The SAMAL Model for Affective Learning:
A multidimensional model incorporating the body, mind and emotion in learning

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Abstract—In this study we propose a new model for affective learning, SAMAL Model (Smart Ambience for Affective Learning Model) which illustrates the interplay between the body, mind and emotion in learning. This model is based upon experiential theories and the use of the body moving within the virtual reality space. The SAMAL project investigates the application of immersive interactive media and virtual reality as a tool in education to enhance learners’ motivation to learn, and make a bridge between affect, cognition and learning. The players actively engage with the interactive media experiencing the feelings associated with the challenges and successes of interacting with the virtual learning scenarios. SAMAL learning activities give opportunity for students to feel the many facets of animal survival. Our initial findings revealed that action based trial by error experiential process offered through the SAMAL allowed the students to experience the challenges of survival for birds from an affect sense thus increasing students’ learning motivation. Our data also showed that there was also a higher correlation between affect and greater learning for players than was for the watchers, who actively observed.

Keywords- affective learning; smart ambience learning; immersive learning, experiential learning scenario, action based Trial and and Error Experiential Learning, kinesthetic

I. INTRODUCTION

In this paper, we will present an Affective Learning Model based upon a smart ambience learning environment which we called the Smart Ambience for Affective Learning Model or SAMAL model. The SAMAL environment [13] allows students to step into specially designed virtual reality scenarios, and through a series of interactive and immersive learning activities, to motivate and facilitate the learning of specific topics, and thus provides the learner with a unique learning experience, not found in traditional classroom environments.

Centered around experiential learning theories and the use of the body moving within the virtual reality space, the Smart Ambience for Affective Learning (SAMAL) project investigates the application of immersive interactive media and virtual reality (VR) as a tool in education to enhance learners’ motivation to learn. SAMAL experiential learning activities are designed to provide the learner in tertiary and secondary education with multimodal learning experience and aim to bridge between affect, cognition and learning.

One key element that makes SAMAL a unique learning platform is the emphasis of the use of the whole body movement in interacting with the virtual scenario. Learner’s interaction with immersive and affectively evocative virtual scenarios stimulates a release of energy expelled through the body and is referred to as kinesthetic body release. This release is experienced in the body, taps into the senses and perception such as the sensory-perceptual level of self. While it can tap into the feeling states, it can equally tap into the cognitive states of the learner [1]. SAMAL introduces the learner’s body motion as a new component in learning. Through the kinesthetic physical interaction between the body and the virtual learning scenario, SAMAL provides an effective platform for us to investigate and develop a conceptual model that links the relationship between affect, cognition and learning.

A. The concept of movement and sensation associated with learning

The concept of movement and sensation, associated with learning is one unique attribute that immersive virtual reality offers to education. Active participation, along with being immersed through the senses and psychological states are features of VR that can promote learning [2]. VR allows the user to ‘get into’ the scene and interact with the virtual characters/ environment actively. This kind of inside participation, along with full immersion facilitates an integration of the user in the virtual environment [3].

Winn and Bricken [4] postulated that the users experience of internalizing the virtual world is an authentic, but different hue of reality; this phenomenon enables them to interact
(actively participate) with the virtual world in a unique way, and can be more convincing than passively watching a play or (3D) movie. “The immersion allows the user to experience, interact with and discover digital knowledge first hand while the manipulation of the verity of the virtual world allows the learner to establish visual and/or kinesthetic relationships to help understanding of the real world or concepts related to it ([3], pg. 40).”

In this project, we focus on the learning of the concepts of animal survival. Students may cognitively understand survival needs through traditional learning modes such as teacher prepared written material or watching a wildlife survival documentary. However an immersive VR educational programme offers to the student an opportunity to fully immerse in survival tactics through action gives them a deeper understanding in terms of the associated affects and cognition of the desire and concept of survival. Through such real time interactive activities, the students can directly ‘feel’ the experience in their body, and feel the emotions, such as anxiety, of survival. The student can connect to the animal concerned, e.g. a bird, in the learning scenario, as he/she perceives oneself as that animal (full immersion) in the VR scenario. Results from recent studies carried out about immersion and learning show that there was a higher level of enjoyment and motivation to learn for those learners exposed to immersive conditions as opposed to non-immersive ones [3].

B. Affective Learning

Much has been written about how emotions affect cognition and memory [5], as well as how emotions attached to the success/failure of academic performance impact learning [6]; but little has been researched about the association between immersion in VR and emotions and learning. Emotions within the educational setting most often relate to achievement (success/failure) and the associated feelings such as pride/happiness and sadness/shame based upon the perceived controllability of the activity [6].

