Understanding the Barriers to Implementing Video Games in the Classroom

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Abstract

Video games have been used in the classroom before, but rarely as an actual teaching tool. The problem therefore, is to find out why video games are not used as educational tools when there are many educational video games available out there. These barriers will reveal the underlying issues and hopefully present possible solutions that will allow researchers to convince teachers of the usefulness and necessity of using video games in the classroom. The barriers will be separated into those which game designers can address and those which teachers and schools can address.

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Introduction

There are many ways that people can learn information. In today's society, education usually comes in the form of lectures and, occasionally, some form of hands-on work. Some students learn perfectly well with this method, which may be why it is still the predominant method of teaching in schools. However, with the advancement of technology, it is possible to take hands-on learning to a whole new level. Virtual reality systems may be too complex and expensive to use in a daily setting in schools, but there are other types of virtual media that can be implemented in more cost effective ways. Video games and virtual worlds like Second Life can allow students a more interactive method of learning than what is currently offered. However, teachers and administrators are hesitant to try placing this technology in their schools. They have many valid reasons, but if it were possible to address most of their concerns, perhaps this form of teaching could be added to the existing learning structure. By using video games and virtual worlds, schools would be able to cater to those students who learn better by doing and not just seeing. Even those who learn fine by the normal methods may find their interest is better piqued by something visual and interactive. Video games are not a perfect medium, but they offer opportunities in the classroom which would normally not be possible.

There is also the growing need for the younger generations to be proficient in the use of technology. The world is becoming more and more technologically based, requiring those that inhabit it to have a good understanding of this technology. If the students of today are to survive and succeed in this type of world, they need to start becoming comfortable using computers and the like as early on as possible. Many students of today are already technologically savvy, which is due to their world immersing them in technology. These students have been called the 'net

generation' because of their affinities to computers and the World Wide Web. Therefore it is important to teach to what the students know and like and also to teach them knowledge they will require in the coming years.

Problem Statement

To address the problem of getting video games into the classroom in the first place, there are many issues which need to be addressed. These issues are the many barriers blocking teachers and administrators from accepting video games in the classroom. If these issues are acknowledged and addressed, it may be possible to see video games used as learning tools by teachers all over. These problems are fairly universal to any country attempting to implement video games, therefore some of the solutions may be applicable worldwide.

The first thing that must be done is that the main impediments that are preventing video games from being accepted into the classroom need to be identified. Identification of the specific issues is the first priority. After this, those impediments need to be categorized into issues that game designers can address and issues that the schools themselves will need to address. Finally, any possible solutions for the game designers need to be identified. This problem is of some importance. It is not just that some students may learn better this way, but also that this society is evolving to become more and more dependent on technology. By using video games in the classroom as a teaching aide, the teachers are helping their students to become more adept at using technology. If technology is kept out of the classroom, it could have adverse effects on children later in their lives. Therefore, research shall be undertaken on this topic, the research shall be analyzed, and solutions shall hopefully be discovered.

Background

Previous research studies. A number of research studies have been conducted on the educational merit of video games. These studies did not focus on the experience of the teacher or how well the experience fit into the class schedule and curriculum. Instead, they were looking for evidence that showed that serious games could be used to teach students. Many did show that video games can be useful in the classroom. These studies are very important because they provide a basis for the argument that video games can and should be included as a learning resource.

One such study was conducted in Turkey (Tuzun, 2007). This researcher was attempting to implement video games into Turkish classrooms. He found that students are capable of learning through video game use and that they seemed to enjoy the experience. In his study, the educational merit of video games was shown to be there. He did note that there were some problems, such as teachers adjusting to their new roles and trying to fit the gaming into a set curriculum. However, these were merely side notes to what he was trying to discover.

Another study (Dalgarno & Lee, 2010) was conducted to discover the merits of virtual learning environments. These are a type of gaming experience that is more changeable and can be adapted to the user's needs. The study showed that true virtual systems are too expensive to be used in most schools at this time. Since they are not in high demand, virtual systems are still very pricey. However, the researchers were able to determine that using a system like a virtual learning environment was good as a teaching tool. Virtual environments allow students to practice things that would be too dangerous in the real world, or not readily available.

Since it has already been shown that games can teach, the next step was to see how far they could go. One skill needed to practice the sciences is higher order inquiry. The question in this study (de Freitas, Rebolledo-Mendez, Liarokopis, Magoulas & Poulovassilis, 2010) was

could a video game teach this skill and assess it in students. The conclusion was that it is possible to teach higher order inquiry skills and assess how well a student learned them. This is important for convincing teachers that games are not just toys that rot your brain.

Games have been used in the classroom for years. Since games began to be made for computers, there has been the possibility of using them in the classroom. A few games were, and sometimes still are, used in the classroom. These games are those like Where in the World is Carmen Sandiego? (Broderbund Software, 1985), Oregon Trail (MECC, 1981), and Amazon Trail (MECC, 1994). These games can be used to teach history and geography. However, their use in the past has been less as educational tools and more as something to do on computers. The educational merit of these games is not as pronounced as those made specifically for educational purposes.

However, the mere fact that games have been used in the classroom before, and some of these still maintain a presence in the classroom, shows that it is possible to place video games there. The problem then lies in the games themselves. Since teachers have accepted video games before, there must be a way to get them to accept more sophisticated and educational games than games like Oregon Trail, which while a good game, is not very educational.

Research Questions

Researching this topic has posed some questions which will hopefully be answered in this study. The first question deals with the reasons behind the reluctance of teachers to accept video games. As has already been pointed out, video games have been used in the classroom before, so this doesn't seem like it should be that much of an issue. Therefore, the first answer that is needed is to find out why teachers aren't readily accepting video games as teaching tools.

