Revisiting an Engaging Experience to identify Metacognitive Strategies towards Developing a Multimedia Design Model

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Abstract— Looking at metacognitive strategies on the way children think when playing an engaging computer game could help designers design educational game courseware that engages children to learn. This paper will analyze the strategies children use in their thinking to overcome problems whilst still remains engaged when interacting with an engaging multimedia application, The Sims. The Sims is an Edutainment Multimedia CD chosen as a vehicle to discover more about engagement under varying interactive conditions and experiments. The CD was found to have features of what children want in a multimedia design for them. A theoretical model "An Engaging Multimedia Design Model" [1] renamed, after an extended research, The NEMD Model (Norma™ Engagement Multimedia Design Model) [2] was developed from this study using this application. This paper is a result of revisiting the recorded engaging experience the children encountered whilst doing the experiments to design, test, redesign, and retest the final form of the engagement model. A number of metacognitive strategies were detected during the interaction. Analysis of the metacognitive strategies used will help designers design multimedia game courseware that is engaging as well as educational for children.

Keywords— multimedia, game design, metacognitive, educational courseware

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I. INTRODUCTION

Studies have shown that there is a need for us to redesign our educational courseware so as to include elements that are not only educational but engages children as well. According to cultural psychologist, children prefer game CDs than educational CDs when children were given the freedom to choose. Studying the way children play computer games could help us design better features to assist them to learn.

It was found that basically there are four main features that seemed to be present in any discussion of children interacting with computer applications, that is:

- Whether the application allows the children to interact with it? If so, what type of interactive design is used?
- How is the system being operated (the operating tools)?
- What kind of feedback will the children get when using it? Is it immediate or delayed?
- What are the goals set for or could be set by them when interacting with the multimedia environment?

Through the literature search and the findings from a scoping study it was found that children like a design when they could interact with the system. However, the study has revealed that having lots of interactive features in a design do not necessarily means that a child will be engaged by it because not all interactive design features are appealing to children. Through interviews of their 'wish lists', children tend to like two types of interactive design features, one that allows them to act out a role and be in control through movement and animation (**simulation** interaction); and another that brings in the elements of creation (**construct** interaction).

The study has also revealed that well designed operating tools must include the elements of ease of use. Complex and challenging designs are not appealing to children. It is important for children to be able to see and know what they are doing. The study has revealed that children tend to like using operating tools that could give them an ability to see every move they make when interacting with the system, e.g. the changing position of the pointer when a mouse is moved forward or backward, or what happens when the

arrow keys on the keyboard are pressed to the left or right. Since this feature involves the dynamics of interacting activity this feature is termed in the study as **immediacy.**

The study also revealed that children too like any form of **feedback** that is the outcomes from inputs given by them during interaction. However, findings have suggested that children preferred immediate rather than delayed feedback. Immediate feedback refers to some kind of response when an action is taken whilst delayed feedback refers to those that they have to wait till it is completed before they could get the result.

The study also revealed that children is comfortable when the multimedia has **goals** that are crystal clear either set for them by the designer or intrinsically set by them as they interact with the multimedia application. The number of goal settings could affect children's engagement levels.

Therefore the scoping study have revealed that multimedia that have features like **simulation, construct, immediacy, feedbacks** and **goals** will make children stay engaged [3]. The five experiments conducted later to develop the model of engagement was done by manipulating these features. Previous experience was later added as another contributing factor as 'an engagement design model' gets to its final form. This paper will not discuss the model of engagement but the metacognitive strategies identified by revisiting the engaging experience the children had when doing the experiments to develop the model.

Metagonitive strategies could be one form of design features that could help designers design engaging educational multimedia courseware. Knowing metacognitive strategies' characteristics and identifying it with an engaging interactive game-play experience could give us insights into features that could be included when designing engaging educational multimedia courseware for children.

Generally, metacognition refers to thinking about thinking or cognition about cognition [5]. Flavell defines metacognition as *"one's knowledge concerning one's own cognitive processes and … that influences the execution of cognitive tasks."*[6]. Through metacognition, a person confronting a cognitive task can select a strategy and then monitor and regulate their progress on a task. The monitoring process allows a person to more effectively control his or her cognitive processes, thereby affording more efficient and active learning [7].

In this context, metacognition refers to the process of active control over one's own cognition [8]. It represents the "executive control" system that one has over their thinking process. Studying reflective patterns of understanding, planning, execution and evaluation of a problem-solving activity in mobile learning environment [9] shows us that reflective thinking are part and parcel of metacognitive strategies.