Shen, et al. [7] conducted a study that explored how emotion develops during the process of learning and how emotions can be tracked; giving feedback. They postulate that this emotion feedback can improve the learning experience for students. An affective e-Learning model was proposed, based upon concepts from Russell’s circumplex model of affect and Kort’s learning spiral model which merged learners’ emotions with the e-Shanghai e-Learning platform [7].

The focus today on e-Learning is learner-centered, with an emphasis placed upon pervasive and all-encompassing, along with personalized learning technologies. E-Learning should ‘better engage learners in the learning process; engaged learners are behaviorally, intellectually, and emotionally involved in their learning tasks [8]. Research points towards the link between positive moods and effective problem solving. Positive mood generates a more creative approach to problem solving with more thorough decisions made.

Kort, et al. [9] proposed a four quadrant learning spiral model in which emotions change when the learner moves through the quadrants and up the spiral. They also proposed five sets of emotions that may be relevant to learning. However, empirical evidence is needed to validate the learning spiral model and to confirm the effects that these emotions might have on learning.

II. THE SAMAL MODEL FOR AFFECTIVE LEARNING: A MULTIDIMENSIONAL MODEL

In recent years, with the advent of e-learning technologies, learning models are being developed to help us understand the role of technologies in the learning process and how technology serves to enhance learning effectiveness. Such attempts aim to provide a structure to the learning experience and a context in which learning material can be presented, enabling the learner to move through the learning quadrants. In this paper, we focus on developing a model that provides a rationale that underpins the SAMAL learning environment and scenarios design. Based upon our trials with students trying out the SAMAL learning environment, we propose a model that begins to explain how the immersive element of the SAMAL design links all three parts of the learning domain: the body, the mind and emotions. This model is multi-dimensional and has been inspired by two earlier models: Kolb’s model for experiential learning and Sundstrom’s model [12] of the affective loop.

SAMAL offers a new platform whereby all three parts of the learning domain (the body, the mind and emotions) are stimulated in virtual space; this model integrates two key concepts, otherwise known as components:

- That of experiential learning, an active learning process based upon trial and error through the interaction with the virtual environment and engaging the body in the learning scenario.
- The concept of control and focus in relationship to learning.

Features of the SAMAL design are linked to how the students can actively participate and control their body movements within the virtual environment and experience the challenges of achieving certain goals, in this case animal survival. Success can lead to positive feelings resulting in greater learning about the topic from this unique learning media. In the SAMAL design, the focus is placed upon creating a learning environment where the student can learn through a process of action based trial and error, whereby kinesthetic physical interaction with the virtual characters and environment are simulated.

This kind of experiential learning is linked to Kolb’s theory of the experiential learning cycle shaped by earlier theories of Dewey and Lewin and Piaget, who all stress that learning involves a process in which new concepts are formulated from, and ceaselessly re-modified by, the experience [9,10]. The SAMAL Model for Affective Learning incorporates aspects mentioned in the above.
A. The Experiential Learning Cycle Component

With reference to Figure 1, the first component of the SAMAL Model for Affective Learning denotes a learning process based upon the concept of using a trial and error experiential approach set within the immersive virtual learning environment. This component of the SAMAL Model is shaped by Kolb’s Experiential Learning Cycle and Basic Learning Styles Model. The theoretical underpinnings of Kolb’s model postulates that learning occurs in four stages: concrete experience, reflection, abstract conceptualization, and then active experimentation, which then leads back to a new, more formulated concrete learning [10].

In practice, SAMAL is conducted in a workshop format. For the animal survival topic, students experience two virtual education activities related to the topic. The objective of one of the activities, the Hummingbird Flying activity, is to experience how a bird needs to control flight navigation to reach his food target in order to survive which involves strategy design and implementation in order to achieve the goal of survival.

1) Concrete Experience: After introducing the learning objectives, the instructor will demonstrate the Hummingbird Flying activity, and explain how to operate the interactive devices, in this case a pressure sensor and a motion sensor. The instructor will encourage the students to try out the scenarios themselves. Players actively participate, handling the devices and directly controlling the virtual characters. Players will navigate and reach the flower for gaining sustenance in a 3D scene through shifting his/her body weight while flapping the arms at the same time (Figure 2).

