A Collaborative Learning with Conceptual Teacher-Learner Model

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Abstract: This paper introduces a conceptual Teacher-Learner framework for a collaborative learning with serious games. An initial study identified twelve attributes of educational serious games that can be used to support effective learning. These attributes are used in the conceptual framework to support learning and pedagogy in combination with a game. A considerable number of serious games have been developed over the last ten years, with varying degrees of success. Due to a lack of clear standards and guidelines for game developers; it is difficult to justify claims that a specific game meets the learner's requirements and/or expectations. This paper defines a conceptual model for serious games that will contribute to their design and the measurement of achievement in meeting the learners' requirements.

Introduction

Currently teaching and learning activities are focussing on how to score all As and burdening students with unnecessary memory retaining load. Therefore it is of no surprise if students easily get bored and not really immersing their mind with the teaching in the classroom. Another major problem with traditional teaching is that the ratio of learners to teacher keeps increasing. As a result, learners are getting fewer contact hours and, as the rooms are bigger, they are given less guidance on how to progress in their studies. This will cause a few students to become easily trapped in the crimes and get caught in disciplinary actions because they are looking into alternative life that is more fun outside from school. A Malaysian education ministry has reported that in 2011, there have been over eleven thousand students or 2% of students have a disciplinary problem nationwide. Even though the percentage is currently small at the moment, this is quite an alarming number concerning our young generation and must be taken seriously in order to bring down these problems in the future. Therefore this paper aims to find a benchmark learning model for the young learners that can be adapted to the current schools and with immersive learning material with games which are known to be fun and entertaining could attract and motivate these learners to learn and to keep them engaged until they have achieved the learning objectives with the help of serious games. However, due to unclear standards and guidelines, it is difficult to claim that serious games really

meet the learner's requirements or expectations. One view is that most of the available games for learning have not been created by language or pedagogy experts (Verdugo & Belmonte, 2007).

In order to address the problems caused by unclear standards, this paper defines a conceptual model for collaborative learning with serious games based on learning theory. This will assist developers in ensuring that the resultant serious game will provide effective learning.

A Conceptual model for collaborative learning

The framework that we have developed includes learning and pedagogy theory in combination with gaming requirements (Garris, Ahlers, & Driskell, 2002; Gilbert & Gale, 2008; Prensky, 2001; Thompson, Berbank-Green, & Cusworth, 2007) and aims to establish a conceptual model that will be used by the game designer or educational practitioner when designing serious games for effective learning. The framework is illustrated in Figure 1 and is an evolution of the input-process-outcome game model discussed by Garris et al (Garris, et al., 2002), the conservation framework by Laurillard(Laurillard, 2009) and the conceptual framework presented by Yusoff et al (Yusoff, Crowder, & Gilbert, 2010; Yusoff, Crowder, Gilbert, & Wills, 2009). The individual components of the model are discussed in this section.
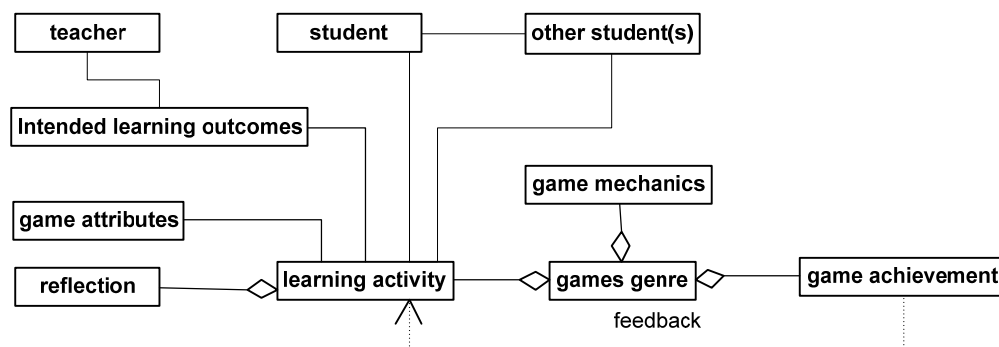

Figure 1. Conceptual Framework for Collaborative Learning shown as a Structural Class diagram.