Relative to games activity, metacognitive strategies involves strategic planning, monitoring, and regulating action. More specifically, planning involves setting goals, generating questions, analyzing how to achieve the target goal, and selecting and organizing information for one's decision. Through regulating action, a child modifies the actions or decisions in order to achieve the goal**.**

This paper is a discussion of the thinking process a group of children from three age groups 9-10, 11-12, 13-14 with equal representation from each gender, as they went through one of the five experiments conducted to develop the theoretical model "An Engaging Multimedia Design Model" [1] renamed, after an extended research, The NEMD Model (Norma™ Engagement Multimedia Design Model) [2]. The data presented will give us insights into metacognitive strategies they might have used or might have helped, if available, whilst interacting with an engaging multimedia application that was used as a vehicle to study about engagement to develop the model.

2. PROBLEM FORMULATION OF METACOGNITIVE STRATEGIES IN GAME PLAY

Having the chance to be in control seems to be the most profound element in engaging children to any form of learning activity. Metacognitive instruction that guides the decision making process through questioning techniques that promote the aspects of planning, monitoring and evaluating decisions made during game play, could be hypothesized to give children the feeling of 'being in control' over the game, an element most important in determining levels of engagement. Having metacognitive strategy markers like cues, prompts, etc for planning, monitoring and evaluating their achievement at appropriate time, could be useful when designing educational game courseware for children because such inclusion could increase children's level of engagement in the game activity.

These metacognitive strategies will not only add the learning effect of the game but also creativity in game play. Such a strategy may not have been thought off, or even if they have, might not be explicitly stated in the games or educational games design for children, thus making some designs non-engaging to children than others. Relating their thinking to metacognitive strategies will help us design better educational multimedia game for children.

As the larger study was about engagement and the phenomenon surrounding it, the problem formulation of this study was to revisit the engagement patterns the data depicted from the video recordings experience of the children whilst doing Experiment 2 from the five experiments conducted to study about engagement.

This paper will discuss a detailed account of an interactive experience a child had playing an engaging game whilst doing the experiment to develop the model and a

number of data describing engagement patterns plotted from 16 children. This paper will look at factors found in these engagement patterns to relate them to how metacognitive strategies are used, consciously and unconsciously, in game play.

3. PROBLEM SOLUTION

In this experiment the children were given to play The Sims [6], a popular game about Life Management. The players play a major role in the management of every day family life - providing a place to stay, managing finance, basic needs, moods and desires. A scoping study using a grounded theory of "discovery led by children method" has led to the findings that The Sims has the features in children's "wish lists" of what constitutes a successful multimedia designed for them. The Sims was chosen as a vehicle to understand multimedia engagement behaviour.

The data for this particular experiment comprised of

1) Data from engagement scores marked by every child at every 5-minute interval when playing Condition 1 and 2.

2) The Engagement Scale Score Fig. 1 was created, calibrated and validated before it was used to measure engagement [1].

3) Data from semi-structured interviews conducted at the end of both the conditions.

4) A video recording of each child as the child goes through Condition 1 and 2.

The purpose of the video recordings was to validate some points raised from close observations of the engagement scores and the interview. This "triangulated approach" (video observation of computer interfaces and facial expressions; semi-structured interview answers; and the plotted graph of the engagement pattern of Condition 1 and 2) was used to crosscheck and validate the issues of what engages children most.
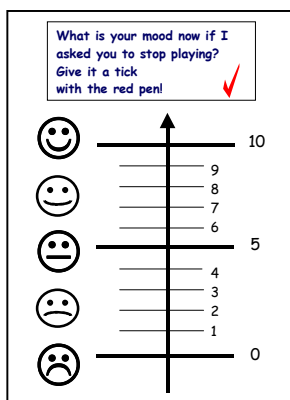

Fig.1: The Engagement Scale Score [1]

Fig.2 and Fig. 3 are an example of some of data used in this study i.e. the engagement patterns plotted and analyzsed with the interfaces recorded revisited.
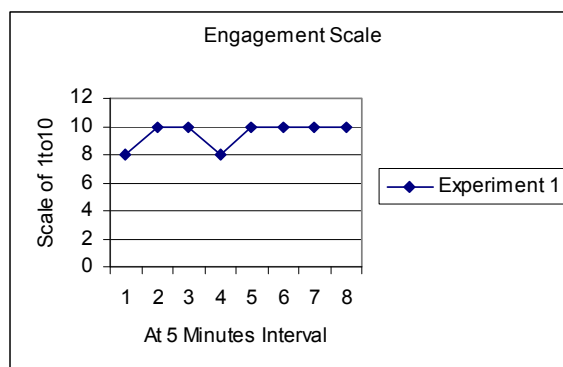

Fig.2: Case Example of a Simulation Interaction

Fig.3: The Interfaces during the 4th- interval relating to one of the engagement patterns – The Dips

The two experimental conditions chosen to be discussed in this paper were:

Condition 1: Constrained creation: an example of construct interaction with fixed goals: create a family with restricted resources (build a house within limited budget and in specific locations) and maintain family lives;

Condition 2: Unconstrained creation: an example of construct interaction with no fixed goals: given a family with unrestricted resources (build or buy a house with unlimited budget of any location) and maintain family lives.