2) Reflection leading to re-conceptualization: At this time some form of intervention from the instructor is carried out. The student is encouraged to stop and reflect upon what may have gone wrong in the virtual process of flight impeding them to reach their target. After this reflection process, the instructor will work with the student (player) to facilitate him/her to re-formulate the strategy for reaching the target in the 3D space as if he/she was the bird in flight. At this stage modifications to the flight/navigation are made.

3) Active Experimentation Leading to a New Concrete Experience: This active experimentation leads to a new concrete experience; successful or unsuccessful. The student will try it again, putting into action new concepts and modifications of strategy; the right movements and exertion of appropriate power (energy) can enable the student to become

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**Figure 1. Experiential Learning Cycle Dimension of the SAMAL Model**

**Figure 2. A snapshot of a student (Player) playing the hummingbird flying scenario**

**Figure 3. Navigating towards the target**
immersed in the virtual scene and achieve the goal successfully. If the student still encounters trouble then the trial and error process repeats again with a period of re-reflection and re-conceptualization/modification.

Through this experiential learning process the students can learn to control the flying direction and speed by carefully controlling the pressure of the legs and flapping the arm to control height and speed. The kinesthetic rapid shaking of the students arms echo the flapping of the wings of the hummingbird. The use of the body heightens the immersive experience of this Hummingbird Flying Activity. The process goal is met if the player succeeds in controlling the hummingbird to reach all the flowers (Figure 3).

B. Reflection of New Concrete Experience: Specifications

Successes can lead to positive feelings resulting in greater learning. As a way to solidify the new concrete experience the SAMAL Model cycle incorporates a post experience reflection process, enabling the student to reflect upon what learning elements lead to success and the learning achieved. It is proposed that this process can take place on two levels: 1. a brief verbal interview where the student reflects upon ‘what went right’ as a result of making modifications and 2. A questionnaire devised to assess the link between affect, motivation to engage in the educational activity, and perceived learning outcomes in this experiential learning activity.

C. The Variability Component of the SAMAL Model

In addition to the experiential learning cycle component which creates a framework for the SAMAL Instructional Plan, the SAMAL Model for Affective Learning incorporates another component, variability, which helps to explain the interface and interplay between focus, control and the resulting feelings in this kind of experiential learning process.

The development of this component looked to Sundstrom [12] who proposed an interesting concept known as an ‘affective loop’, which refers to an affective interaction process or cycle where emotion plays an important role in interaction involvement and evolution’. His 2-dimensional planar model looks at how to predict and interpret emotions on two axes: from much-control to little-control on the y-axis; and from high-focus to low-focus on the x-axis.

Taking aspects of Sundstrom’s plane model, the second component of the SAMAL Model looks at the variability of how much control the student has in the learning activity, i.e. controlling his/her body and movement to interact with the virtual scene; and the level of focus the student has whilst engaging in the activity. Both axes follow a continuum ranging from high to low focus on the x-axis and little to much control on the y-axis. If the student is highly focused and has much control navigating in the virtual environment then especially positive feelings will result such as excited, happy, and amazed. On the other hand, if the student has some control and low focus, then boredom will often result. Continuing on with the activity with low focus will affect control in a negative way and, with little control, negative feelings such as irritated and frustrated will emerge. But at the same time these negative feelings will also emerge if the student is highly focused but has little control over the activity and if something does not change then the student will give up and cease the activity.

This is where the concept of re-focus becomes paramount in this model. If the student can find a way to re-focus and make a change in how he/she approaches the activity/ or have a new concept (either gained from the student or through intervention by the facilitator/teacher), then he/she becomes more insightful, and can become curious and interested in engaging again. Applying this change with renewed high focus can result in greater control and with continued high control of the activity then excited and happy feelings related to achieving success will materialize. The movement towards having much more control over the learning activity stems from re-focusing and correlates to the reflection and re-conceptualization/modification aspect of the experiential learning dimension of this model seen above. Contrary to this would be that the student would re-focus and still not gain greater control, resulting again in diminished control and negative feelings.

