options for learner to select e.g a school teacher, a student, a scientist, a parent, government employee, etc. Pop-up response box as in diagram D.	What if you are a …, what would you like to do to keep our atmosphere clean and healthy?	
	End of the above activity, provide an animated 'Our suggestions' button and narrate. Pop-up feedback box (Our Suggestions) as in diagram E. Response box and feedback box are to be on the same fixed screen.	How about looking at some of our suggestions?	

Figure 5. Instructional storyboard for integrating phase

The activity in Figure 5 provides a focal point for the learner to consolidate what the learner has been acquiring throughout the learning process in the three phases to then apply to the different scenarios. In other words, it's a time for not only reflection but also application by the learner.

For example, the use of a newspaper article from local news that can be easily updated & uploaded for the specific activity concerned. For example, another scenario involving the bird flu virus in which the learner is engaged in the activity to think along the line of how that can upset the natural ecological system that may lead to a possible increase in global warming and what can be done to avoid this situation that may become a potential threat or problem to mankind. Where appropriate, certain thinking skills such as observing, comparing, analyzing as well as predicting are infused in the relevant activities.

4. Conclusion

The need to first identify the salient features of the concept is essential so that a variety of relevant and meaningful activities in the 4 phases can then be "crafted" to assist the learner to identify these critical features and eventually leading to acquisition of concept mastery and exposure of learner styles inclinations.

In this case, the use of the instructional storyboarding to illustrate pedagogical application of the TSOI© model for the design of the multimedia learning materials for enhancing public's scientific literacy on global warming is generic in nature. The rationale being this will depend on the context in which public's scientific literacy is addressed to. For example, if the context is in a science centre setting which besides, serving the public but also educational institutions then one can have competitions such as posters or essays writing to raise the level of understanding global warming. For example, if the context is in a school curriculum review setting, one can have integrating global warming in the science syllabus and providing the relevant resources such as videos or printed text or even mini experimental kits.

The Translating phase is similar to exploration phase of the Piagetian science learning cycle model and concrete experience stage of Kolb's experiential learning cycle. Misconceptions can also be confronted in the Sculpting phase which is similar to concept invention phase of the Piagetian science learning cycle model and reflective observation stage of the Kolb's experiential learning cycle.

The Operationalizing phase similar to the abstract conceptualization stage of the Kolb's experiential learning cycle involves increasing the understandings of the relationship between thinking and concept acquisition and prepares the learner to be operationally ready for applications in the Integrating phase which is similar to the application phase of the Piagetian science learning cycle model as well as the active experimentation of Kolb's experiential learning cycle.

Equally important is also the knowledge and application of multimedia design principles, for example, principles of Multimedia, Contiguity, Modality, Redundancy, Personalization and Coherence [2]. In essence, the TSOI© model of learning, a hybrid learning model for multimedia learning will have the capacity to address both concept learning and learning style inclinations.

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