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QUESTION ONE:

There are many different ways that technology can be used to help people learn new material, practice and reinforce previously acquired knowledge, and improve cognitive and psychomotor learning skills. Educational games and/or game-based learning have recently emerged as a method for helping people acquire knowledge and skills concerning different subject areas. In the essay, please define educational games and/or game-based learning and explain its development in education. Then, summarize the research findings about the impact of educational games and/or game-based instruction on learning. What are the features of games that promote learning and positive attitudes? How can educators or trainers implement games in their curriculum to stimulate the motivation to learn? Do games accommodate and meet the needs of all learners? These are questions to ask yourself when writing the essay. Please cite appropriate experts, theories, and/or research related to this question to reinforce the answer.

"Let's play a game!" If everyone is like me, the phrase immediately conjures feelings of excitement and anticipation. Most—if not all—people find games entertaining, amusing, and relaxing. The phrase, "Let's learn something!" in my experience as a teacher, either does not result in the same responses, or results in much diluted feelings of approval and excitement. Even the statement, "We're going to play a game that will teach us something." is typically met with guarded—if not outright pessimistic—responses. As adults, we understand that games do teach, although perhaps not as a primary goal of the game, so what real purpose do games have in education? Games can help students feel more motivated and in control of the learning. Games can challenge students and provide immediate feedback via wins and losses. Games can be simple and quick or can involve many hours of effort. Games can also distract students from the instructional component. Games can cause students to not take the learning component seriously. While few purely educational games have the same visual appeal as many of the multi-million dollar commercially produced games, teachers can still use games to enhance learning if only as a "hook" or reward. Commercial games such as *World of Warcraft* or Minecraft have recently been touted as effective approaches—based on constructivist principles--to develop students'

higher-order skills in analysis, creativity, complex problem-solving, and collaboration, all skills necessary to meet the requirements of Common Core curriculum frameworks.

Teachers are told we must endeavor to make learning fun in an effort to motivate students, and that we must entertain as we educate. In an effort to do just that, teachers have historically turned to games: card games, dice games, and board games such as Monopoly™ and Trivial Pursuit™. As technology has advanced, such games have been computerized and many are now online. Games are used for review and to practice concepts or skills, but just how effective are they and how useful to higher-order learning? Can instruction be based on games or are games just another learning activity with more entertainment value than worksheets.

This essay will begin by discussing definitions of terms and phrases related to the use of games in education: game-based learning, educational games, gamification, and digital game-based learning. The discussion will continue by reviewing the development of games in education, especially games designed primarily for education. With the rapid advances in technology, especially with highly mobile handheld devices such as smartphones and tablets, and fully online software programs that do not require downloads, the focus will narrow to the impact of digital game-based learning on education, including how gaming in education may provide for motivation in students to learn. Along with student motivation to learn as part of game play, this essay will discuss teachers' motivation and implementation of games as part of instruction. In addition, a review of research will be included to discuss the efficacy of educational games in meeting the needs of all learners, at all levels of ability.

The *Miriam-Wester* online dictionary definitions of the word **education** include "action or process of educating or of being educated" and "the knowledge and development resulting from an educational process" (n.d.), while definitions of the word **game** include "activity

engaged in for amusement", "competition conducted according to rules" and definitions of the word **learning** includes "activity or process of gaining knowledge or skill by studying, practicing, being taught, or experiencing something." These definitions have been combined to create definitions for "educational games" or "game-based learning" that vary depending on the individual creating the definition, but as of yet, no recognized single definition has been constructed. Further, the word **digital** has been added to create the phrase **digital game-based learning (DGBL)** to specify the use of games in education that require computer and/or Internet access. From the *Learn NC* website, Coffey promotes DGBL as an instructional tool that can be used by nearly all teachers for almost any subject to provide constructivist learning for students operating at pretty much any skill level. Coffey further contends that the interactive nature of DGBL creates a more engaging instructional setting resulting in students being better prepared to be effective users of technology on a global level. (Coffey, 2015)