Sixteen children, 8 boys and 8 girls were chosen to participate in this experiment. The children were given 40 minutes to interact with the application and their levels of engagement were recorded at every 5 minutes intervals. The study used a repeated measure method, that is, each child did both conditions. The order of conditions was alternated to counter any learning effects.

4. THE RESULTS FROM PLOTTED ENGAGEMENT SCORES

The characteristics of engagement patterns could be seen when the engagement levels were plotted on to a graph at every 5-minute intervals. Results from these could give us views about patterns of engagement as the children interact with the game in a 40-minute game time.

In order to assess the engagement levels of each condition and of each child an initial set of standards were first established as follows:

- The maximum level of engagement is a score of = 10/10
- The lowest level of disengagement is 0/10.
- High Scores = 5/10 and above
- Low scores = 4/10 and below

The indicators for engagement to occur for the above standards were when the scores were from 5/10 to 10/10. Anything below is a sign of disengagement.

3.1 Average Engagement Scale Scores

From Fig. 4 and 5 it could be seen that the average engagement scale scores are above 5/10 for all children for both experimental conditions. This is evidence that the children had an engaging multimedia experience in this study and that The Sims does indeed contain features that provide children with an engaging experience. However, there is a slight difference on averages in both conditions. Average for Condition 1 is 7.8 whilst Condition 2 is 9.1
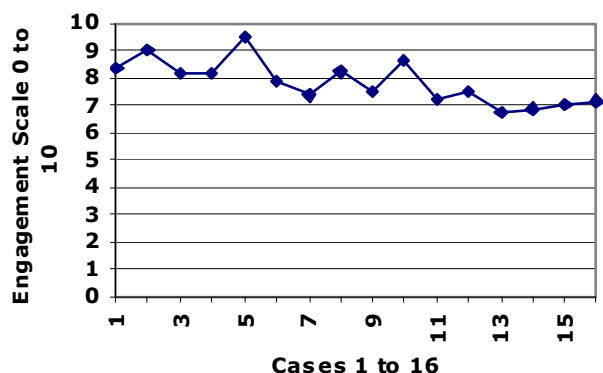

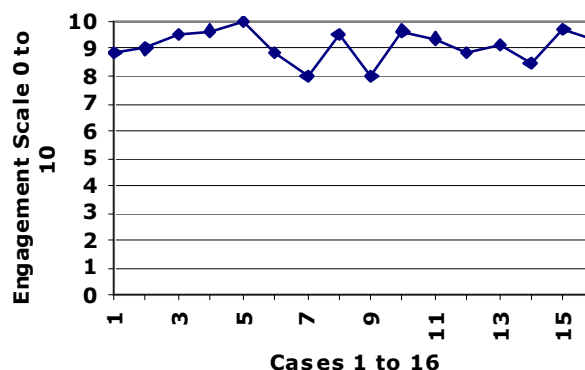**Fig. 4**: Average Engagement Score per Child for Condition1

Fig. 5: Average Engagement Score per Child for Condition 2

3.2 Description of Engagement Patterns

The emerging pattern of engagement when the scores were plotted individually could be described by giving case examples of individuals as they go through the engaging experience. The patterns could be classified into seven categories:

1) Low levels of engagement
2) The starting level range
3) Dips
4) Gradual increase and gradual decrease
5) Plateaus
6) Maximum
7) The ending level range

The description of these categories is based on three sources:
a. Comparing data
b. Scores of Engagement that fit the discussed category
c. Individual Cases Examples.

3.4 The Lowest Level of Engagement

From the engagement scores gathered it was found that the gaps between the highest and lowest level of engagement are very small. Each score is within the level of engagement. This means that everybody was engaged by these experimental situations. The average lowest level of engagement for all the 16 children in Condition 1 is 7/10 while Condition 2 is 8/10. Therefore the range 7/10 and below became the new indicator for the lowest scores of engagement for this particular experiment. Any score within this range is a form of disengagement or disinterest. Deeper analysis from the data has shown that the lowest level of engagement scores found in Condition 1 were at the beginning of the game i.e. from the first 5 to 10 minutes into the game whilst fluctuating after that till the 40-minutes game time is reached. The pattern is however different in Condition 2. The lowest level of engagement scores found in Condition 2 even though were also found at the first 5 to 10 minutes of the game, none of the children doing Condition 2 regressed back to this level after 20 minutes into the game.