When we combine the two components together we get a 3-dimensional model of the SAMAL model for affective learning, shown in Figure 5. Merging the experiential learning cycle component of the SAMAL Model with variability component serves to illustrate the interconnectivity of the body, mind and affects encompassed in the learning process of trial and error experiential learning.
III. THE EFFECTIVENESS OF SAMAL

Details of the SAMAL system design and the associated instructional design have been described in [13]. After participating in the SAMAL workshop, students are asked to complete a questionnaire devised to determine the effectiveness of the SAMAL activities and affective outcomes. The questionnaire asks the students to select all the feelings that they felt while engaging in the two experiential learning activities: Hummingbird Flying and Animal Jumping. There were 31 players in all and most players indicated between 2 to 3 feelings in all. The highest responses are shown below in Table I. For the players 61.29% responded that they were curious and also happy, as well as excited and interested (both at 54.84%). On the other hand 29.03% stated that they also felt frustrated while engaging and 6.45% felt irritated. This may point to the fact that for some students, they were not able to initially control flight navigation in the bird flying activity, and not achieving success became frustrated/ or irritated as a result.

Table II denotes players having positive feelings (happy, curious, excited, interested, awed/amazed, and insightful) and negative feelings (frustrated, irritated, and bored) while experiencing SAMAL. 21 out of 31 players (67.74%) responded that they had positive feelings during the activity. The 1 player who expressed negative feelings and did not want to further engage was due to having an unsuccessful experience. In summary, there was a high correlation between positive feelings and learning for players; as 19 out of the 21 players (90.48%) indicated that they had ‘learned a lot’. 9 out of 31 players, or 29.03%, experienced both positive and negative feelings but at the same time 7 out of the 9, or 77.78%, specified that they had also learned a lot. Most of the players went through a process of trial and error, where they needed to modify their movements and re-focus, and as a result gained more control leading to success.

![TABLE I. FEELING STATES FOR PLAYERS](https://example.com/table1)

<table>
<thead>
<tr>
<th>Feeling</th>
<th>Players 31 in total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curious</td>
<td>19 (61.29%)</td>
</tr>
<tr>
<td>Happy</td>
<td>19 (61.29%)</td>
</tr>
<tr>
<td>Excited</td>
<td>17 (54.84%)</td>
</tr>
<tr>
<td>Interested</td>
<td>17 (54.84%)</td>
</tr>
<tr>
<td>Awed/Amazed</td>
<td>11 (35.48%)</td>
</tr>
<tr>
<td>Frustrated</td>
<td>9 (29.03%)</td>
</tr>
<tr>
<td>Insightful</td>
<td>6 (19.35%)</td>
</tr>
<tr>
<td>Irritated</td>
<td>2 (6.45%)</td>
</tr>
<tr>
<td>Bored</td>
<td>0 (0.00%)</td>
</tr>
</tbody>
</table>

![TABLE II. CROSS CORRELATION DATA: FEELINGS ASSOCIATED WITH STIMULATION/MOTIVATION AND LEARNING FOR PLAYERS IMMERSED IN SAMAL](https://example.com/table2)

<table>
<thead>
<tr>
<th>Feeling</th>
<th>31 people in total</th>
<th>Players</th>
</tr>
</thead>
<tbody>
<tr>
<td>% out of 31</td>
<td>Responses</td>
<td>Engaged in flying</td>
</tr>
<tr>
<td>Positive Feeling</td>
<td>21 67.74%</td>
<td>17 80.95%</td>
</tr>
<tr>
<td>Negative Feeling</td>
<td>1 3.23%</td>
<td>0 0.00%</td>
</tr>
<tr>
<td>Both Pos/Neg Feeling</td>
<td>9 29.03%</td>
<td>4 44.44%</td>
</tr>
</tbody>
</table>

IV. CONCLUSION

In this paper, a model for affective learning which we called the SAMAL Model (Smart Ambience for Affective Learning Model) has been proposed. The SAMAL model serves to help understand the interplay between the body, mind and emotion in a novel learning environment where a learner interacts with specially designed virtual scenarios in a VR space. The SAMAL model is based upon experiential theories and is a multi-dimensional model that integrates two components of a learning process: an experiential learning cycle component based upon the concept of using a trial and error experiential approach within the immersive virtual learning environment and a variability component that models the concept of control and focus in relation to learning.

The SAMAL learning environment developed at City University of Hong Kong provides a platform for investigating the effect of immersive interaction through body movement of a learner with the virtual characters and scenarios as a tool in education. Through a set of specially designed interactive scenarios to help students to understand animal survival, the SAMAL environment offers students an opportunity to fully immerse in survival tactics giving them a deeper understanding of the concept of survival and to experience from an affect sense what it is like for animals to survive, thus increasing students’ learning motivation, according to the data collected. The proposed affective learning model (the SAMAL model) helps us to begin to understand the relationships between affect, cognition and learning through an inter-linking process of control, focus (re-focus) and reflection.

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REFERENCES