In a keynote address, Juul identifies what he believes are the six necessary characteristics of a game: rules, variable and quantifiable outcomes, valuation of differing outcomes, challenge or conflict requiring player effort, player motivation, and negotiable consequences. (2003) In comparison, Prensky (2007) describes games as "…highly social, highly interactive experiences." (p05-2) as characterized by "…a combination of 12 elements:" (p05-1) fun; play; rules; goals; interactive; adaptive; outcome and feedback; win states; conflict / competition / challenge / opposition; problem solving; interaction; and representation and story. It is interesting to note that all of Juul's (2003) characteristics can be paired with one or more of Prensky's characteristics. Reviewing these definitions, we see game being linked with words like fun, value, and motivation; however, the words education and learning yield words like process and study. The question remains, of course, how to combine the fun of games with the deep

learning expected of education. The Institute of Play organization's website (http://www.instituteofplay.org/about/) graphs results from two Gallup polls to show that engagement in school or work drops from 80 percent at the elementary school age level to only 30% of working adults, and credits this serious decrease with a lack of engagement in education.

To understand how games might be effectively utilized to improve student engagement in an effort to increase student learning, it is important to review the history of how games have been used in education. Games in learning are nothing new; chess was used in the Middle Ages to teach war strategy and it could be theorized that Socrates' method of teaching was a type of game. Froebel's work in the 1800's was founded on the integration of games. ("History of Games," 2015) In the early 1930's, Piaget discussed peer cooperation in learning (collaboration) and compared its construction and development to the ways in which children agree on rules for games, with the suggestion that such cooperation—when undertaken in an atmosphere of respect—would be useful and beneficial as an instructional tool. (Lisi, 2002) In the 1950s, Gordon Pask created an adaptive teaching machine for students of keyboarding; this machine adjusted based on the individual student input and included cueing lights—meeting game characteristics of goal and challenge while helping a student build a skill. (Britt, 1967, pp. 74-75) The decade known simply as The Sixties is hugely historical, not only for its political significance, but more to the purpose of this essay, to the advances in educational technologies. In 1959, the first computer assisted instruction system was introduced by Donald Bitier from the University of Illinois; this system, named PLATO (Programmed Logic for Automatic Teaching Operations), is the root from which many educational and communication technologies have grown. (Molnar, 1997) While PLATO may be the foundation for computers in education—the PLATO Learning Environment for curriculum delivery, now owned by Edmentum, is still in use

today—the most significant technological advancement for education has to be the U.S. Defense Department's Advanced Research Projects Agency Network (ARPNET), begun in 1969 and the origin of the Internet and the World Wide Web. (Zimmermann, 2012) By the early 1970s, computer gaming was being used as part of the educational landscape, as evidenced in Zinn's report, with includes examples of educational computing, "…including…simulation, gaming, … problem solving, …." as well as identification of similar situations occurring at other universities. (1973) In a contribution to the Te@chThought website, Heick (2012) offers a list of 20 educational video games arranged in a historical timeline, beginning with *Logo Programming* from 1967 (designed to teach programming to children in an entertaining fashion), through the very popular *Oregon Trail* and *Where in the World is Carmen Sandiego?* from 1985 and on to *The Amazon Trail* (a spinoff of *Oregon Trail*) in the 1990s. While Heick's list is a useful and educational look at some of the computer games designed and developed for education, it is far from complete and does not include commercial game products of today that many believe make excellent teaching devices. Bringing gaming into the classroom as an instructional tool within the constriction of today's educational budgets means turning to the Internet. The most popular games today are the massively multiplayer online role-playing games (MMORPGs), such as *World of Warcraft*. Annecdotal evidence found on Wikipedia suggest that the first graphical, internet-based massive multiplayer online game (MMOG)—not a role-playing game—was a simulated flight combat game called *Air Warrier* introduced in 1986. MMOGs allow many players from anywhere in the world to play against each other or to form collaborative teams. These MMOGs are creating new and interesting questions for education and the possibility of not only implementing games for engagement and motivation of students, but as platforms for

collaboration (the keystone of constructivist learning) and creativity (the pinnacle of Bloom's Taxonomy).

