

A FRAMEWORK FOR FLIPPED LEARNING

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ABSTRACT

Over the last few decades, with the rapid developments of mobile technology, the advent of Web 2.0 sites, and the expansion of social media, there has been an incremental use of technology in the classroom. One of the approaches for technological integration into the classroom is via flipped learning. This pedagogical method has become increasingly popular and there is a growing body of literature that is investigating the implementation of this teaching methodology in the various classrooms. The present paper is an overview of the research related to the flipped classroom. The goals are threefold: a) to provide a synthesis of the definitions of the concept of the flipped learning as used in field b) to review the various theories and models that may explain the theoretical underpinnings for flipped classroom; and c) to develop a tentative framework based on the literature.

KEYWORDS

Flipped learning, inverted learning, mobile learning.

1. INTRODUCTION

Over the last few decades, with the rapid developments of mobile technology, the advent of Web 2.0 sites, and the expansion of social media, there has been an incremental use of informational technology in the classroom to meet the needs of twenty-first century students. Indeed, these students “prefer to access subject information on the internet, where it is more abundant, more accessible, and more up-to-date” (Paige, Hickok, and Patrick, 2004, p. 11).

One of the approaches for technological integration into the classroom is via flipped learning. This pedagogical method has become increasingly popular in the educational arena. There is a growing body of literature that is investigating the implementation of this concept especially in the area of STEM subjects (science, technology, engineering and mathematics). In a survey, Bishop and Verleger (2013) researched flipped learning and listed 39 blog posts and online articles that focus around the flipped classroom as well as 11 websites that promote the flipped classroom or provide resources to help educators flip their classroom. Yarbro, Arfstrom, McKnight and Mcknight (2014) referred to the Flipped Learning Networks community of practice which showed that there has been a significant increase in the number of members. In 2012, there were 2,500 members to 10,000 in 2013 and then another jump to more than 20,000 members in 2014.

Another example of this increase appears in a simple Google search. According to these same scholars, when they carried out a Google search they found that the term “flipped learning” resulted in 244,000 hits in June, 2014. When we put in the term “flipped learning”, we found 412,000 in January, 2016 which is an increase of about 200,000 in just under 2 years. In Google scholar, using the same terms they found 314 in June, 2014. We found 5440 hits which is an increase of over 5000 in 2 years. Therefore, there does appear to be an increase in interest in the concept of flipped learning at least.

As flipped learning, the type of learning that occurs within a flipped classroom, becomes part of the academic vernacular so does the need to develop a clear definition of flipped learning and an understanding of how it works or why it works based on theoretical frameworks. Thus, the goal of this paper is multi-fold, a) to provide a synthesis of the definitions of the concept of the flipped learning as used in the field, b) to review the various theoretical models that account for and explain learning in the flipped classroom and c) to synthesize current information about flipped learning into a potential framework for flipped learning. While we are far from fully understanding all of the areas in which flipped learning is successful or not successful, this model is a first step in developing a better understanding of the process.

2. WHAT IS FLIPPED LEARNING

Inverting the classroom so that the transmission of information (lecture) happens outside of class and the traditional out-of-class work is completed in class with the teacher is not a recent concept. The researchers often credited with first mentioning inverted learning, Lage, Platt and Treglia, published the paper "Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment" in 2000. In this article they explain that inverting the classroom is an approach that occurs when "events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa." (2000). Lage, Platt and Treglia (2000) results indicated that both students' and teachers' perceptions of the new methodology were positive. Crouch and Mazur (2001) conducted a study where they investigated the concept of peer instruction that is in its essence similar to the flipped classroom in the sense that transmission of information occurs outside of the classroom while class time was devoted to conceptual questions and mini lectures which ideally would include higher order thinking and assimilation. Strayer (2007) published his dissertation entitled "The effects of the classroom flip on the learning environment: a comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system". This study examined students' comfort with learning in an inverted classroom. However, the term "flipped classroom" was not readily adopted till Bergman and Sams, two chemistry teachers, started flipping their classroom by providing the students with videos to watch at home and devoting class time to projects. Their book *Flip your classroom: reach every student in every class every day* (2012) outlines the concept of the flipped classroom and defines its key elements. From this, we can note that the development of flipped learning was organic and that the changes in the method, and therefore the definition, mirrors technological developments in the world at large. Technology and specifically social media has changed the way that information is transferred. Therefore, at one point flipping the classroom included reading and/or the dissemination of videotapes or even DVDs. However, now it is possible to access, edit and disseminate videos easily so flipped classrooms have adapted to match this technological transformation.

Flipped classrooms differ from traditional classes in many respects. Traditional classes as opposed to flipped classrooms, include lectures, and therefore transmission of information, in class (Talbert 2012). In this format, students often take notes during the lecture while in class. Outside of class, students complete assignments that are often targeted at assimilation of the information acquired during class time. This work is then submitted or assessed in class. In this approach, individuals work outside of class either alone or in groups but usually without the presence of an expert or a mentor.