3.5 The Starting Levels

Most children for most sessions begin their scores at 5/10 and above with one exception, a child in Condition 2 that started with a score of 4/10 at the first interval of the game. The oddness of this particular finding has led to further investigation about engagement factors (not discussed in this paper) to be added to the model before it reaches its final form

3.6 Dips

Dips are falls in engagement scale scores. Fig. 6 shows the points where dips occur in Case 6 of a boy doing Condition 1. Some individuals have more than one dips, whilst there are others which show a much smoother ride to reach the maximum score. There are more dips occurring when the individuals did Condition 1 as compared to when they were doing Condition 2, 26 in Condition 1 and 6 in Condition 2. Most individuals experience only one dip before rising to a maximum. Note that a lot occur at 25 minutes into Condition 1. For those that experiences more that one dip, the results gave signs or signals of a "troubled" or "unstable" performance that affect their engagement pattern when interacting with the multimedia. There are 8 case examples in Condition 1 with 2 or more dips. These children are displaying quite a lot of difficulty staying engaged under these conditions.
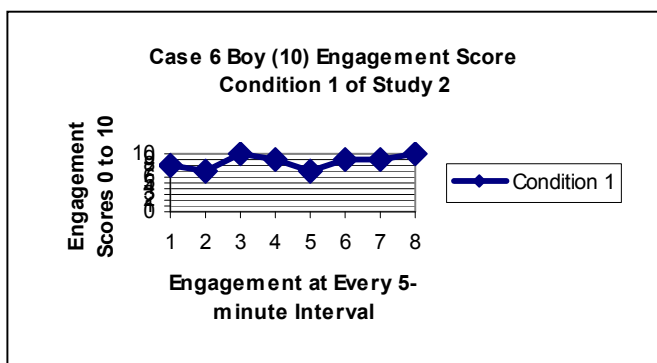

Fig. 6 Evidence of dips in the Engagement Pattern of Case 6 plotted whilst doing Condition 1 in a 40 – minute session

3.7 Gradual Increase and Gradual Decrease

There are two types of gradual patterns, one that increases and the other that decreases. There are other ways of determining indicators for this category. The research categorised gradual patterns as clusters of scores in succession either increasing or decreasing. Therefore, gradual increase in this area of discussion is when scores move up from lower to higher, one point up for the next two to three consecutive intervals. For example, from 5/10 at a second interval of 10 minutes into the game, to a higher score of 6/10, than 7/10 or whatever combinations till it reaches a maximum of 10/10. Gradual decrease, however, is about decreasing scores from higher to lower in three

consecutive intervals. There are 6 out of 16 children that had this kind of gradual increase experience in Condition 1, and 3 out of 16 in Condition 2. For the gradual decrease feature, there is only one case (Girl 3) (9) that experienced this pattern in Condition 1 (another oddity that has led to further tests to develop the model, not discussed in this paper).

3.8 Plateau

The term plateau is used when the pattern of engagement scores remains consistent for a number of interval points. Children at most times reached a plateau when they reached the maximum range score. While some do not regress after this stage, others do. There are a number of places where plateaus occur. However, a certain pattern did emerge in Condition 2. Plateaus tend to occur at the time when the individuals reached maximum score and rarely seem to regress after that.
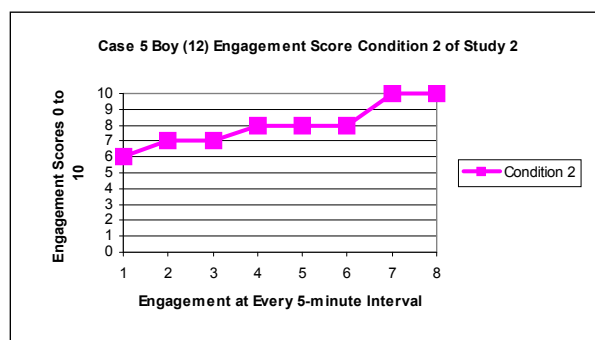

Fig 7: The Engagement Pattern of Case 5 plotted for Condition 2

Fig. 7 is an example of an engagement pattern plotted for a Boy Case 5, age 12 doing Condition 2. The child's engagement patterns revealed three plateaus. One plateau was at 7/10 for the second and third interval (10 to 15 minutes). Another at 8/10 remained consistent from the fourth Interval to the sixth interval (20 to 30 minutes). And lastly, whenever the maximum plateau is reached 10/10 at the seventh and the final interval (35 to 40 minutes).

3.9 Maximum

Maximum level scores occur, in most cases, at the end of the session. There seemed to be other occurrences as well worth further investigation but overall, only half (8 out of 16) of these children placed their maximum at 10/10 at the last interval for Condition 1. The same phenomenon however does not occur for Condition 2. The maximum scores for Condition 2 seemed to suggest that the children are more engaged towards the end of the session when doing Condition 2 than when doing Condition 1. Whilst there are some children who place their maximum score at the start of the game, 2 out of 16 (an oddity that as led to further tests), everyone (all 16) doing Condition 2 reached

the maximum at the end. Some indicated maximum engagement as early as 15 minutes into the game (2 out of 16), whilst 14 out of 16 reached the maximum 30 minutes into the game.