With students deeply immersed in the colorful, fast-paced, and socially engaging worlds of online gaming, it is no wonder traditional teaching methods are having difficulty motivating students, but does gaming actually have a real and valid impact on student learning, especially higher-order thinking and transfer of knowledge?

Clark, Tanner-Smith, and Killingsworth (2014) conducted a meta-analysis of 69 pieces of published research to determine the efficacy of digital game-based learning and found evidence that the use of digital game-based learning will result in more effective learning than the same instruction without using games. The results indicated these learning improvements on interpersonal, intrapersonal, and cognitive learning outcomes. This analysis also found support of immersion and constructivism, as multiple gaming sessions and multiplayer situations (collaboration) also provided for better learning outcomes. Interestingly, the meta-analysis did not support significantly higher learning outcomes as a result of games with higher entertainment value. In an earlier study, Harteveld, Thij, and Whitton (2011) concluded that computer games used for learning in and of themselves were not necessarily motivational to all learners, but rather that motivation increased if the learners felt the games were the best way to learn the material. The study surmised that games which were developed using sound pedagogical principles to demonstrate the constructivist characteristics of collaboration, problem-solving, active engagement, and of an experiential nature were both more likely to be motivational and better equipped to result in solid student learning outcomes.

A method of increasing motivation and efficacy in computer games used in education is to use adaptive games which provide an "optimal level of challenge," as reported by Sampayo-

Vargas, Cope, He, and Byrne (2013). Such an optimal level would be exemplified by tasks at or near the upper level of a learner's abilities; an educational game which adapts to a player's abilities by increasing or decreasing the difficulty of the tasks and accompanied by support in amounts correlated to the task difficulty were evaluated as being the most likely to increase motivation in learners as well as increase the level and quality of learning. Hainey, Connolly, Stansfield, and Boyle (2011) identify five factors that increase motivation when playing computer games: "…challenge, competition, cooperation, control, and curiosity." (p.2207) These five characteristics correlate well with the six essential features of Communal Constructivism as identified in a study by Girvan and Savage (2010), including: course dynamics and adaptivity (challenge), interaction, active collaboration, and transfer of knowledge (competition and cooperation), construction and publishing of knowledge (control), environment interaction and knowledge construction (curiosity). The data from these studies seem to support the idea that challenging games requiring collaboration of multiple players with a component allowing communication and construction of artifacts would be the most motivational games to play, which should lead to greater student engagement and deeper learning of instructional objectives, with greater demonstration of higher-order cognitive processing such as evaluation, analysis, and creativity. The important thing to remember about game-based learning is as stated by Mayer and Johnson (2010): "Although the game format may increase learner motivation … motivation alone does not translate into meaningful learning. Meaningful learning occurs when the learner attends to the relevant information, organizes the material into a coherent cognitive representation, and integrates it with prior knowledge from long-term memory." (p.259)

Having determined that digital game-based learning can be an effective instruction tool, the next question to address would be how educators or trainers can implement games—

particularly computer or online games--in their curriculum to stimulate the motivation to learn. In their 2013 study, Bourgonjon, DeGrove, DeSmet, Van Looy, Soetaert, and Valcke state, "The adoption and the effectiveness of game-based learning depend largely on the acceptance by classroom teachers, as they can be considered the true change agents of the schools." (p.21) The study also concluded that teachers do not think computer or online games would do much to improve their teaching, yet do agree that game-based learning has some validity. Still, the use of computer games—machine-based or online—is sporadic, at best. Certainly, technological availability is an issue in today's economy and with constrained educational budgets; however, Kenny and McDaniel (2011) posit that, more than the money that is or is not being spent on technology, professional development is the most significant reason that more teachers are not making computer games a regular part of instruction. As with any new pedagogical principle or method of teaching, implementation of digital gaming into the curriculum requires additional time and new knowledge that all teachers may not have. Professional development is critical to educate the educators in the benefits of using digital game-based learning, how to find and then to access appropriate games for the curriculum of instruction, and most importantly, how to smoothly and effectively include the games into the instruction. In addition, the training should include informing teachers as to ways of assessing student learning directly link to the games, especially when using games that do not tie directly to the curriculum, but are rather used as methods for developing higher-order skills such as collaboration and creativity.