Teacher

Teachers can play the role as a facilitator and help guide the student to achieve the objectives or intended learning outcomes. The educational perspectives suggest that the learner constructs their own knowledge, and their understanding is generated from negotiation within their community or peers. While peer-to-peer learning is how

a learner acquires from others how to navigate a game world, mastery of knowledge has to come from their learning experience as well as from collaboration with their peers (Langer, 2009; Sauvé, 2009). Learning is not necessarily restricted to the classroom or tied to a curriculum. Instead, the learner may be seen as a producer, a contributor to their knowledge, and autonomous in their learning (Kafai & Fields, 2009; Steinkuehler & Squire, 2009). The development of knowledge by the learner can be achieved from self and active exploration within the game (Conati & Manske, 2009). Looking for clues to the game's obstacles, and searching for answers within the game, is a way in which this might work. To gain mastery in certain skills within a game requires two things. Firstly, to be able to solve certain problems within the game and this normally requires some work by the learner to undertake some critical thinking within the game. Secondly, is the ability to transfer a previously learnt skill when progressing to the next level, i.e. reuse of the previous skill to gain a new skill. Skill advancement is progressive while playing the game, and mirrors the mastery of some skills from experiences in the real world.

Self-efficacy is reflected by player behaviour. Self-efficacy can be measured by the amount of time spent within the game. The longer time spent by the learner playing the game usually means that the learner is doing well and further boosts their confidence. Offering help and support (or scaffolding) within the game, reinforced with learning feedback, will increase the learner's self-efficacy (Yates, 2005). To ensure that the learners can cope by themselves or be able to apply the learning skill on their own, the serious game developer must know when to apply and when to remove this scaffolding before the responsibility is shifted to the learners.

The instructional content delivery can be done by carefully design of the game activity. Learners can be informed of their progress by adequate feedback during this activity. If the educational perspectives require that the learner takes his time to learn based on the development of better performance than the serious game can cater to this by adjusting the learning activity according to the learner achievement.

Problems will arise from trying to adapt the educational perspectives based on a single method. For example, if the learner is allowed to chart his own learning, how does he know how to learn and to plan his own activity? If learning is based on the learner's own natural experience, how can standards be set in order to assess whether meaningful learning has taken place? How can the learner be confident that the knowledge gained is the correct knowledge that he is supposed to have learned

and not the 'wrong' knowledge and skill? Addressing these questions requires a multi-method approach and carefully considerations by the teacher.

Student and other student(s)

A learner can acquire new skills from his own experience of learning, and can take time to do it until he is happy with it. This resembles a learner exploring on his own and picking up skills (experience) within the game in order to continue to the next level at their self-learning pace. Rogers developed the theory of facilitative learning or the humanist approach (Rogers & Freiberg, 1994; Zimring, 1994). He suggests that learning will take place where the teacher acts as facilitator, and the learner feels comfortable with exploring new ideas on their own and charting their own learning path. In this framework, we take an approach of constructivist that is the learning will build up from the learner experience based on their collaborations with other learners by trying to find the answer through sharing and cooperating. For example, one particular student can build up their knowledge or trying to complete their learning by sharing and asking information from other student. In the end, they both will know will have the amount of knowledge and this mutual collaboration will shorten the learning process if it is done independently. The teaching material given to the entire student will be based on *capability* and instructional content.

Capability refers to the cognitive, psychomotor, and possibly affective skills which the learner is to develop as a result of playing the game. These skills have been identified by, for example, Bloom (Clark, 2004) in the cognitive domain, Dave (Kennedy, Hyland, & Ryan, 2007) in the psychomotor domain, and Krathwohl (Krathwohl, 2002) in the affective domain.

Instructional content

The instructional content is the subject matter that it is intended that the learner should learn. The detail of the actual subject matter to learn, or the type of content that the learner learns, could be an exhaustive list. Gilbert & Gale (Gilbert & Gale, 2008) illustrate the classification of content into four types: facts, procedures, concepts, and principles.

Intended learning outcomes

Learning outcomes are the goals to be achieved from playing the serious game. An intended learning outcome is a particular combination of capability and subject matter. For example, the learner should be able to recall the date of the George Washington in the French and Indian War or should be able to analyse whether a particular bird is a raptor.

Typical examples of learning outcomes are based on taxonomies of educational objectives with learner capabilities drawn from the psychomotor, cognitive, and affective domains (Gilbert & Gale, 2008). For example, pilots undertake rigorous training in both the classroom and in aircraft. A study has shown that by introducing a number of hours playing aviation computer games, pilots have performed better in test flights (Connolly, Johnson, & Lexa, 2007).

Game attributes

Game attributes are those aspects of a game which support learning and engagement. The game attributes are developed based on the critical thinking resulting from the literature review on behaviorist, cognitive, constructivist, educationist, and neuroscience perspectives (Yusoff, et al., 2009), as listed in *Table* 1 . The game attributes include:

Incremental learning provides the learning materials and introduces the learning activities incrementally. Intended learning outcomes are addressed one by one and not all at once.

- Linearity is the extent to which the learning activities are sequenced by the game (and would suit a serial learning style), and the extent to which an active learner may be able to construct their own sequences.

- Attention span concerns the cognitive processing and short-term memory loads placed upon the learner by the game. These loads need to be carefully calibrated to the target learner.

