Intrinsic fantasy: motivation and affect in educational games made by children

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Intrinsic Fantasy: Motivation and Affect in Educational Games Made by Children.

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Abstract: The concept of intrinsic fantasy has been considered central to the aim of usefully applying the positive affect of computer games to learning. Games with intrinsic fantasy are defined as having "an integral and continuing relationship with the instructional content being presented", and are claimed as "more interesting and more educational" than extrinsic fantasy games [1]. Studies of children making educational games have shown they usually create extrinsic games for curriculum learning content. In this study, children were encouraged to create non-curriculum games, more easily distanced from the extrinsic preconceptions of formal schooling. Forty, 7-11 year olds took part in this study (17 boys and 23 girls), designing and making their own games at an after-school club. Despite non-curriculum learning content, no more intrinsic games were created than in previous studies. The children failed to create their own pedagogical models for non-curriculum content and did not see the educational value of intrinsic fantasy games. The implications for transfer and learning in intrinsic games are discussed whilst the definition of intrinsic fantasy itself is questioned. It is argued that the integral relationship of fantasy is unlikely to be the most critical means of improving the educational effectiveness of digital games.

Pioneering work by Malone and Lepper in the 80s used computer games as a platform for studying intrinsic motivations for learning. This work produced a taxonomy identifying four categories of individual motivations responsible for the positive affect created by computer games: challenge, fantasy, curiosity and control [1-7]. The theory behind the taxonomy suggests that the motivational effect of a challenge depends on engaging a player's self-esteem using personally meaningful goals with uncertain outcomes. Uncertainty can be achieved through variable difficulty levels, multiple level goals, hidden information and randomness. It also proposes that it is the emotional appeal of fantasy and the sensory and cognitive components of curiosity that provide their motivational effect in digital games. It further suggests that cognitive curiosity is aroused when learners discover that their knowledge is incomplete, inconsistent, or unparsimonious. The motivational effect of control is attributed to empowerment and self-determination, suggesting that it is affected by the range of choices offered by a game, the extent to which outcomes are dependant on the responses of the player, and the inherent power of these responses. In addition it proposes that the perceived level of control is more important to motivation than the actual level of control.

Whilst these theories did not focus on what makes games educational, they made a significant theoretical claim by attributing educational benefits produced by the positive affect of fantasy to the distinction between *intrinsic* and *extrinsic* fantasy. Based on a number of empirical studies it was proposed that, "in general, [intrinsic] fantasies are both more interesting and more educational than [extrinsic] fantasies" [7]. An educational game with intrinsic fantasy is defined as one in which "the skill being learned and the fantasy depend on each other" and "there is an integral and continuing relationship between the

fantasy context and the instructional content being presented" [7, p. 240]. Conversely an educational game with extrinsic fantasy is defined as "one in which the fantasy depends on the skill being learned but not vice versa". To illustrate this we could contrast the extrinsic fantasy of 'hanging a man' in a game of computer hangman, with the intrinsic fantasy of 'darts and dartboard' in a game of computer darts. The fantasy context of hangman is usually applied to a spelling exercise, guessing missing letters in a word, but could just as easily be applied to a mathematics exercise, guessing missing numbers in a sum. However in the fantasy context of darts, using mathematics is intrinsic to the strategy of reducing a score to zero without a remainder and cannot be removed without fundamentally changing the game.

Two previous studies of educational games made by children found that children rarely attempt to create educational computer games with intrinsic fantasies [8, 9]. This would seem to suggest that children do not naturally attempt to harness the motivational potential of computer games in the most effective way. The explanations offered for this included the extra difficulty in creating intrinsic games, a design tension between game and educational content, and the prevalence of extrinsic question and answer models in 'edutainment' and teaching practice in schools. However, these studies concentrated mainly on learning content from the traditional school curriculum such as fractions. In the current study children were encouraged to create computer games that taught non-curriculum learning content that might be distanced from the extrinsic teaching methods used in school. They were also provided with concrete examples of games containing both intrinsic and extrinsic fantasy as models for completing the exercise. In this way we hoped to gain a deeper understanding of children's attitudes and preferences for intrinsic and extrinsic fantasy and how the positive affect of computer games might be more effectively applied in creating educational digital games.