Another question deals with the solutions that will be needed. Teachers and administrators have options for dealing with some of the barriers to teacher acceptance. It just remains to explain figure out what is possible for schools themselves to do to make video games more easily accepted.

The last question also deals with the solutions that will be needed. Game companies have the ability to deal with some of the barriers that must exist. Therefore, the answer to this question will be what game companies can do to get teachers on board with using video games in their classrooms.

Methods

To get a broader sense of what teachers are having problems with, the best method of research is a qualitative analysis of studies previously undertaken by researchers. By reviewing these studies, it will be possible to discern many of the barriers teachers have against video games. Each study will be analyzed to find the perspectives of the teachers regarding the use of video games in their classrooms. Any comments of the researchers regarding these barriers will be taken into account when coming up with possible solutions to the many barriers. Some researchers may have solutions of their own which they believe may solve the problems they have encountered. These will also be taken into account.

Once a good list has been compiled using previous studies, each barrier will be looked at individually for its importance as a problem to address and a possible solution will be drawn up. Any further studies which have dealt with similar situations as some of the barriers will be consulted when creating solutions for those barriers. Some of the barriers that may be found might have been addressed in a different context and the solution used then might apply in the context of getting video games into the classroom.

Hypothesis. The hypothesis of this study is that analysis of previous research will reveal many barriers to getting teachers to accept the use of video games. Analysis of these and other studies will also provide some solutions to the problems found or point to possible avenues to for more research on the topic. Therefore, if this all holds out, then it will be possible to provide gaming companies and schools with possible solutions to the problems found.

Target audience. The target audience of this thesis is primarily game companies. It should interest them to know what they can do to help create a market in educational video games. A new market means more money for the company and a larger potential customer base. Also, companies which already create educational video games should be interested to learn how they can change their games to suit the needs of the teachers who will be employing their games.

The secondary audience is the teachers and administrators who might be thinking of getting video games for their classes or schools. It should interest them to see what can be done on their end to make it easier to use video games.

The tertiary audience is the research community for this topic. This thesis should add to the base of information out there and possibly give researchers new avenues to look into. Also, when designing studies using video games in the classroom, researchers could use some of the information in this thesis to make the study better.

Literature Review

Educational Value of Video Games

Much research has gone into answering the question of whether video games can be successfully used to educate students. Many studies have been conducted with varying success. One such study by Hakan Tuzun (2007) explored the possibility of using video games in the classroom. He conducted three separate studies in three different schools. The study was meant

to look at how video games could be used to study different subjects in different levels of school. Tuzun was also looking for any problems that might occur when trying to implement video games in the classroom. His results found that while it is possible to teach via computer games, finding time in a busy curriculum to use those games was a problem. Also, the availability of technology and the time required to create subject specific games might be a deterrent to using video games in the classroom.

One possible way to fix one of Tuzun's concerns, that about the time it takes to create a video game, could be to use a virtual learning environment. Several studies have looked at the merit of using virtual learning environments in the classroom. Dalgarno and Lee (2010) did an analysis of studies done on the usefulness of virtual learning environments. They chose many studies to look at and found the advantages discovered in those studies. These advantages included enhanced spatial knowledge, experiential learning, increased motivation and engagement, and more effective collaborative learning. The one problem they found, though, was the lack of empirical studies corroborating these findings.

An empirical study that exists on the subject was done by de Freitas et al. (2010). This group of researchers was looking more at college level educational experiences. They did a study at two colleges in the United Kingdom to see whether virtual learning could be useful to college students and lifelong learners. A virtual environment called Second Life was used as the tool for teaching the students. Questionnaires, observations, surveys, and interviews were used to gather information. The findings from this study were that availability of technology was a problem, but that virtual environments could be used as a learning tool. This study corroborates one finding of Tuzun's study, that availability of technology is a hindrance to the use of computer games in the classroom.

Another empirical study was done by Ketelhut, Nelson, Clarke, and Dede (2010). Their study looked at multi-user virtual environments and how they could be useful in science classrooms. Specifically, they were looking for a way to teach students how to use scientific inquiry. They used several different schools and many different classrooms spread throughout the United States. Different methods were used in each classroom as well, to measure different things. The results these researchers got showed that using the virtual environments to teach science worked. The students did learn more about science. They were also able to increase their skills in scientific inquiry. However, a problem that the researchers found was that, like with Tuzun's study, time was a problem. For American students, the teachers must teach the content that will be found on the standardized tests the students must take each year. Thus, finding time to use video games in the classroom while sticking to curriculum was also a concern.

Some researchers in this field like to analyze other studies that have been done. Garry Falloon (2010) is one such researcher. In this study of his, he looked at other studies that argued for using virtual environments in the classroom. He then looked at a specific study done in New Zealand. This study used a program called MARVIN in two different schools to show how avatars and virtual environments could work in schools. He found that avatars allow students to interact with one another in the virtual environment. This promotes communication amongst the students and stimulates higher thinking as students work through problems together. From what Falloon found, it seems that virtual learning environments can be very helpful as learning tools. The one problem that Falloon found was that the teachers needed to adjust their way of teaching and embrace their new role in the classroom.

Inhibiting Factors

In a study done by Baek (2008), six factors were found to be inhibitors in the integration of video games into the classroom. These six factors included: inflexibility of the curriculum; negative effects of gaming; students' lack of readiness; lack of supporting materials; fixed class schedules; limited budget. Baek's study was done by first having thirty-five teachers make a list of reasons why they wouldn't use video games in the classroom. Then the lists were compiled together and a questionnaire was formed. This questionnaire was given to over four hundred teachers and the result of this was the list of six factors. These six factors seemed to matter most to teachers and this is why they were chosen to be part of the list.