Successful implementation of digital game-based learning requires thorough planning and careful evaluation. Limited resources—financial and technological, uncertain faculty, unaware parents, and students too familiar with the high-quality (from high funding) of commercial games can all attribute to a less-than-successful implementation or worse, a failed

one. Gordon (2010) describes how a school district in Texas successfully implemented a game for teaching pre-algebra and algebra, resulting in improved test scores and greater levels of engagement among poorly performing students in these subjects. As part of the article, Gordon outlines a list of important considerations to be identified before implementing a game, especially on a large scale. This checklist includes the same types of items addressed in a well-prepared technology plan, such as knowing

- who is the game's intended audience (players),
- who can provide assistance in guiding game play,
- who will be called in for repair issues (in-house or outsourced),
- what is the primary goal (better test scores, increased attendance, reduction in dropout rates),
- how will the game's efficacy be assessed,
- where can the game be accessed (classroom, media center, home, library), and
- when will learners access the game (during class, only on campus outside of class, off campus outside of school hours)?

One of the items utterly necessary immediately upon deciding to implement a game as a regular part of the curriculum is also mentioned in the article: Communication. Because many people still see games as toys or strictly for entertainment, it is important to inform the parents—and community if implementing on a school- or district-wide scale—to ensure understanding of how the game will be implemented and how the game will improve student achievements. After all, as mentioned in the article, misunderstandings could occur if a student went home only to tell his/her parents all he/she did in class was play games.

While administration and faculty approval and involvement are required for successful implementation of computer games in education, the primary goal is, as always, to improve the educational experience of and increase the learning outcomes for the students. Students learn in different ways and at different ability levels, so a critical criterion when implementing games is whether the games to be implemented will meet the needs of all learners who will be expected to play the games. In a contribution to the Global Digital Citizen Foundation's website, Crockett (2015) references a list from his 2011 book of six 21st century skills that are felt to be the most necessary for students to be fully prepared to meet the challenges of life in an ever-changing technological society:

- Accountability and ethics
- Analytical thinking
- Collaboration
- Communication
- Creativity
- Problem solving

The research reviewed here seems to support the use of computer games for developing these skills; however, Rondon, Sassi, and Furquim deAndrade (2013) discovered that traditional text-based instructional methods resulted in better retention over time for some of the test subjects than did the same instruction delivered using digital game-based instruction for the students in their study. Results such as these indicate that not all students would best be served by using computer games for instruction, which the authors concluded might be a result of some students being more comfortable with printed texts or because the ability to go back to review specific material related to incorrect assessment answers was not available in the computer game.

Kim and Chang (2010) performed a study of 4th grade math students with the focus on diversity in gender and native language, with interesting results. The study found little difference in math achievement between genders for English-speaking students after playing the math games, but did find a significant difference in achievement for both genders based on frequency of gaming with students who played the game only sometimes performing much better than students who played the game every day. Students in the study for whom English was not their first language showed much different results with male ELL students who played daily showing high performance gains while female ELL students showed higher gains when only playing the game sometimes. Additional support for the use of computer games was found by Ke and Abras in their 2013 study of the effects of three computer games for pre-algebra instruction on middle school students with special learning needs, although several codicils were included in the results. In this study, special needs learners seemed to be more engaged when the game was simpler and offered immediate rewards for success. In addition, the authors caution that educational computer games may be engaging yet fail to imbed the curriculum in a way that improves student learning. Finally, the study suggests that special needs learners may be unwilling to ask for or accept external support (teacher, calculator, etc.) because such was seen as disruptive or intrusive.