1. Method

The study was run within the context of a weekly after-school computer club at an English primary (ages 7 to 11) school. The club was advertised to the children as a chance to learn how to make computer games and spaces were allocated on a first come first served basis. Due to the overwhelming interest, the club was run twice a week with two separate groups of different age groups. The younger group was made up of 11 boys and 9 girls and the older had 6 boys and 14 girls. The children's ages ranged from 7 years 7 months to 11 years 4 months old. At the club each child had access to their own computer in the school I.T. suite and as far as possible both groups were exposed to the same instruction and direction over the course of the study.

The clubs began by getting the children to discuss their favorite computer games and what made them motivating to play. This gave an initial insight into the children's mindset and their answers mapped well on to the taxonomy of intrinsic motivations for learning. This was followed by eight weeks of tuition in Stagecast Creator, the software package used to create the games. Stagecast is a commercially available package that provides a visual programming environment specifically designed for children [10, 11]. Programming is achieved by creating 'before' and 'after' pictures that define how situations are changed by each programming rule. This visual method of programming is very easy to pick up and accessible to children as young as seven years old. A number of lessons were prepared in collaboration with a class teacher at the school, and these were delivered in whole class sessions by the principal researcher. These sessions covered the essential skills for making simple games as well as introducing them to different examples of games that can be created with the software.

Stagecast was also used to create the intrinsic and extrinsic example games for the study. In keeping with the context of a computer club, the learning content of the games was about the functionality of computer components. This choice also had the advantage of being obscure enough to prevent the children from directly plagiarizing the game ideas. Both examples covered exactly the same learning content, but contrasted intrinsic and extrinsic fantasy solutions.

In the intrinsic example players have to control a robot whose abilities are directly dependent on the functionality of the components he collects (see figure 1). In order to escape an alien base he must decode the codebooks for a number of security doors. Upon reaching the first codebook, the robot is told that he needs to do 'hard sums' in order to break the codes. Using the on screen information the player can work out that the robot needs to collect the missing processor first. The codebook for the second security door is some distance away from the door and the robot forgets the code as soon as he moves away from the book. The player can then work out that the robot needs to collect the memory first. In this way the learning content is firmly embedded within its application in a fantasy context, creating the 'integral and continuing relationship' of an intrinsic fantasy.
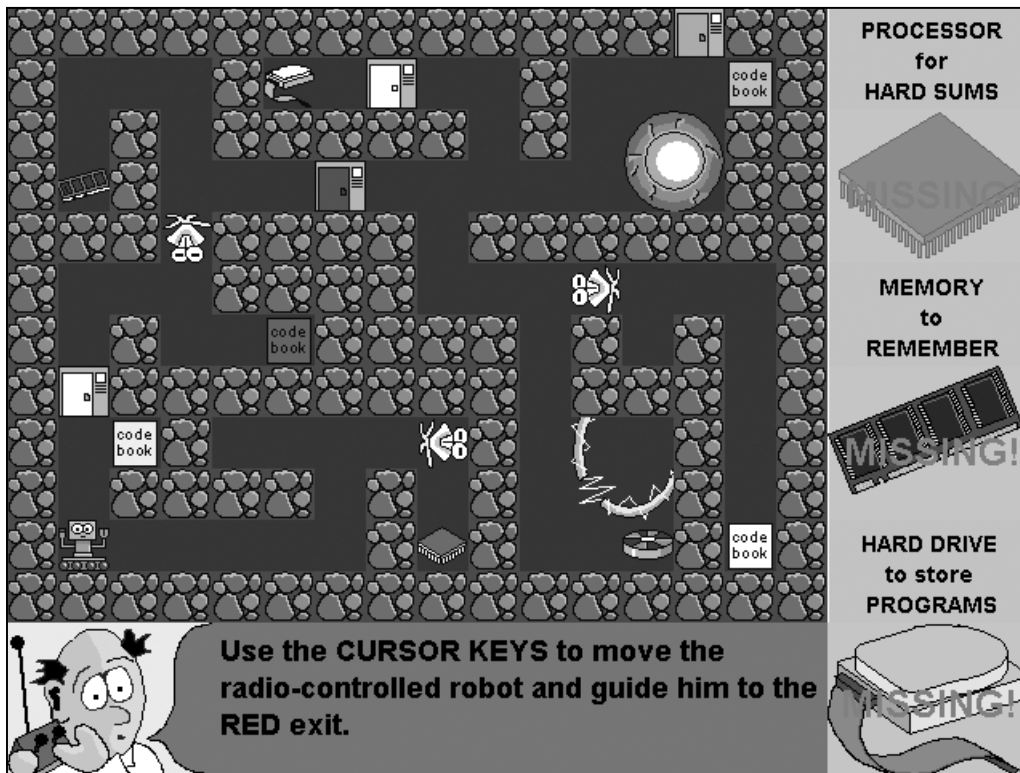

Figure 1: "Robot Rescue" the intrinsic example game.