A researcher, Rice (2007), also came up with a list of six factors affecting video game adoption in schools. Instead of directly asking teachers for their opinions, Rice looked through research on the subject and decided that his six factors were part of the problem. These six factors are: negative perceptions toward video games as educational components; availability of state-of-the-art graphics in educational games; lack of adequate computing power in classrooms; short class periods; a lack of real world affordances; a lack of alignment to standards. For each factor, Rice explained the factor, gave the implications of fixing the problem, and gave suggestions for future research. The six factors that Rice came up with are possibly a more subjective set than Baek's, since Baek did a study with actual teachers.

Advice on Integration

Kebritchi, Hirumi, Kappers & Henry (2009) conducted a study to find out what teachers needed to facilitate integration of video games into the classroom. She used a survey conducted using teachers K-12, and analysis of existing websites, and literature. These helped her come up with three problems and what might be done to solve them. One of the main problems was support. Kebritchi et al.'s advice was to create better support websites for educational games.

These websites needed to be easily navigable, contain technical support, and include some way to ask questions. According to Kebritchi et al.'s research, one of the biggest problems is that teachers do not have enough support for the games that they are trying to use.

Wood, Mueller, Willoughby, Specht & Deyoung (2005) wrote an article on the barriers preventing teachers from accepting technology in the classroom. One of the problems mentioned focused on a lack of support for the teachers. They felt that they didn't have enough help when there were problems and so didn't feel comfortable with the technology. A solution for this would be to offer better support for teachers to help them feel more comfortable. Also, the authors found that there was a problem with the hardware and software available to the teachers. Schools don't tend to have the best machinery or programs, and this made the teachers hesitant as well. Another solution the authors thought of would be to have better technology available to the teachers. These are simple problems with simple solutions, however, the solutions are not very cheap.

Another article written by Mansureh Kebritchi (2010) focused on what issues teachers were facing. A case study was done where three teachers were given an introduction to a math game called Dimenxian. They were then asked a series of questions. The results found that while the teachers could see the value in the game, they weren't convinced that the students would actually be learning math concepts and not just how to play the game. They also worried that they wouldn't have time to allow the students to play the game due to curriculum. If the game couldn't teach the students something that was hard for the teachers to get them to learn under normal circumstances, then they didn't see the need to use the game. Also, they wanted the game to come with supplemental worksheets and such to test the knowledge that the game was supposed to impart. These concerns added to the normal ones of available technology, classroom

time, etc., show a picture of what needs to be addressed for research in this field to really move forward.

Another article focused less on giving advice and more on asking the right questions. Chee (2007) came up with six key questions to ask when deciding to bring games into the classroom. These questions are: what should students be trying to learn; how should games be used; why should games be used; how should we deal with *design issues*, both with respect to the game itself as well as the design of the broader classroom-based learning environment so that game adoption can be scaled up and sustained; how do we help schoolteachers to assimilate and internalize suitable *pedagogies* for game-based learning; how do we evaluate the *effectiveness* of game-based learning, and what forms of assessment can we use. Each of these questions deal with integrating video games into the classroom.

An article by Stoddard & Marcus (2010) didn't focus on video games. However, it focused on using film in the classroom. The reasons why film could help students learn can also be applied to the usefulness of video games for learning. Also, Stoddard & Marcus pointed out that students need to have a clear understanding of why they are watching a film, the same can be said of video games. It might help students to fully accept video games as a learning tool if they understand why they are playing them. Another important point the authors brought up is that students need to be taught how to critically analyze the content of the films. This concept may be brought into the topic about video game learning. Perhaps it would be a good idea to have the students able to critically analyze the content of the games they are being asked to play. This article works as more of a comparison with other types of media.

Advice on Available Software

Angelone (2010) wrote an article on how to use commercial video games in the classroom. She expounded on the virtues of games that are already available and can be put to educational uses. These games are listed with a description on how they might be applied to different lessons taught in schools. The author also included some good advice on how to get a hold of these potentially expensive games. Some of her advice included asking the PTA for funds or seeking a technology grant. There was also the option of having students who own a copy of the relevant game bring it in and have the students rotate through game stations. The author also recommended that these games not be used as the primary source of learning, but as a supplement at the beginning or end of a unit to solidify students' understanding of the lessons. The advice in this article is good advice for teachers looking for something more for their students.

Annetta (2008) focused more on software that is available for free on the internet. He gave examples of games that teachers can access for free to use in their class. Along with these examples of games, Annetta gave advice on how to use the various resources so that they fit better into a teacher's curriculum. Beyond the available software, Annetta also advised that the students of today are not being served well when teachers omit technology from the classroom. Children brought up in today's society are more in tune with technology and may learn better with it.

Experimenting with Teachers

Devlin-Sherer & Sardone (2010) conducted a study using ten teacher candidates to see how they reacted to educational video games. The results they got showed that many of the subjects thought that the games would make good supplements to a lesson. They were intrigued by the idea of using video games as a teaching aide. However, some had a few problems. They

think of games as fun, and for them, a lot of reading in a video game is not fun. They didn't like the amount of reading they had to do while playing the game. Though, one good point they had about using video games is that it would help make their students into independent learners, more in charge of their education. This, apparently, is a goal worth striving for and video games can help.