Based on the research, it seems apparent that game-based learning can be very useful as an instructional tool. New research indicates that many of the online massively multi-player games such as *World of Warcraft* may be especially suited to the learning of higher-level, constructivist skills such as creativity and collaboration. Unfortunately, subject-specific computer games with the same level of artistry and complexity are rare in comparison to the commercially-developed games; this scarcity is attributable to the far lesser profit typically

achieved by games developed strictly for education when compared to commercial products. The regular use of technology in education is seen as desirable and necessary to produce the skills students will need to be successful in their educational and career pursuits. This necessity is supported both empirically and anecdotally; however, the efficacy of computer games in the development of higher-order skills shows a deep need for further research. Game-based learning can provide greater levels of motivation and engagement, which will certainly assist in the learning process, but engagement in and of itself is insufficient to achieve learning goals and objectives. To be truly effective, games must be carefully developed to embed and convey content in such a way that learning takes place and that said learning is retained. Much research remains to be done to determine how game-based learning can best be used in educational practice.

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QUESTION THREE:

Recent years, innovative technologies such as flipped classroom, MOOCs, Open Educational Resources (OER), etc. have greatly impacted teaching/training and student learning. You will select one of these topics to discuss. In the essay, please explain (a) what this method is about and its purpose in relation to teaching and learning, (b) how this method is implemented in instruction (e.g., examples of instructional strategies, design of systems/materials, assessment methods), (c) the pros and cons of using this method, (d) what researchers have found in the literature concerning this method, and (e) future implications. Your discussion should be based on your own learning and/or teaching experiences and supported by the literature

More than 20 years ago, teacher education dealt primarily in the delivery of instruction by the teacher to the student and included such information as the best color combinations to use for the most effective contrast of words to background so students would have an easier time taking down the notes; writing good lectures, including the use of anecdotal stories to engage students; methods for calling on students to determine if learning was taking place; and many other tools for being an effective lecturer. This teacher as expert was supported by all the coursework undertaken by future teachers to become the possessors of expert knowledge about their chosen subject areas. The accepted point of view was that the teacher knew what the students needed to know, therefore, the teacher was the best suited to provide the students with the instruction. Of course, teacher education was and is so much more than these tips and tools, but since the teacher was the expert, then it stood to reason that the teacher would fill the students with the knowledge and the students would absorb it like a sponge. As any teacher will attest, the reality of teaching is more often than not far removed from the psychology and ideology of teacher education. New information, presented only in the classroom, typically leads to the same problem of division: some of the students understand the material very quickly and are almost immediately ready to begin working on activities on the higher end of the cognitive ladder, some of the students are almost ready to move up the cognitive rungs but need just a little more time with the foundational skill. Meanwhile some of the students simply cannot understand

the material or do not understand the material and so need much more time and teacher attention. A tried and true method for addressing the issue of preparedness is to have students review the upcoming material ahead of time from home and to attempt a sample set of problems or an exploratory activity; the following day's face-to-face (F2F) class meeting then begins with a review rather than an introduction where the teacher can quickly learn who understood (as evidenced by correct responses to the exploratory activities), who needs a little more help (as evidenced by partially correct responses to introductory samples completed for homework), and who needs extensive help (as evidenced by fully incorrect or never-attempted homework). With this formative information available, the teacher can easily subset the class, perhaps allowing the first group to aid the second group in a peer collaboration mode while the teacher herself is able to devote the bulk of her attention to the last group.

The instructor as the provider of the educational information was described by King (1993) as the "sage on the stage," and she identified this style of teaching as the transmittal model. (p.1) While lecture certainly does and always will have its place, the idea that lecture is sufficient—especially in our media rich, technologically advanced society—is ludicrous. King uses the phrase "guide on the side" (provenance unknown) to describe a teaching method whereby the instructor—with, it is hoped, expert-level knowledge of the subject matter—acts as a guide, a facilitator, and an aide to the students in their actively engaged pursuit of learning rather than simply a spigot from which knowledge pours while students soak it in. This facilitated method of instruction has been advocated since Piaget proposed that learners have to reflect upon their associations and experiences and apply those to new experiences to reconstruct new knowledge (1952); in Piaget's developmental theory, adults (teachers) are to facilitate events, processes, and opportunities so that the learners may build new understandings and then

integrate the new awareness into their own actualities. Piaget's theories led to Suchmann's constructivist approach, which was simply Piaget's method in a more disciplined format involving five instructional phases to increase the efficacy of instruction through curiosity, analysis, creativity, and evaluation. (Gilliani, 2010)