In the extrinsic example the player's had to retrieve the same computer components by correctly answering multiple-choice questions about their functionality (see figure 2). The game is set within a skateboarding fantasy context, but this is entirely extrinsic to the learning material being presented. The fantasy context could be used for any kind of learning content as 'the fantasy depends on the skill being learned but not visa versa'.
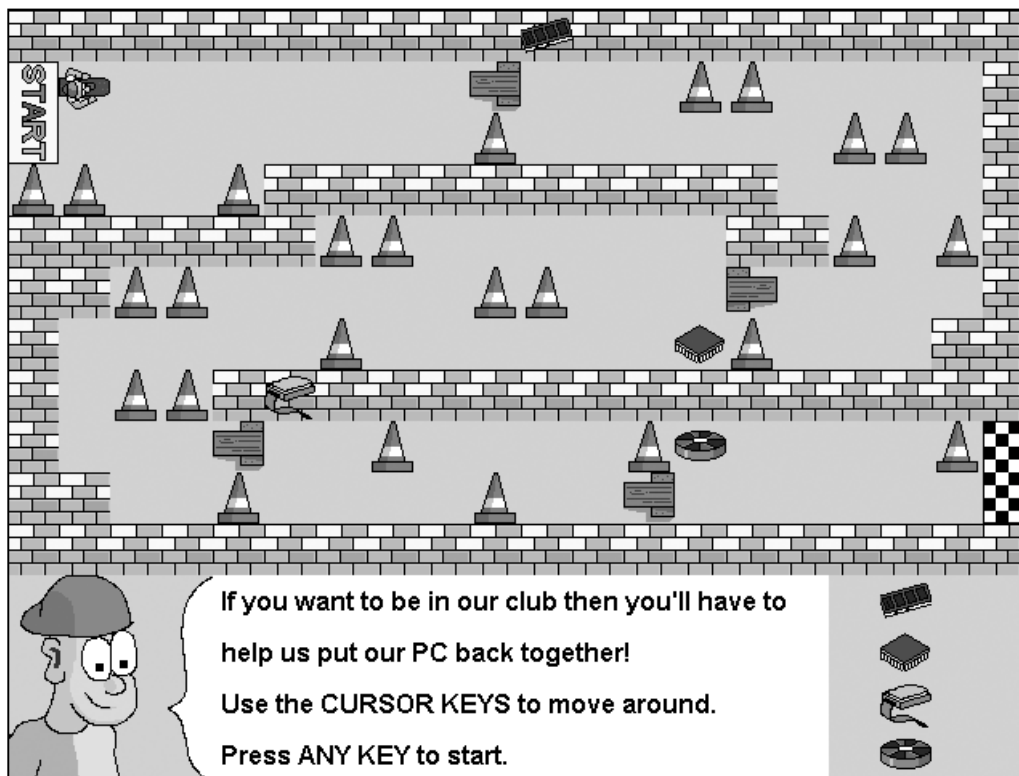
Figure 2: "Silly Cone Alley" the extrinsic example game.

At the end of the eight weeks of tutorials the children were presented with the two games as potential models for their own game designs, and given a chance to play and discuss them as a class. Afterwards, they were shown real computer components and asked to explain what they do in order to demonstrate that they had learnt something from the games. Next they were asked to design their own games to help players learn about a topic of their choice such as a hobby or interest they had outside of school. They were told that the learning in their games should be something that would be useful to the player in the real world after they had finished playing the game. They were provided with templates to structure the design process and taken through the procedure of completing them using the two games as examples. These included specific questions about the fantasy context of the game design (story and characters) as well as about what would make the game motivating (fun) to play. Two club sessions were then devoted to completing their designs, and stragglers were given time to finish off at lunchtimes. All of the children's designs were copied for later analysis.