A study by Jaipal and Figg (2009) used four grade 8 science classes to test how well the games worked in the classroom. The results found were that the teachers found the games to be useful in the classroom, but that they found the games insufficient or not covering the right material. The teachers suggested that games that are meant to teach science should have accurate graphical representations of the material and should follow the standardized material that a class at that level would be expected to learn. They found that the game went over more advanced topics while skipping topics that the students were supposed to be learning. They also felt that if supplemental materials are provided, then they need to be challenging enough to force the students to think more. There are some good insights into what teachers need in a game in this article.

Sardone & Devlin-Sherer (2008) conducted a study using teaching candidates to see if multi-user virtual environments are within the scope of a new teacher's abilities to use in the classroom. They introduced the candidates to a program and asked them what they thought of it. The subjects liked the program and thought it had potential, however, they also came up with a few negatives. One problem was the length of time that it took to complete the game. They didn't think it was a good idea if a game task took longer than one class period to complete. Another problem they thought might come up was that there might be trouble keeping the

students on task. Also, the difficulty of the content was a concern for some. Overall, the participants were excited about the idea of using a game to teach students.

Sardone & Devlin-Sherer (2009) conducted another study using teacher candidates and their views on using computer games in the classroom. One of their purposes was to see if the candidates learned anything new about their role in the classroom while using video games. The role that was found to work best was as more of a facilitator rather than the center of attention. It is a different role for a teacher to embrace, but necessary to make using video games go more smoothly.

Ideological Issues

Amory (2007) took a look at some ideological issues surrounding the use of video games in the classroom. One of these problems has to do with gender exclusion in video games. Most video games pander more towards males than females, which may make teaching using video games a bit of an unequal enterprise. Also, teachers are of a different generation than their students and don't always have the same ideologies as their students when it comes to technology. This can cause some issues in the classroom. There is also the problem of educational pedagogy and whether or not video games can become a part of the pedagogy for teachers. It is not a normal method of teaching, which may make some teachers uncomfortable. Amory did a thorough job looking at how ideology may play a role in bringing video games into the classroom.

Kirkley (2005) wrote a brief article expounding on how important it is to find a way to integrate video games into the classroom. He feels that integrating video games is a demanding process, but necessary and he has high hopes for the future.

Results

The following is a list of the barriers found through research and their importance.

New Role for Teachers

One barrier found through research was the idea that teachers would have to take on and accept a new role in the classroom (Tuzun, 2007). By using video games, teachers are no longer the only source of learning. To make it easier for students to learn through use of video games, teachers must become more like managers or coaches. They need to manage the classroom by keeping students on task and making sure they are doing the work in a timely manner. However, they must also be coaches. The students will need help and guidance occasionally while they are using the video games. The role of the teacher then is to help steer the students in the right direction.

This barrier is important because it is a fundamental change in the classroom. Teachers are used to being in complete control of how the students learn. By being in the front of the classroom, the students must look to the teacher for knowledge. However, by placing the students in front of computer screens, the students are now looking to the game for knowledge and don't need the teacher in the same capacity as before. For a teacher who has never taught like this before, it can be strange and unsettling. Some teachers may not know how to give up control and will hate this new role they are being forced into. It is not their fault, it is merely the way they learned how to teach. Also, the longer someone has been a teacher, the more ingrained this role will be. Teachers need to feel comfortable in their own classrooms or they will come to despise their job. Some may even quit teaching, or move to a school which uses the traditional teaching methods. Therefore, it is important to address this concern over the new role of the teacher in the classroom when video games are used as teaching tools.

Set Curricula

Many school systems have a set curriculum which teachers are required to follow (Rice, 2007). As of right now, the content of video games is not geared towards these set curricula. Therefore, some teachers have noticed that video games are not teaching the correct material. If the teachers are to use this technology in their classrooms as a teaching medium, they need to be able to rely on it to teach their students the right topics.

This barrier is important because for many teachers, teaching outside of their set curriculum is out of the question. If students are only supposed to learn certain topics in a certain class, then the teacher is not allowed to teach topics from another class. For instance, if in a history class the students are supposed to only learn up until the Civil War because in their next history class, they will be learning topics from just after the Civil War, it would be bad if their teacher taught them about World War I. That topic is not a part of their class, therefore it should not be included in a video game they are using for their class. These restrictions are usually placed on teachers for a reason and administrators are not likely to take kindly to a teacher not teaching the correct topics.

Standardized Testing

This barrier builds upon the last one of set curricula (Ketelhut, et al., 2010). Some curricula are so rigidly set because the teachers must teach to the standardized tests their students must take at the end of the year. In America, students are required to take standardized tests almost every single year until they go off to university. To ensure that students pass these tests, teachers have been forced to tailor their curricula to teach only what will be on the test at the end of the year. If the students do not pass the tests, then the teachers failed to teach them everything they needed to know.

This barrier is important because teachers will be very resistant to use video games in their classrooms if they know that the games won't teach their students what they need to know to pass the standardized tests. As of right now, video games do not cater to either set curricula or the topics included in each year's standardized tests. While this remains true, American teachers will remain reluctant.

Perceptions Among Educators

Besides the barriers of video game content, there is the stigma attached to video games (Rice, 2007). While it is true that video games have been used in the classroom before, there were not expected to teach the students anything valuable. Rather, video games were used to keep students occupied in the computer lab when they had finished their assignments. Therefore, it is possible to see why educators might have formed the opinion that video games are not educational and cannot be used as effective teaching tools. There is also the idea that learning through play is not true learning. Teachers will find it hard to believe that valuable information can be relayed to and retained by students.