3.10 The Ending Levels Range

Even though findings in Condition 1 show some sign of differences in the place where maximum engagement patterns are marked, most children in this study seems to have a very engaging experience because they all seems to be uniformly engaged by the end of both the conditions. All the children finished the game with a score ranging from 8/10 to 10/10, except for one case Boy (Case 1) (12) that scored 6/10 for the final interval of Condition 1 (an oddity that has led to further tests). From the scores we could say that at the end of the game all the children were engaged by the game because all of the scores were above 5/10.

5. THE RESULTS FROM INTERVIEWS

The interview sessions were conducted in the same way as in the scoping study, i.e. in a laddering pattern of questioning because children were not necessarily articulate. The children were asked which of the sessions they liked most: free play (a section omitted in this paper), Condition 1 and Condition 2 and which of the modes of using The Sims they preferred, 'live' or 'build and buy' mode.

It was found that 9 out of 16 children enjoyed the free play session as compared to the two experimental conditions. When asked why, most of them said they enjoyed discovering the game. For those that preferred otherwise it was mainly due to the experiences they had at the time of play. Through video observations, it could be seen that the children that did not find the free play the best times of play were those that encountered a bad experience when playing it. Some said that they felt lost when playing it for the first time. They did not know what they were supposed to do and what they were supposed to get from it. Some thought that the game was about achieving certain levels, like most games they played before. Managing people's lives seems to be "a bit weird at first, but after awhile it was fun…you get to control them…god-like thing…"

Others liked free play because they found it fun playing with friends. Some got very useful tips from friends. Others expressed their preferences for playing alone rather than with peers. Some said, "They kind of control the game, you could not enjoy it much, I prefer to play alone". Some said it was useful to have friends to teach you how to play but prefer to play alone when they have the skills.

Fig 8: Picture of children playing during free play

When the children were asked which part of the game they liked most they mentioned the 'live' (simulation) mode. Eight children expressed a likeness for playing the 'live' mode, because "you could be like God…telling and controlling people…tell them what to do…" However, when asked to choose amongst the sessions, Condition 2 got picked after free play. None mentioned Condition 1 as a preference.

When asked why they liked Condition 2, some of their comments were "There was so much money there …did not know that we had to stop much earlier…have not had the chance to see and play with them…no time…I wish there was more time…". The ones that disliked Condition 1 find it too restricted. "I don't like it at first… not having enough money, I had to let them work, after a while it was ok…"

5. ANALYSIS OF METACOGNITIVE STRATEGIES IN THE ENGAGEMENT PATTERN

In order to explain metacognitive strategies in game play, this study need to revisit the video recordings and make a comparative study with the characteristics of the engagement patterns as described earlier. The visit will enable us to analyse the metacognitive strategies used in these engagement patterns. However it is good to know that the overall results of the experiment, from the 16 children to develop the model, have revealed that the lowest engagement scores were mostly in the first 5 to 10-minutes of the game and in Condition 1, that is, a condition of constrained creation.

The engagement score traced at this level decreases steadily as the children go deeper into the game. However, when the children were given Condition 2, a condition of unconstrained creation, the children were free to explore

their imagination to the fullest; thus, became very engaged faster than that when they were playing Condition 1. From the findings it was evidence that metacognitive strategies are best described by looking at individual cases rather that by analyzing it through the data as a whole.

5.1 The Case Study Data of Fig.6 and Fig. 7.

The analysis of metacognitive strategies could be made by looking at engagement patterns in plotted graphs, the video recordings of the child as he or she interacts with the interfaces, the interview data conducted after each experiment, and the characteristics of the interfaces the children accounted at each interval as the patterns unfold.

1. Fig. 8 is the graph of the engagement scores plotted for Girl (Case 5) (12) and the account she gave when doing Condition 1 and Condition 2 as seen on the video and in the interview.
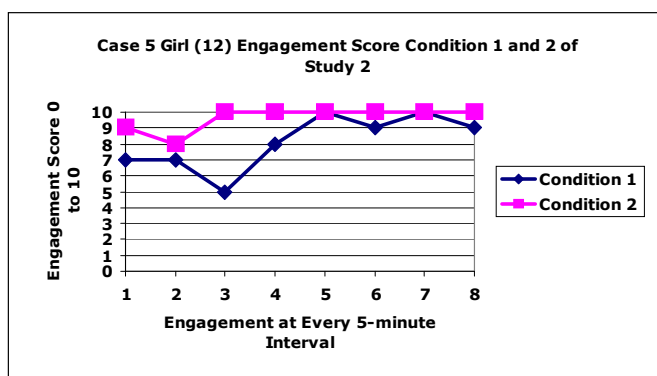