For the remainder of the study the children worked independently on their games in the computer suite. The children were given periodic reminders that their games were supposed to help someone learn something, when it started to become apparent that many of them did not contain educational content. Towards the end of term they were given the opportunity to spend additional time working on their games in their lunch hour, giving them the potential of 10 hours total development time working on Stagecast by the end of the project. Copies of all the games were taken at the end of every session, providing a complete development history of the children's games. In the last week of term the children were interviewed in groups of 2 or 3 about their games and their learning content. These interviews were videoed and transcribed for analysis along with the class discussions about the example games.

2. Results

The children created a total of 34 game designs and 29 finished games. The mean number of hours spent developing the finished games was 7.0, with a minimum of 2.0 and a maximum of 10.0. Table 1 shows the number of games created in each year group along with the corresponding number of intrinsic, extrinsic and non-educational games. Games were considered to be 'educational' if they contained learning content that was identified by the game's author as relevant outside of a gaming context. This is because most games contained unintentional learning content (such as improving reaction times, or hand-eye co-ordination), which would be unrepresentative to count unless the child designer had included it deliberately.

Table 3: The number of games designed and created by children of each year group and the distribution of extrinsic, intrinsic and non-educational games.

Year Group	Games Designed/Created		Designs classified by researcher as:			
			Extrinsic	Intrinsic	Not Educational	Educational Misconceptions
7-8 Years	10	10	1	1	5	3
8-9 Years	10	8	0	0	5	5
9-10 Years	6	6	3	0	2	1
10-11 Years	8	5	5	0	3	0
Combined	34	29	9/34	1/34	15/34	9/34

26% of the games were extrinsic in design, nearly all following the same multiple-choice question and answer format used in the extrinsic model provided to them. Common themes were shopping adventures based around maths questions and horse riding games based on questions about riding tack. Only a single game had intrinsic learning content that was identified by its author as relevant outside of a gaming context. This game taught players not to touch dangerous electrical items, by making them switch off a number of electricity pylons in order to safely progress through a maze. 44% of the games and designs did not include instructional content at all, and were not considered to 'help player's learn anything' by their authors, despite most of them beginning with this intention. One example was a space adventure game that was supposed to teach players about the structure of space rockets. Unfortunately, despite producing a very polished game the author left out the learning content altogether. 26% of the games and designs were considered educational by their creators, but suffered from significant misconceptions in their choice and implementation of their learning goals. Examples include games that attempted to teach players how to drive cars, fly planes or swim by moving a character around the screen using the cursor keys.

3. Analysis: The Role of Intrinsic Fantasy in Educational Games

The children in this study put an enormous amount of energy and enthusiasm into the project and demonstrated that young children are capable of designing and making sophisticated computer games. Nonetheless, despite the use of an intrinsic model and a free choice of learning content, there was no increase in the number of intrinsic games over previous studies. However, a simple preference for familiar extrinsic learning models does not seem to fully explain their prevalence in the children's game designs. Many of the

children in this study found it extremely hard to create realistic learning models for non-curriculum content and the intrinsic model did not appear to help. Furthermore, the interview data shows that many children struggled to see the educational value of the intrinsic model or intrinsic reinterpretations of their own games. Our interpretation of these results is that using non-curriculum learning content did remove some of the extrinsic associations of schooling, but without an understanding or appreciation of the intrinsic model most children were left with no model at all. This then either resulted in children creating misconceived learning models of their own, or avoiding this difficulty by leaving out their intended learning content altogether.