This is an important barrier because it is a belief which must be combated. Video games have long had a bad reputation, but they have potential. It has been shown in numerous studies that video games have the potential to educate just as well as traditional methods such as lectures. This potential will never be realized if teachers continue with their biased opinions on video games. They need to be shown that video games can teach just as well as a lecture can, if not better. For video games to be given a chance in the educational world, this opinion held by educators must be negated. Video games are not something bad, something that can't educate. Video games can also be something good, something that can teach many different topics in

many different ways. In order for this idea to see the light, the negative perceptions of educators must be addressed.

Negative Effects of Gaming

Not only are games thought to not be good teaching aids, they are also thought to be harmful to children (Baek, 2008). The arguments are that video games rot the brain and make children violent. This view is held not just by educators, but by parents as well. They believe that the use of video games will have negative effects on their children.

This barrier is important because the views of the parents will dictate how willing a teacher will be to accept video games into the classroom. If parents strongly object, than the teachers will have no choice but to object as well. If this happens, then the same argument as the last barrier applies. Video games, serious video games, the kind that are developed specifically to teach, will never see the light of day and companies will not be willing to invest time, effort, and money in ventures which will bear no fruition. The market will dwindle and an opportunity for enhanced learning will slip by. Barriers such as negative perceptions need to be faced head on as they will be the hardest to overcome.

IT Infrastructure

Every school that has computers has an IT department. This department deals with the maintenance of everything computer-related. The IT infrastructure of a school determines how computer-related issues are dealt with. The computers are set up in a certain way according to this infrastructure and everything must be according to the plan. Adding video games to the computers may not fit well within this proscribed infrastructure (Tuzun, 2007).

It is important to address this barrier because for video games to be used in schools, they must first be able to get on the computers. For teachers to be able to make a firm decision on

whether or not they will accept the use of video games, they need to be confident that they will actually be able to get the video games into the school for use in their classrooms. If the IT infrastructure does not allow this, then the teachers will have no reason to even contemplate using video games as teaching tools.

Insufficient Hardware

Along with the IT infrastructure is the problem of insufficient hardware (de Freitas, et al., 2010). Computers in schools are not upgraded very often and many schools can't afford the latest and greatest technology. Therefore, the computers that teachers and students have access to are insufficient to play most newer games simply because the hardware is not powerful enough to handle newer games. Video games are not generally created for low specification machines, which will be a problem when trying to put new video games on these lower specification machines.

It is important that this barrier be addressed for the same reasons as the IT infrastructure. If it will not be possible to play the games without them freezing up couple of seconds or not even installing, then teachers won't see a need to consider using video games. Teachers are aware of what their school computers can and can't do. Even if the teacher in question is one who isn't technologically savvy, they will understand that better computers than the school can afford will be needed to play video games. Without addressing this major problem, there is no way that video games will ever make it into the classroom.

Access to Computers

Along with the last two barriers, is this one. If schools can't afford new computers, then it is reasonable to assume that they also only have a limited number of available computers (Kebritchi, 2010). These computers will most likely be kept in computer labs which the teachers

will have to schedule time for their class to use the computers. This situation will cause a lack of access to computers, which means that it may not be possible for teachers to have access to the computers for the length of time it will take for their students to get everything out of the video games session that they are supposed to.

This is an important barrier because it is prevalent in most school systems. Without the means to support a large number of newer model computers, most schools have to rely on a limited number of older machines instead. Again, along with the last two barriers, if teachers know that their access to the computers will be spotty, they may not be so eager to employ video games as a method of teaching. Since computers are needed to run the educational video games, not having enough computers will make it very hard to use those games for teaching.

Limited Budget

The last few barriers have all had something in common which is probably the over-arching barrier for many other barriers as well. This commonality is a lack of money (Baek, 2008). When a school system only has a certain budget, they are not likely to feel that it is money well spent to buy video games for the student's to play. This barrier is very understandable because, as it stands right now, video games do not come cheap. School systems are more likely to spend their budget on better after school sports since these at least have the potential of gaining revenue.

This is an important barrier because it will determine whether a school system can afford to buy the necessary video games. Without the budget, teachers will never be convinced that video games area viable method of teaching. They can be shown how well video games can teach, but without the money there to support the existence of video games in the classroom, there is no way that teachers will be able to say yes. Lack of a budget for new technology can

discourage teachers and administrators from adopting new technology. Not only does the school need to pay for the software itself, there will also be maintenance costs eventually, and upgrades to the software. They may need to upgrade their hardware to support the software. Budget is a very important subject to those who hold the purse strings. If it can't be proven that this will be money well spent, the holders of the purse strings will say no. If they say no, then the teachers have no other choice but to say no as well. Not addressing this problem means that video games may never find their way into classrooms.

Teachers Need Training

Besides all of these barriers is the simple problem that the teachers themselves do not know how to play the video games. If they don't know then they won't be able to show their students how to as well, or help them when they run into problems (Kebritchi, et al., 2009). Also, there are still teachers out there who did not grow up with technology. These teachers will feel uncomfortable using computers and this may make them not want to use video games. Even if a teacher is technologically savvy, there is no reason to assume that they are also gamers. Educational video games may teach, but they are still video games first and foremost. These video games require knowledge of how to play them. In order to prepare teachers to be effective as managers and coaches in the classroom, they first need training.

This barrier is important because there are not that many teachers out there who will be able to pick up an educational video game and completely understand how it works in less than an hour. Training takes time and money, which the schools and teachers may not have. Without these skills however, many teachers will just not feel at all comfortable using video games to teach their students. For the teachers to feel confident, they will need to know how to play the

games and use the technology effectively. Until this happens, companies will find it hard to get teachers to use their video games in the classroom.