A movement towards a more constructivist instructional model that has been promoted is the flipped classroom, although the authors usually credited with coining the term prefer the term flipped learning. (Bergmann & Sams, 2014) As discussed in the article, flipped learning is not truly a new educational principle since instructors have been utilizing pre-teaching methods for centuries (i.e. having students read new material, then attempt review activities prior to discussion and more advanced activities attempted in class.) The flipped learning/classroom methodology is typically paired with technology in its implementation. Bergmann & Sams caution that implementing a flipped learning model is far more that simply pre-teaching using technology (i.e. having students watch videos or access websites from home instead of reading from the textbook). When moving to a flipped learning methodology, the direct instruction—such as the much maligned lecture—is moved from the face-to-face, multiple learner setting of the classroom to an individual learning setting. Traditionally, after the instructor presents the lesson, students are then expected to complete projects and other higher-order activities outside of the classroom. Moving the introductory and explanatory instruction in this fashion then allows the more effective utilization of face-to-face class time so that the students may engage in more creative, constructive, collaborative activities with the teacher available to guide, facilitate, and assist. According to Sams and Bergmann (2013):

> Education is for everyone, but the way we deliver education—and the way students receive it—is not the same for everyone. A flipped classroom gives

> teachers the flexibility to meet the learning needs of all their students, and it gives students the flexibility to have their needs met in multiple ways. By doing so, it creates a classroom that is truly student-centered. (p.20)

When initially implementing flipped learning, the teacher must first understand that moving the same lecture from the front of the classroom to a website—such as YouTube—only changes the geography and does not address problems of motivation that classroom teachers face daily. Also, although the word "flip" is described as an suggestion of total reversal in delivery and methodology (Bull, Ferster, & Kjellstron, 2012), the phrase *flipped classroom* or *flipped learning* are simply catchphrases to indicate a refining of focus such that students have more time for the higher-order activities related to the top three of Bloom's revised Taxonomy--analyze, evaluate, create—with the immediate availability of the teacher for guidance and assistance if necessary. Bull, Ferster, & Kjellstron emphasize that instructors can implement a flipped learning environment in numerous ways and at varying levels of immersion, from only occasionally to a complete restructuring of the course. As posited by Carpenter & Kease (2012), higher gains from learner efforts will be seen when those students participate in challenging and meaningful work and also take responsibility for the instructional process they engage in. By making the basic instructional material available to the students individually, students can review as much or as little as necessary to gain at least a basic understanding of the material. When beginning to contemplate the strategies for instruction, it is advisable to remember that it is typically information and activities from the lower levels of Bloom's Taxonomy—remember, understand, and apply—that students are most likely to be able to understand and apply successfully. (Gilboy, Heinerichs, & Pazzaglia, 2014)

An initial strategy to the implementation of a flipped learning environment is the restructuring of how materials related to the lower levels of learning are delivered. A teacher could simply create a video of the lecture that would typically accompany the instruction, and then post that video to a web-accessible site such as YouTube; however, and especially if the lecture is of some length, the issue arises of student motivation to watch the entire video. Recommendations on what the optimal length is for an instructional video vary, although Sams and Bergmann (2013) recommend about 10-15 minutes for high school students. Teachers can include links to supplemental websites for further exploration, add illustrations and demonstrations, include questions to be answered and problems to be solved, all in an effort to enable students to achieve a solid foundational readiness to move on to the application and higher levels of learning in the topic. Even with a video of shorter lengths than the usual lecture, even with the addition of pictures, animations, web links, etc., some students will avoid doing the homework—a fact of life for all teachers. One method for addressing this issue might be to require that a question or comment be posted in the videos comment section—if such is available, as it is with YouTube videos; these questions and comments can provide excellent discussion material as well as providing the teacher with an opportunity to assess if the instructional video itself has weaknesses which need to be edited. As some students may attempt to fake their way by simply creating a question without actually watching the video—easy enough to do after a few questions and comments have been posted by others—then the teacher might implement bell work in the form of a brief quiz, which again will provide the teacher with an idea of the overall preparedness of the class. Through the use of a learner management system such as Canvas or Edmodo, a teacher can track if a student logged in and if the video was played, although this is still no guarantee the student actually watched the video. Despite all best efforts