This study has also raised questions about the definition of intrinsic fantasy, and the significance of fantasy as the key factor in creating a closer integration between a game and its learning content. The children's games have provided a diverse range of fantasy contexts with which to test the definition of intrinsic fantasy, and the results have often proved ambiguous. Three of the games in particular illustrate this point. In the first of these a quartz crystal, called Nile, must escape from a dungeon by collecting a number of rocks and minerals (see figure 3). The learning content is delivered by displaying the name of each mineral on the screen as Nile collects it. This elaborate fantasy is certainly 'depends on its subject matter' – even to the point of the main character being a mineral himself. However, the learning content is not needed to complete the game, and can be completely ignored, so it can hardly be intrinsic. The second game design takes place in a haunted school where players have to answer questions put to them by monstrous teachers. As the game is set in a school and the questions are all on school subjects so it could be argued that there is a 'continuing relationship between the fantasy context and the instructional content being presented'. Unlike the mineral game, the learning content is also integral to completing the game, as each question must be answered correctly to proceed. Yet this game uses the same multiple choice question format that was used in the extrinsic example game.
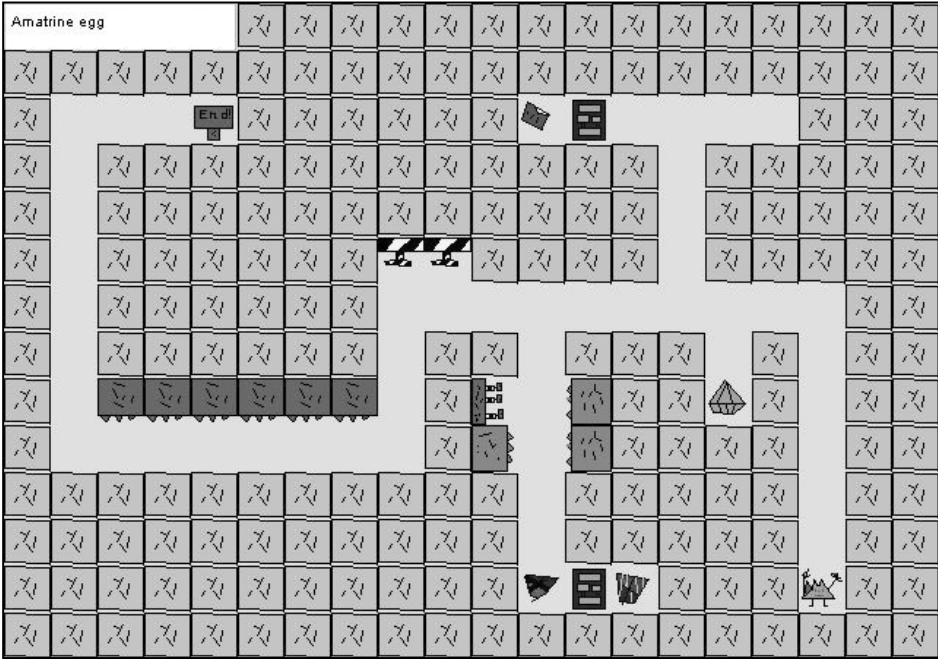

Figure 3: "Nile the Quartz Crystal" (boy aged 8 years 3 months).

The final game is about a collecting gold, whilst avoiding robots and live electricity pylons (see figure 4). Compared to the other two games the fantasy context is relatively thin, and its author freely admitted that there isn't really a story behind the game. In his interview the author was solely concerned with the rules and goals of his game rather than the fantasy context. However, he was the only child who was able to verbalise how he had embodied his learning material within the game and how it was relevant in the real world. He taught players not to touch dangerous electrical items by making them switch off electricity pylons before going near them in the game. As a result it was considered to be our only intrinsic fantasy game, but how much of a role can such a thin fantasy play in the integration of learning content? These examples, and others illustrate the ambiguity involved in classifying intrinsic fantasy games.
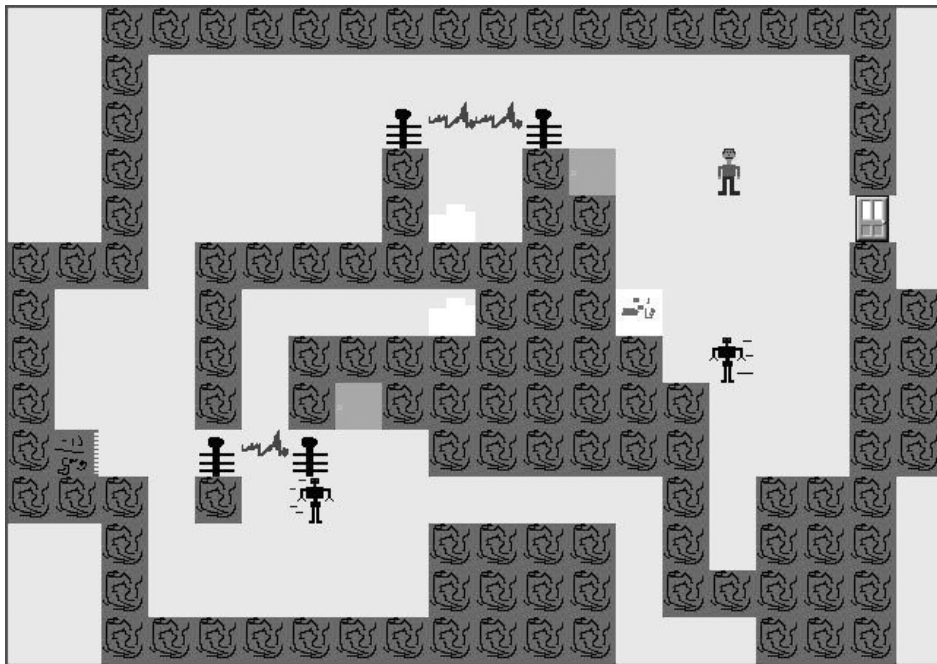