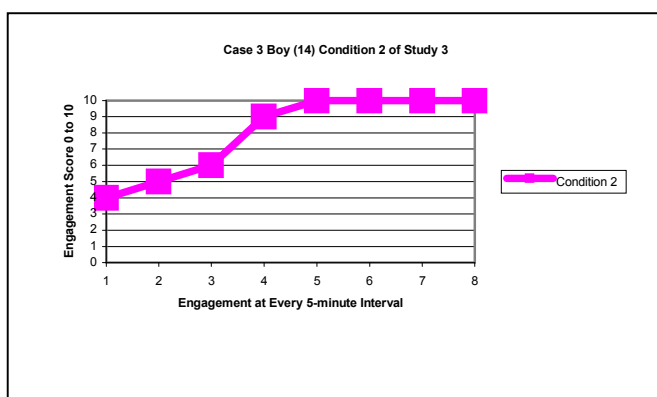**Fig. 8**: Graph of the Engagement Scores plotted for Girl (Case 5) (12)

Fig. 9: The Engagement Pattern of Case 2 plotted for Condition 2

2. Fig. 9 is an example of an engagement pattern plotted for a Boy (Case 2) 9, doing Condition 2 where the child starts off quite low (6/10) then rises steadily (7/10 and 8/10) before reaching a maximum score of 10/10.

5.2 Analysis of Metacognitive Strategies in Condition 1of Fig.6

a) The starting level

The girl started by marking a 7/10 score. The score remained consistent at 7/10 for the next interval (after 10 minutes into the game) when she was creating a family, in the 'Create a Family' Mode. *(In metacognitive strategies this would mean the child starts to evaluate the outcome of the action).*

b) Dips

The engagement score dropped to Point 5/10 (the lowest level engagement scores) after 15-minutes into the game. The interface she was working with at this moment was when she enters the neighbourhood. She tried the "build mode" and built a fence but after sometime she stopped doing this mode.*(In metacognitive strategies this would mean that after evaluating the outcome of the action, the child now begins to figure out what she wants to do next.)*

c) Dips before a rise

She started to choose a ready-made house instead. She used the Buy Mode and started buying furniture and decorating the house. *(In metacognitive strategies this would mean the child changes her strategy.)*

d) The gradual increase level

Soon her scores started to gradually increase to 8/10 till she reached 10/10 after 25 minutes into the game. *(In metacognitive strategies this would mean the child feels in control again.)*

e) Another dip

When the girl entered the live mode, after about 30 minutes into the game, her scores dropped to 9/10. She started playing with the characters. *(In metacognitive strategies this would mean the child does not have enough knowledge to plan a strategy to help her solve her encounter of a new interface 'the live mode' from that of the 'buy mode' she was at earlier and therefore her engagement patterns regressed as she tries to find a new strategy to solve the problem. She would make a choice on either to ponder on finding a strategy to solve the problem or gave up and started playing with other things that need not make her to re think of strategies and becomes disengaged by it.)*

f) Maximum level

As she made the choice to continue playing her engagement scores increased to 10/10. She continues with the live mode, doing mundane things, go to work, serve dinner, take a bath, bladder, and watch TV. *(In metacognitive strategies this would mean that the child is in control again and there her engagement level increases to the maximum.)*

g) <u>Regression or gradual decrease after reaching maximum</u>

However, since she created only two characters, therefore only two family members to take care of, she found out there is nothing much to do. After about 40 minutes into the game her engagement score decreased to 9/10 when the bell rang for her to stop. (*In metacognitive strategies this would mean that after reaching the maximum level, the game becomes boring again therefore the scores regresses. There is no more challenge for the child in the game because the child does not have to plan, or monitor the activity anymore because the task has become too mundane doing routine things.*)

5.3 Metacognitive Strategies in Condition 2 of Fig.6

After doing Condition 1 the girl did Condition 2

h) <u>The starting level</u>

The girl started her next session by marking a 9/10 score as a starter point. (*In metacognitive strategies this would mean the child was basing her action on her previous knowledge and experience*)

i) <u>Dips</u>

After 10 minutes her score drops to 8/10. The girl had first to move the given family to the neighbourhood. She was unsure of what to do with so much money; either to build a house or buy a ready made one. She used quite some time to make a decision. After considering her previous experience she decided to buy a ready-made house. (*In metacognitive strategies this would mean the child changes her strategy by using her previous knowledge to overcome the obstacles she is facing.*)

j) <u>Maximum and plateau effect</u>

Her scores increase to 10/10 and remain consistent at 10/10 up to the end of the game. She used the whole session to decorate the house and to buy things. Because there was still so much money she kept on buying and decorating till time passed. She did not want to stop when the bell rang. (*In metacognitive strategies this would mean that the child now feels 'in control' of the game again. Thus, she could plan, monitor and evaluate easily as she has learned and used it before, therefore at this stage, her engagement was at its maximum level.*)

Full accounts of the experience were got from the interview data. When the child was interviewed about her experience the child was most happy playing Condition 2 rather than Condition 1. In Condition 2, "there was lots of money' and "you just keep on buying things and creating things and the game was a lot easier to play with". For this child her lowest level of engagement was 5/10 placed in her Condition 1 experience. Even though her score increases after sometime into the game her engagement patterns were not smooth. The patterns were fluctuating as she went through the game.