Students' Unreadiness and an Orientation Period

Not only the teachers, but the students may not have the skill sets to use the video games as they were meant to be used (Baek, 2008). If the game or its mechanics are in any way new to the students, they won't be able to just dive right into the game. The students will then require an orientation period which could last more than one class period depending on the complexity of the games (de Freitas, et al., 2010). This is a problem because it takes time out of learning the necessary topics while the students become acquainted with the game.

This is important to address because teachers only have a set amount of time in which to teach their students everything they need to learn. If the teachers have to take time out of the learning schedule just to show them how to use a game, then they will feel that they are wasting valuable teaching time. This could get worse if the students are unready to even use a computer at all. Then the teacher will have to spend time showing the students how to use the computer and then how to play the game. This situation will be off-putting for teachers.

Off Task Behaviour

Some teachers may see the possibility of students being off task more if they are playing a video game (Sardone, et al., 2008). The students might spend more time just playing with the game rather than learning from it, as they are supposed to. Also, if students have to share computers due to a shortage of computers, they may spend their time socializing with each other rather than doing their assignment. Teachers may feel that doing something associated with fun will cause students to be off task more often than if they weren't using the videogames.

This barrier is important to address for teachers because it is a valid concern and something that the teacher will inevitably have to deal with at some time. If teachers feel that a game, while educational, will promote bad behaviour in the classroom, they may have problems with using the game it may cause extra work for them.

Lack of Support for Teachers

As of right now, most educational video games don't offer enough support for teachers (Devlin-Scherer & Sardone, 2010). If a teacher has technical problems with the game, they don't have any way of getting help with their problems. Games also don't have a place where teachers can find information about the game or a way of contacting the creators with questions. This is really discouraging for a teacher contemplating using a video game in their classroom.

This barrier is important because not all teachers are technologically savvy. If they don't know how to solve a technical problem with a game, they need to have access to someone who can. Also, if something goes wrong with the game, the teachers need to have somewhere to ask questions or find out what went wrong and what to do about it. Without this knowledge, of something goes wrong in the classroom, the teachers will lose at least a day's worth of time that they had put aside for playing the game. They will need to try and figure the problem out on their own. If they can't figure it out, then it is likely that they will never try to use that game again.

Length of Game Assignments

Classes in school are only a certain length of time. If a game assignment will take more than the allotted class time, then it can cause problems (Sardone, et al., 2008). Teachers are not always able to get a computer lab for two or more consecutive days. They may only be able to book the lab once a week. Therefore, if the assignment takes more than one class period to finish, then it is possible that the students will have forgotten what they did previously when they finally

get to use the game again. As of right now, not many games have assignments within game that will take less than forty-five minutes to complete.

This is an important problem because teachers will see the game as not particularly useful. If their students can't even get through one whole assignment in the game within a class period, then they may not see use of the game as worthwhile as a teaching tool. The amount of time it would take for the students to get back into the game, possibly a week or more after they started, will waste class time and it is more of a disjointed way of learning. Teachers will not be appreciative of this problem and it may be enough to make them not want to use the video game in their classroom, or any other video game.

Fixed Class Schedules

In a school, the length of each class is determined by administrators and teachers cannot deviate from this predetermined class length. The length of the class will vary from school to school as well. Some schools stick with forty-five minute classes, others may vary slightly up or down from forty-five minute classes. Still others use a block schedule where each class is about ninety minutes or more long. Therefore, as with the previous barrier, length of game assignments will become an issue (Baek, 2008).

This is an important barrier because if a teacher feels that a game is too long to be useful in their classroom, they will not adopt it as a teaching tool. Some schools can make use of longer game assignments, but most schools have forty-five minute classes in which to fit a lesson plan. If a game will run over that time limit, it will discourage teachers.

Graphics

With the various consoles and upgraded graphics cards on PCs, the students that would be using the video games in their classrooms will be used to games with really good graphics

(Rice, 2007). The current consoles on the market have the capability of displaying incredible graphics, as do the better graphics cards on PCs. Any student who has played games on any of these mediums will be expecting any game they play to have great graphics. As of right now, most educational video games do not have stunning graphics. Also, any games that did have good graphics, the school computers will be unable to play them if the computers are older machines.

This is an important problem because students may vocalize a dislike at playing video games in the classroom that look nothing like what they can play at home. They may find the games' graphics too simple for their liking and this will discourage them from wanting to play. If this is the case, then teachers may decide that since the students don't want to play the games, then they won't learn from them. If the students won't learn from the games then there is no use for the games in their classrooms. If the teachers know what their students are likely to like or dislike in a video game, then if they see a video games with inferior graphic, they will know that it won't be useful to them.

Length of Development Time

A last barrier is the length of time it takes to develop a video game (Dalgarno & Lee, 2010). Teachers may be waiting for a particular video game to come out, but by the time it comes out, the game may be obsolete for their needs. A good video game will take over a year to produce. In that time, the standardized tests students have to take at the end of the year might have been updated and the lesson plans of the teachers will have changed accordingly. These changes may render the usefulness of a particular game obsolete.

This is an important barrier because if a teacher is to make use of a game, it needs to be relevant to their current needs. If any changes have needed to be made to lesson plans in regards

to content, then a video game which may have once suited a certain set of lessons when it went into production may no longer fit when it comes out. Also, teachers may not want to wait so long for a video game on a certain topic to come out. If they have to wait a long time, they may decide to scrap the idea of using video games in the classroom and just go back to traditional teaching methods, such as lectures.

Conclusions

There are a lot of barriers that face anyone who wants to produce educational video games or use educational video games in the classroom. If video games are ever going to become a fixture in the classroom, then these barriers need to be addressed and dealt with. There are various ways to deal with these varied problems, and the responsibilities will need to be shared out amongst the interested parties. There are some barriers that only teachers can address, or only game producers can address, or only school administrators can address.