and motivations, some students will still not do the homework, for various reasons, some of which will be discussed later in this essay.

The next strategic move in implementing flipped learning is to utilize the face-to-face classroom environment to have the students engage in active learning. Rather than beginning the class with an explanation of what will be taught, the teacher may begin the class with an assessment of the previous day's homework assignment. Such assessment can be completed in a very short time through a simple, verbal question and answer period, or with very short "bell work" (a very short activity meant to be completed in the first few minutes of the student's arriving to class) paper quiz, or with a clicker response system quiz, if the technology is available; the methods possible for this type of assessment may very well be limited only by the teacher's creativity and the technology available. This brief assessment may also highlight a common question among the students, for which the teacher could then provide a quick overview, or perhaps have students engage in peer tutoring by putting students who indicate a firm grasp of the topic under discussion with a student or students who could use a bit more assistance. After assessing the students' comprehension of the at home instruction, the teacher may decide to split the class into groups, with the highest function students perhaps immediately beginning collaborative assignments, middle-ground students would possibly be given a few more examples of the homework lesson and allowed to work using the think-pair-share learning strategy (think about the question or attempt the problem, pair up with someone else, share your responses and discuss them), freeing the teacher to work individually or in small group with the students whose formative assessment results indicate a lack of understanding or a lack of preparation. This, of course, is only one possible example of how a teacher might use the flipped

learning environment and formative assessments to increase and enhance the face-to-face classroom environment.

In the more traditional classroom model, where instruction happens face-to-face, students then complete assignments at home. This is often problematic as students must recall material they have only been introduced to once in a limited span of time. One of the best strategic reasons for the flipped classroom model is not only that the students can—as often as they like-pause, rewind, and replay instructional videos and other tools such as web links and images, but what would typically be the homework assignment is then completed in the classroom where the teacher can monitor the students' progress as well as assist and reteach as needed. Additionally, the face-to-face portion of the flipped learning environment allows for such active learning activities as think-pair-share, where students can work in pairs to share their thoughts and solutions. (Fulton, 2012) The most important and effective feature of the flipped learning environment is providing students the opportunity to actively engage in higher-order skill building activities for more effective learning. Working on these active learning assignments in the face-to-face classroom setting provides for several important advantages, the first of which is the immediate availability of the teacher for assistance, guidance, feedback, and monitoring of progress. Additionally, when constructing collaborative projects, the ability to work on the projects in the face-to-face classroom addresses potential logistics issues that some students may have (lack of transportation, after school activities creating scheduling conflicts, job and/or childcare responsibilities, etc.).

One of the most common obstacles, even in our technologically advanced society, is access. The teacher must think creatively about potential obstacles before the first video is assigned; a proactive approach is always better than a reactive one. For students who have access

to a dvd player, the teacher could burn videos to dvds and would then end up with a collection for use with future students. If a student has access to a computer, but not the Internet, the teacher might offer to save the instructional materials to the student's flash drive; if the student has no flash drive, the teacher could checkout or issue a flash drive to the student much in the same way that books and movies are checked out at the library and textbooks are issued to students in the classroom. If a student has the necessary access, but simply prefers the printed page—as I have seen in my own professional experience—the teacher may certainly allow the student to choose the method by which instruction is accessed. Sams & Bergmann (2013) advocate the three Universal Design for Learning principles, all of which promote using multiple means for obtaining instruction, for expressing and processing learning, and for assessing and regulating learning; each of these principles are further broken down into three guidelines, which are themselves expanded into multiple checkpoints. Teachers can readily explore this information at the National Center on Universal Design for Learning website. (Rose & Gravel, 2014)