Analyzing her case suggests that "disengagement" occurred during first encounter, in this case, a change in mode from 'create a family' mode, which was quite straight forward, because the child only had to choose the criteria by scrolling through the bar; to the 'build' mode, creating a house from nothing. The child had no idea how to begin from the two given locations, one a little more expensive than the other; which keys to choose to build the house; and where to start first the floor, the fence, etc.? (*In metacognitive strategies this would mean the child was loosing control of the game, therefore disengagement sets in*).

After sometime she decided to opt out and choose a ready made one where she just needed to know some basic operating skills of dragging and dropping, positioning, rotating and deleting furniture and accessories. It is after choosing this option that her engagement scores started to increase. (*In metacognitive strategies this would mean that the child is now looking for other strategies to help feels 'in control' of the game again. The straightforward tasks give her a sense of ease of control. As she gets into the moment of being in control the child starts to plan, monitor and evaluate the steps as she progressed into the game thus became engaged after sometime into the game*)

The situation differ in condition 2 where the child showed more consistent pattern in engagement because of the simplicity and feeling of in control of the situation. (*In metacognitive strategies this would mean that because of the simplicity in the game the child gets to be 'in control' of the game very fast. Thus at this point, the child has embarked from its level of acquiring basic motor skills to that of mental models skills. The child at condition 2 were able to explore their imagination to the fullest thus were on its maximum level of engagement all through the course of interaction.*)

5.4 Analysis of gradual increase and maximum from an individual case data of Fig.7.

An overall result from the engagement data has revealed that the children reached the maximum level of engagement faster in Condition 2 than Condition 1. Whilst most gradual increase patterns occur after dips some individuals have them from the start, starting low but then rising steadily to a maximum at the end of the game. Whether the gradual increase occurs after dips or from the beginning, there are a number of reasons why the children recorded their scores in this way. Fig. 7 is a typical example of engagement patterns in Condition 2.

Such findings could be interpreted into metacogintive strategies. One of the reasons for the patterns above could be that, after going through a few stages of learning from previous mistakes, the child was able to be in control of the game better. This result supports the importance of the sense of 'in control'. The child began to understand most of the rules of the games, what to do and not to do. They know the

strategy of the game, and therefore were in the position to be in control of the game. Thus, as their level of confidence increases so is their level of engagement. Several problems that they had encountered before they now know how to solve. Their mood began to change and their level of interest began to increase till they reached the maximum level of satisfaction.

The peak of gradual increment is at the stage where they became very engaged and their concentration shifted from the point of learning and acquiring skills to the point of setting goals, of problem solving or task completion. *(Gradual increases in acquisition or achievements are common in metacognitive strategies. Users tend to achieve them in stages, sometimes retracting previous steps or moves or sometimes planning and designing new ones. As they become more in control their levels of engagement increases. Their level of confidence in the game increases as well. They now know how to use previous experience to solve problem they encounter. The peak of engagement is when they are fully in control of the situation. The point they are at this time is the point of setting goals, problem solving and task completion. This is also the point when the child is most engaged and the metacognitive strategies they used need not be prompts, clues or hints. It all comes from within, an inner drive to complete an aspirations of self fulfillment and satisfaction)*

6. DISCUSSION

From the above it could be seen that every move made by the child has some form of correlation to metacognitive strategies. Consistent engagement score for ten minutes in condition I could be described in metacognitive strategies as a stage when a child started to plan and evaluate the outcome of an action taken by him or her. It is believed that at this point, the child's level of engagement is influenced by his or her perception about the outcome. If he or she likes the outcome, he or she will become engaged and vice versa. It seems that whenever a child does not like the results of the game the level of engagement drops.

Most initial stages of metacognitive strategies begins with experimenting without any specific goals. Without a goal, a child does not involve in any planning and monitoring processes thus lowering down their engagement level. At this point, scaffolding in the form of metacognitive prompts can help direct a child to set a goal and planning what to do next. Pop up questions asking the child what they intend to do would be able to increase their engagement level.

Repetition of failure could either made the child discard the game totally or encourage the child to try out different strategies. Positive reactions to failures would mean using metacognitive strategies to solve a given situation. A child at this stage will keep on changing his or her strategy to achieve a more satisfying result. Any experience of success

at this time will make a child feels in control again. It is important to sustain the feeling of in control to maintain the level of engagement. This notion can be seen in Condition 1, when the engagement level gradually increases to 8/10 from 5/10. The increase in engagement reflects the feeling of being in control. Therefore, engaging children in the metacognitive processes can help them take control of their activity. In other words, it is important to involve them in the planning, monitoring, and the evaluation process of the activity to maintain maximum engagement level.