Scaffolding is the support and help given by the game during the learning activities.

Transfer of learned skills is the support provided by the game to enhance the application of previously learned knowledge to other game levels.

Interaction is the extent to which the game activities require responses and engagement from the learner.

Learner control is the extent to which the learner can direct their learning activities within the game, providing self-study and self-exploration to suit their own pace and experience.

Practice and drill provides for repeating learning activities with increasingly harder tasks for better achievement of the intended learning outcomes.

Intermittent feedback is the extent to which every game interaction receives feedback, or whether feedback is provided less frequently.

Rewards are arrangements in the game to encourage the learner and to keep their motivation high.

Situated and authentic learning involves the provision of a gaming environment or world where the learner can relate their learning to their needs and interests in the outside world.

Accommodating to the learner's styles refers to the game's ability to suit and to reach out to different learner styles by offering variation in game play.

Attributes for Serious Games	Values for Learning and Education
Incremental learning	Learning material is delivered incrementally. Additional new knowledge is delivered and not done all at once. It will have a proper start and end section. Learner feels and learns in a natural way and less complex.
Linearity	Learning will be in sequence. This will suit the sequential learner. However, due to the games flexibility, active learner can skip chapters.
Attention span	This concerns with the cognitive processing and short-term memory loads placed upon the learner by the game. These loads need to be carefully calibrated to the target learner Not to be overwhelmed and too long in the learning process.
Scaffolding	Support and help during learning within the games.
Transfer of learnt skills	Learnt knowledge to apply to other skills in the next level.
Interaction	Higher engagement, higher learning.
Learner control	Active learning, self study and self exploration based on individual pace and experience.
Practice and drill	Repeating for harder task, better knowledge retention and can have plenty of game activities for drills.
Intermittent feedback	Learner to reflect on what has been achieved so far and motivated for higher score (higher learning). Also using just in time feedback for learning.
Reward	Encourage learner and keep motivated. Negative reward as punishment within the game may also contribute to learning.
Situated and authentic learning	Learning where the learner can relate what is being learnt within the game to the outside world.

Accommodating the learner's styles	To suit and to reach out to different learner styles.

Table 1. Serious Games Attributes

Learning activity

Learning activity is the activity designed to keep the learner engaged and learning in the game world. The deep involvement or immersion by the learner depends on the effective design of these activities.

Gilbert & Gale (Gilbert & Gale, 2008) suggested a number of methods for constructing learning activities to support given intended learning outcomes. For example, if a learner needs to be able to recall a concept, the learning activities would include showing an example of the concept and asking the learner for the concept name, followed by feedback on the answer.

Activities should involve learning materials that are appropriate and challenging for the target learner seeking competency at a level slightly above that of their current competency (Gee, 2007). The majority of game designers spend considerable time in perfecting this area of "game play" in order to make the game successful.

Reflection

Reflection is where the learner thinks about the purpose of the learning activities that have been undertaken, and decides the strategy to apply during the next activity. Reflection should take place within the game without letting the learner step out of the game world, and this can be done by offering reflection activities within the game. Garris et al (Garris, et al., 2002) have stated that the reflection activity can be included within the game by providing a description, an explanation of why this activity is chosen, a discussion of the errors made by the learner, and some corrective suggestions.

Games genre

Game genre is the type or category of the game played. Genres range from "beat-em-ups", through open-world sandboxes, to strategy games, and simulation. More recently game designers have developed serious games adopted for learning purposes according to games genres.

Game mechanics

Game mechanics and game rules define the details of the game (Thompson, et al., 2007). If the game genre is a Real Time Strategy, for example, then it may require game mechanics of resource management and territory control. The desired learning activities and required instructional content influence the selected game mechanics in order to design a better game that will suit a particular style of learning, a particular target learner, or a particular set of intended outcomes.

Game achievement

Game achievement is the level of learner achievement in playing these games. This achievement can be indicated by the game scores, total amount of resources or assets collected within the game, or time taken to achieve game goals. In addition, it gives the pleasure of reward to the learner, and also serves a purpose of learner assessment. The learning activities can be modified based on the student's achievements and progress in the game.

This paper demonstrates that the proposed conceptual framework for serious games supports the design of serious games for effective learning, and to confirm that serious games, based on the proposed framework, would be both accepted by the learner and would be useful for learning. It is believed that these issues can be answered by using the Technology Acceptance Model (Venkatesh & Davis, 2000) applied to serious games.

Conclusion

The serious games framework presented in this paper identifies the major components that create an effective model for learning through the use of serious games. Every component inside this framework plays a role to ensure that learning would take place while playing the game. We propose this framework as an appropriate basis for effective serious games design for designers and teaching practitioners.

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