Figure 4: "Get Out" (boy aged 8 years 1 month).

Even our original darts example doesn't stand up to much scrutiny as an intrinsic fantasy game. If we were to swap the fantasy context of throwing darts for the fantasy context of firing elephants out of a cannon, how would this change the game? If there was an 'integral and continuing relationship' between the fantasy and the learning content then the game should no longer function. However, providing that the rules and the scoring mechanism remain the same then the game should remain just as integrated and just as educational. Consequently, we suggest that fantasy is not the main factor in creating effective integration and that integration of the learning content and the rule-system of a game is a more significant factor. Such rule systems are commonly referred to by game developers as the core mechanics of a game and are defined by Salen & Zimmerman as the "mechanism through which players make meaningful choices and arrive at a meaningful play experience" [12](p. 317). Core mechanics are the procedural mechanisms of a game that provide the essential interactions required to create a meaningful gaming activity. So the core mechanic of the classic game of Breakout is in controlling the horizontal position of one object in order to repeatedly intercept another moving object and keep it bouncing around a confined space. Whether the game uses the fantasy context of a bat and ball or (as in a later interpretation of the game) a space ship and energy bolt, it makes no difference to the fundamental gaming activity.
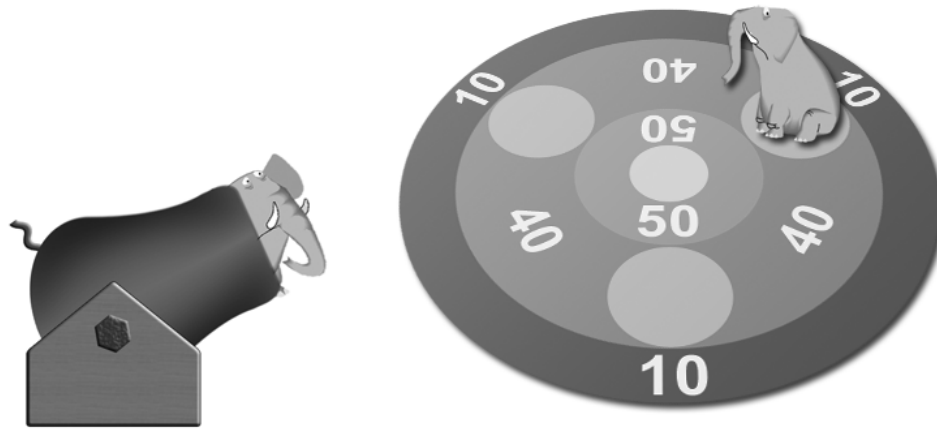
Figure 4: An alternative fantasy context for darts?

Our experiences in this study suggest that children have great difficulty in understanding the pedagogy behind intrinsic fantasy games and as a result often do not see them as educational at all. This raises important questions about how this viewpoint affects children's learning and particularly the transfer of learning content in intrinsic educational games. However, this study has also raised doubts about the "integral and continuing relationship" of fantasy as a critical means of improving the educational effectiveness of digital games. We suggest that intrinsic fantasy is a misnomer, which merely clouds our ability to distinguish the effect of fantasy elements within games from the more precise distinctions between them. Continuing to use the term intrinsic fantasy in this context would therefore only stand in the way of gaining a deeper understanding of how to successfully harness the positive affect of computer games for educational use.

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