Designing and developing materials to implement a flipped learning environment may seem daunting, especially for teachers with little or no experience creating videos. The investment of time may seem too great a cost for already overworked educators as well. Sams & Bergmann (2013) caution that implementing a flipped learning environment is not something that happens overnight, but rather something that is ongoing and constantly evolving. Flipped learning has developed a large and expanding following in the last decade, which has resulted in an abundance of tools and instructional materials ready for use by the burgeoning flipped classroom instructor. Rather than starting out creating new videos, a teacher could instead curate suitable videos from websites such as TeacherTube, TEDEd, Khan Academy, and Flipped

Learning Network, just to name a few. Teachers who want to create their own videos would likely need some sort of screencast software, which captures a live video of what is happening on the teacher's computer screen (i.e. PowerPoint presentations) while recording the audio of the teacher's instructional explanations. In a contribution to the International Society for Technology in Education (ISTE) website (https://www.iste.org/), Letter (2015) discusses instructional screencasting software programs, including free programs such as Educreations (https://www.educreations.com/) and Screencast-o-matic (http://www.screencast-o-matic.com/), as well as a discussion of Camtasia (https://www.techsmith.com/camtasia.html), a professional screencasting software program. Options other than making a screencasting video of the lesson include online tools such as PowToons for Education (https://www.powtoon.com/edu-home/) for creating animated videos and presentations, and Emaze (https://www.emaze.com/) presentation software. A simple web search can provide an interested instructor with all of the tools and materials necessary to begin implementing a flipped learning environment, whether the goal is to just test the waters slowly or to jump in with both feet.

As with any method of instruction, assessments are a critical component of a flipped learning environment. Formative assessments may be embedded into the instructional materials or completed at the beginning of the next face-to-face class session. Because in-class time in a flipped classroom is now allocated to projects, presentations, collaborations, etc., to promote and engage students in higher-order thinking, assessments will need to be aligned to the same higher order standard. Rubrics would be the primary method used for grading project-based summative assessments, which may be of many different types, including, but certainly not limited to such constructions as case study evaluations, presentation of projects, reflection on learning, essay exams, etc. (Gilboy, Heinerichs, & Pazzaglia, 2014)

As is true of anything—especially in education—nothing is perfect. Acedo (2013), in a contribution from the TeachThought website lists 10 potential pros and cons to implementing a flipped classroom, as shown in the chart below:

Pros	Cons
• Student control. Students can view at-home materials as little or as much as they deem necessary and can get assistance from the teacher in class for clarification.	• Digital divide. Not all students have equal access to the necessary technologies away from school.
• Student-centered learning and collaboration. Participation in collaborative activities during the face-to-face class meetings is logistically more convenient and allows the student to immediately seek help from the teacher if needed.	• Trust. As with all homework assignments, there is the risk that students will not engage the instructional materials from home.
• Constant access to instructional materials, if the technology is available. Web-based instruction permits absentee students to keep up or catch up quickly as well as providing quality instruction when	• Investment. Teachers must invest time to either create or curate the material that students are to access from home. Also, higher level active learning activities require the teacher to be involved and available

the teacher must be away from the classroom.

- Parental access. Parents are able to see exactly what their students are seeing so as to better aide their students.

- Efficiency. The at-home instructional material is kept short—about 15 minutes is the recommendation; the students spend less time on homework since the activities are completed in the classroom

for feedback and assistance during the entire class.

- Not a natural fit for standardized test preparation. The flipped learning environment may have to be interrupted frequently for standardized test preparation.
- Modality. Not all students learn well from watching videos or listening to lectures.

So what are the implications for the future utilization of flipped learning environments? Information presented thus far indicates that a flipped learning environment can be highly effective in promoting higher level cognitive effort in a constructive, collaborative format; however, careful planning and strategic thought must go into the design of the flipped learning environment if it is to be implemented on a whole class or whole school scale, especially in K-12 settings due to potential issues of accessibility.

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