Barriers Teachers Must Address

New role for teachers. One barrier that is for teachers to address is the new role they must adopt in the classroom. The way to deal with this barrier is that teachers need to realize what this new role is and how it will play out in the classroom. Teachers will need to, possibly through outside research, figure out how to manage a classroom as more of a coach or facilitator than as a dictator. A possible way they may do research would be to ask to sit in on a computer science lab class to see how the teacher handles the students. A computer science lab would consist of students working away at computers with the teacher wandering around and giving aid where it is needed. Observing how these teachers handle their classes may help other teachers in deciding how to reorder their thinking in order to be able to run a computer-centered class.

This solution is not an easy one and will require a lot of effort on the part of the teacher in question, but if that teacher were to follow these suggestions, then the prospect of teaching using video games may not seem so foreign or uncontrolled. By following this solution, teachers will be able to see how their new role is no less than their previous role, that it just requires a new way of thinking. Also, this solution is necessary in order for teachers to be comfortable teaching using video games. If video games are going to make it into the classroom, then teachers need to be comfortable with the role they must inhabit while using the video games.

Teachers need training. This barrier can apply to both game production companies and teachers. If a teacher knows that they will need time to learn how to use a video game, or to even learn how to properly use a computer, then they need to be proactive about it. If the problem lies with using a computer, then the best avenue would probably be to take a night class at a local community college. Most community colleges offer beginning computer classes and it is not necessary to be enrolled full or part time to take a class at a community college. With the way that the world is going in regards to technology, it is probably a good idea to get a better understanding of computers. If the problem lies with learning the game, then the teacher may want to either practice with the game over their summer break or on weekends, or see if there are technicians from the company which made the game who would be able to help train the teacher. This solution is important because the teacher using the game must be competent enough to be a coach or facilitator during its use.

Negative effects of gaming. This barrier can also apply to the parents of students, but is just as important for teachers. There is a belief that video games have negative effects on children. There may be a possible correlation between violence and video games, but the games which will be used in the classroom as not Call of Duty or Halo. Educational video games are

educational. Teachers need to read studies that are out there about the positive effects of gaming. Games can teach skills which are not easily taught in a classroom. Therefore, the recommendation for this particular barrier is that any teachers or parents who are concerned that playing video games in the classroom will have negative effects on their students/children should do a literature search on serious gaming and discover for themselves what educational video games can do to teach students.

This solution is important because teachers and parents need to see for themselves that video games can be good and can teach. If teachers refuse to see the other side of the argument then there is no hope of them changing their minds about video games. By doing research and seeing just what video games can do, sown in an empirical study, teachers will be able to dispel some of their issues with video games.

Perceptions among educators. The negative effects of gaming are an idea that is part of the perceptions educators have about video games. Therefore, the previous solution will also apply to this barrier. Only by doing research and seeing for themselves will educators be able to change their opinions on video games. If educators can look past the bad reputation of video games to see the good they can do, then it may just be possible for them to be able to see themselves using video games in their classrooms. Also, it is important that teachers seek this knowledge and are willing to accept what they find. If a teacher is not ready or unwilling to change their opinions, then it is not a good idea to try and force them. Like the previous barrier, this needs to be the choice of the teacher involved in order to get their full support.

Off task behaviour. The idea that if students are allowed to play video games in school they will be more likely to be off task is not unfounded. Students are not known for wanting to learn and if they get the opportunity to skive off doing work, they generally will. This is common

knowledge. However, it is not up to the game production companies to make sure that the students remain on task. This falls on the teacher in charge of the students. Teachers should merely be aware of this potential problem and be proactive about it. A good idea is to use a computer classroom where the computers are along the walls in a circle so that the teacher standing in the middle of the room can observe the computer screens and the students at the same time. (Tuzun, 2007) Also, the teacher needs to be proactive by wandering around the classroom to make sure that the students are working on their assignments. If the students must work in pairs or groups due to a lack of available computers, then a good idea may be to ask each group how they are doing periodically to gauge whether they are actually getting work done or are just socializing. It is important that even though the teacher has been forced to take on a coaching role they remember they are still in control of the classroom and must make sure the students are doing their work, just like in a normal classroom. As long as teachers understand how to control their class, then this barrier shouldn't be much of a problem.

Limited budgets. Teachers may not have any control over how the school's budget gets spent, but they still have some options when it comes to getting money. Most schools have a PTA which does fundraising. If a teacher really wanted to get a certain video game for their class to use, they have the option of petitioning the PTA for funds to buy the video game. (Angelone, 2010) Also, it is possible to use some commercial games which are readily available at most stores. PTA funds could be used to purchase enough copies, or if that isn't possible, there are some other options. The teacher could apply for a technology grant from the government. Or, if that isn't possible, students could be asked if they have a copy to bring it in for a lesson. (Angelone, 2010) All of these are viable options for purchasing software. However, it isn't always necessary for a school to buy educational games. There are many educational video

games available on the internet for free. (Annetta, 2008) The teacher could just do a search for suitable games and have their students use these free online games in the classroom.

This solution is important because there are some things that teachers can do to get video games for their classes if they really want to. The excuse that there isn't money in the budget isn't much of an excuse when there are others ways of getting money and there are free games available online. Also, if by using the free online games, the teachers can show how much better the students are learning, they may be able to convince the school board to allocate more money for technology in order to purchase better video games.

Students' unreadiness. With any new game there will be a need to prepare the students to use it. The best solution to this problem is to just plan an orientation class into the schedule. If that time is scheduled, then the teacher knows that no learning will get done during that class period and it won't be such a big problem. There is no getting around the fact that students will need preparation to be able to go off and use a new game on their own. If that orientation period is built into the schedule for that unit, then it isn't such a big deal and doesn't disrupt the learning process since it was already taken into account.