In condition 2, especially when done after a turbulence experience, as in this case, done after doing Condition 1, a child will feel being in a state of lost again. In one particular case, a girl started her next session by marking a 9/10 score as a starter point, a level she ended her Condition 1 experiment, a move of relying on previous experience. After 10 minutes her score drops to 8/10. Her level of confidence in controlling the game drops. She was unsure of what to do when the conditions were reversed when in Condition 2 she as given so much money to spend as compared to Condition1. She used quite some time to make a decision. After considering her previous experience, a learning effect of the metacognitive strategies of planning, monitoring and evaluating she decided to buy a ready-made house a move she made on previous conditions.

As more of these strategies were used her scores increase to 10/10 and remain consistent at 10/10 up to the end of the game. This time there was so much money. She need not think of how to overcome obstacles. She used the whole session decorating the house and buying things till the 40-minute game session was reached. She did not want to stop when the bell rang.

The account could reveal how metacognitive experience could be linked to the level of engagement. In Condition 2, the child did not have the experience of a changing interface. Given lots of money the child need not think of the constraints faced when money is limited to build a house she desires. The child was always in the build and buy mode in Condition 2. As the skills needed to master this mode is straightforward like drag and drop she was so engaged in this mode that she refuses to stop when asked to do so. A design that taps on children's creativity in this case helps children stays engaged to the design created for them. When the child had acquired the skills to control and master the steps to take when a problem occurred, his or her anxiety shifted from one of acquiring skills to "what if" and "what next".

On the contrary, in Condition 1 the child was faced with a situation full of uncertainty and beyond their control. They could not anticipate what happens next and there was always the fear of losing control especially at the early stages of this session. Thus the child places her engagement level at the lowest score. The pattern of low engagement level in Condition 1 reflects the sense of loosing control that leads to

the factor of disengagement. It is with such a design that the role of metacognitive instruction should come into place.

From the analysis above, a connection can be drawn between engagement level and metacognitive strategies used by the children. Occupying the child with the activities of planning at the beginning of the game will maintain the engagement level at this point. However, this engagement level is also influenced by their perception towards the outcome of the game. At this point, the child needs to evaluate the outcome as compared to the strategies they used from the planning process. Occupying the children minds with these activities will maintain their engagement level. Helping the child with the process of planning, monitoring and evaluating their strategies and outcome of the game will help them keep engaged with the game.

7. RECOMMENDATIONS

From the case study above it could be recommended that design of educational game CDs should include some form of metacognitive strategies in their design besides factors that engages children[1][2][4]. Having pops up metacognitive instructions in the design could help a child to pause at appropriate stages and assists her to plan, monitor and evaluate her action before proceeding to the next step. Designing cues or dialogue boxes could give the child a chance to plan, monitor and evaluate their achievement whilst playing the game. This, in many ways, could increase their level of engagement and creativity whilst playing the game. Providing a cue or prompt through metacognitive instruction can help the child sets a goal, assesses a situation, devise a strategy to solve the problem, and evaluating their success or failure. Such instruction will make the child feel 'in control' of the situation and cognitively engaged in the game designed for them.

8. CONCLUSION

The possibility of injecting the elements of metacognitive strategies in the multimedia educational game design shows a promising prospect. It provides children with the experience of planning, monitoring and evaluating their achievement at appropriate time. This will more likely give the child the sense of control. This will help them feel that they could achieve their goals thus increasing and maintaining their level of cognitive engagement. At the same time, this activity could also help a child to develop their self-regulatory abilities as they learn how to plan, monitor and evaluate their action. Including this step could add the learning value of simulation game as it contributes to the development of metacognitive ability and creativity amongst children.

It is the limitation of this study to discuss the effect of learnability using simulation games as it is beyond the scope

of this study, but findings from a study on the increase in level usability in multimodal interfaces [10] having simulations and multi-modal interfaces could help to increase users' preferences and satisfaction in any form of learning that is beyond a usual norm. this findings seems to fit very well with the engagement behaviours traced in this study.

Simulation and other multimodal interfaces [10] was said to suggest that such designs may not bring much effect on short–term learning performances but an added value to long-term learnability. This findings is indeed in support of [1][2][4] of the engagement model. Having engagement factors in design with good metacognitive strategies (a result found in this study) as clues, prompts or hints could help to increase levels of user engagement and learnability. A future research into this area might be useful to designers of educational courseware.

However as far as leanability is concerned, whatever the learnability gained from these designs and those designs that encourages experiential learning possibilities, designers should be aware that some high-tech impressive and immersive designs have a tendency of "…becoming more forward" [11] than the intended objective of the instructional design of the system, and if not guided and carefully designed. The design might divert the child from positive learning to negative learning when they are designed as stand alone learning materials. Some designs could lead to immense addiction.

However, having children engage in expository and experiential purposes are essential when designating materials in educational exhibition halls and resource centres because such design would sustained a life long learning skills amongst our children.

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