This solution is important because teachers need to understand that they can't just write off games because their students don't already know how to use the game. The teachers just need to be prepared to teach their students how to play the game and then everything should work itself out from there.

Barriers Game Production Companies Must Address

Set curricula. Many schools have set curricula for their teachers to follow. Therefore, in order for a game to be appealing to teachers as a teaching tool, the game needs to follow their curricula as closely as possible. The solution to this would be to talk to school administrators

about their curricula. If game companies could get a good idea, say for example, what eighth grade science classes are learning, then they can tailor their science game to fit with the correct topics. Teachers can't generally change what topics they are required to teach each year. Therefore, if a game geared towards eighth grade science classes contains ninth and tenth grade material, it won't be useful to the teachers who will be using that video game in their classes.

This is an important solution because a major problem for teachers is that the available games don't cover the correct topics for their classes. Curricula may change from area to area, but some topics will be almost universal in when students learn them. It would be beneficial to game sales if game production companies could figure out which topics should be in a certain game in order to be able to better market it to schools, their potential buyers.

Standardized testing. Another content barrier is standardized testing. In America, almost every grade from Elementary through High School has to take a standardized test at the end of the year. The material that will be on the test is known to teachers so that they can tailor their lesson plans to teach to the standardized tests. If teachers can find out what is on the tests, then game production companies can request the same information as a means to tailoring their games just like teachers do to their lesson plans. If the games can help the teachers instead of take up valuable time, then teachers are more likely to agree to use video games in their classes.

Fixed class schedules and length of game assignments. Teachers have the problem of only having a certain amount of time each day in which they may teach their class. The school sets the length of each class period and the teachers don't have the power to change this set length of time. This problem then creates the problem of game assignments running over the length of the class period. A solution to this problem is a very simple one and will merely require some design considerations. Game production companies interested in creating educational video

games with an eye to marketing them to schools should tailor their games such that each game assignment lasts no more than thirty minutes. This time was derived by looking at the average class length of forty-five minutes and allotting fifteen minutes for checking attendance, booting up the video game, and shutting it down at the end of class.

This solution is important because by following it, any class over forty-five minutes long will still be able to use the video games, they may just do more than one assignment a class period. It is best to cater to the shortest class length so that all possible corners of the market are exploited.

Insufficient hardware. Schools generally do not have money in the budget to replace their computers every few years in order to keep up with the latest technology. Therefore, it is important to remember that the computers that video games will be used on are lower end machines which can't handle most newer games. The best solution for this problem is to create games that don't need the latest and greatest hardware to run. (Rice, 2007) If a game is made so that it will run equally well on a lower end machine as a higher end machine, then the game will be able to be used by a larger group of schools. Otherwise, only schools with a lot of money will be able to use these video games since they will have the budget to purchase better computers.

This solution is important because game production companies should want as wide a base of potential buyers as possible. Also, since most schools will have the problem of limited hardware, the only way game companies will be able to sell their games to these schools is if they allow their games to run on lower specification models.

Graphics. Teachers know that students will be expecting great graphics in any video game that they play. Therefore, it is understandable that teachers expect their students to be less interested in using a game with poor graphics than a game with good graphics. If the teachers are

going to pick a video game to use, they will probably migrate to the one with the best graphics that will still run on the school machines. The solution then is to make sure that the graphics in educational video games are the best they can be for the specifications they must be. (Rice, 2007)

This is an important solution because some game companies may believe that since it is for a school and not a triple A title game that they don't need to make games of as a good a quality. Teachers do understand what their students want and they will give it to them the best way they can. Also, teachers are less likely to purchase a video game which their students won't getting anything out of due to lack of interest.

Length of development time. As of right now, video games, good video games, can take over a year to produce. This can be discouraging for teachers if they need something a little sooner. A good solution for this problem is to create virtual learning environments. These virtual learning environments would act kind of like a massively multiplayer online game in that it would be under almost constant production. The game production company would be able to make quick worlds for students to play in using a single topic. Also, they could set up the virtual worlds so that teachers with the right skills could create their own lessons in the world. By doing this, production time is cut down and it helps with the set curricula issue if teachers can make their own scenarios. All the game companies would have to do is support the virtual environment.

This is an important solution because besides cutting down on production time, it would also give teachers a measure of control. Teachers would be able to create lesson plans and students would still get the benefits of learning through an interactive medium.

Lack of teacher support. If a game company is looking to create a video game to be marketed to schools, they need to understand that the teachers who will be using this game are

going to need support. This support can come in different ways. One of the best ways would be an easily navigable website with a forum and a frequently asked questions section. Included would also be a technical help phone number and email address. This website would also include information about the game and predesigned quizzes, worksheets, and tests based on the material in the game. All of this would be of extreme help for teachers using the game.

This solution is important because it addresses one of the main concerns of teachers when it comes to using video games. They worry about how to get help with the game if they need it. By providing this help in an easy-to-use website, game companies would be making the teachers feel more comfortable with using video games in the classroom.

Future Research

One important aspect of any future research will be the barriers and possible solutions for administrators. There are certain protocols which they must follow which could impact whether a video game can get into a school or not. Therefore, more research needs to be done on what game companies can do for administrators and what administrators can do for themselves. It is important that the viewpoint of school administrators is explored because they are the people who make the ultimate decisions on what happens in schools. These administrators include principals, vice-principals, headmasters, and school boards. By finding out what they need done and need to do, all of the keys may be found that will help get video games into the classroom for future generations.

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