The flipped classroom implies a reversal of the traditional class and relies on a different process. There are a number of definitions of flipped classrooms and they range from broad to specific depending on how the teacher uses the method. The broadest definition of flipped learning is one that proposes that assigning readings to give the students prior exposure to new material is a form of flipped learning. The narrowest definition, on the other hand, limits the concept of flipped learning to instances where educators use technology, especially videos, to transmit information outside of class. In the extant literature, the researchers who are often credited as the originators of the flipped learning concept, Lage, Platt and Treglia (2000), defined flipping (or inverting) the classroom as an instructional method in which "events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa" (30-43). Interpretations of this definition can be quite general and thus can create the idea of an unstructured classroom design; however, using this definition as a starting point can provide teachers with a certain amount of flexibility as well as give them the freedom to employ flipped learning using various methods. One drawback when using this broad definition of flipped learning is that it can be difficult to assess effectiveness. Other researchers (Bishop and Vergler 2013, Gannod, 2008, Enfield 2013, Moroney 2013, Gaughan 2014) have defined flipped classrooms narrowly and include specific methods such as interactive group learning inside of the classroom and videos outside of the classroom. In more pedagogical vernacular, this definition means that the transmission of information takes place out of the classroom; whereas assimilation takes place in the classroom (Talbert 2012). The following table provides examples of definitions of flipped learning and key findings as provided in previous scholarly works.

Table 1. Definitions of Flipped learning.

Title	Author	Definition	Findings
Inverting the classroom: A gateway to creating an inclusive learning environment	Lage, Platt, and Treglia (2000)	“inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa” (30-43)	1. Students generally prefer the inverted classroom. 2. Students would prefer future classes in the inverted classroom format.
Using the inverted classroom to teach software engineering.	Gannod, Burge, and Helmick (2008)	“An inverted classroom is a teaching environment that mixes the use of technology with hands-on activities. In an inverted classroom, typical in-class lecture time is replaced with laboratory and in-class activities. Outside class time, lectures are delivered over some other medium such as video on-demand” (777-786)	<ul style="list-style-type: none"> • Students perceive that outcome of the course is met. • Students view that some level of learning occurred.
The Flipped Classroom: A Survey of the Research	Bishop and Verleger (2013)	“We define the flipped classroom as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. A graphic representation of this definition is shown in Figure 1. We restrict this definition to exclude designs that do not employ videos as an outside of the classroom activity. While a broad conception of the flipped classroom may be useful, definitions that become too broad suggest that assigning reading outside of class and having discussions in class constitutes the flipped classroom. We reject these definitions.”	Results of this survey show that most studies conducted to date explore student perceptions and use single-group study designs. Reports of student perceptions of the flipped classroom are somewhat mixed, but are generally positive overall. Students tend to prefer in-person lectures to video lectures, but prefer interactive classroom activities to lectures. Anecdotal evidence suggests that student learning is improved for the flipped compared to traditional classroom. However, there is very little work investigating student learning outcomes objectively.
Remixing chemistry class.	Bergman and Sams (2008).	students watch vodcasts or listen to podcasts and then complete activities in class (24-27)	just as effective as traditional classrooms quantitatively and perhaps more effective based on anecdotal results
Internet and the Inverted Classroom	Lage and Platt (2000)	“The classroom is designed to mirror the resources or experiences that traditionally take place in a lecture classroom, including online lectures and information about videotaped lectures” (11).	
How learning in an inverted classroom influences cooperation, innovation and task orientation.	Strayer (2012).	“relies on technology to introduce students to course content outside of the classroom so that students can engage that content at a deeper level inside the classroom” (171-193).	
The Flipped Classroom in World History	Gaughan (2014)	The Flipped Classroom is one in which lectures are presented as homework outside of class in online videos so that class time is reserved for engaging directly with the materials	Action research paper that showed both students and teachers indicated that they had a positive reaction to flipped learning
Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies	Hwang, Lai, and Wang (2015)	“the flipped classroom is a pedagogical approach which moves the learning contents taught by teachers’ direct instruction to the time before class in order to increase the chances for the students and teacher to interact. Therefore, teachers would have more time to guide the learning activities and solve students’ problems in order to promote the learning effects” (452).	
Flipping the classroom for English language learners to foster active learning	Hung (2015)	flip teaching can be conducted with many kinds of instructional videos, and other forms of pre-class assignments, such as reading quizzes or worksheets, are often presented together to help students better prepare for in-class participation (p. 82).	The main purpose for this study was to describe instructional design for flipped learning in the classroom. While the paper did include a research component, it was exploratory. The results were therefore not generalizable. The paper is significant in that the subject was language and not a STEM based subject.
The use of flipped classrooms in higher education: A scoping review	O’Flaherty and Phillips (2015)	content in advance (generally the pre-recorded lecture), educator awareness of students understanding, and higher-order learning during class time. Outcomes of implementing a successful flipped class approach should consider effective student learning that facilitates critical thinking, and importantly improves student engagement, both within and outside the class (9-95).	This research was an analysis of the current research in flipped learning to understand the meaning of flipped learning and techniques used for flipped learning.

As we can see from this table, the research shows that flipped learning may yield positive results in terms of students' engagement (Farah, 2014; Enfield, 2013), and differentiation of learning (Enfield, 2013). As Bishop and Verleger (2013) suggested, the studies mostly focused on perceptions and feedback from students and teachers. To our knowledge, there has been little research that includes empirical data. This is uncommon. Indeed in a second-order meta-analysis, Tamim, Bernard, Borokhovski, Abrami, and Schmid's (2011) found that high caliber, detailed research evaluating the efficacy of specific methodologies and approaches of blended learning to be rare. For the purposes of this study, we mainly focus on the narrower definition of flipped learning, which includes recordings of either presentation software or lectures.

3. THEORETICAL BACKGROUND

Despite the increasing popularity of flipped learning, the concept itself as well as the methodologies utilized to achieve it have not yet been comprehensively examined in the existing body of research and neither have the theoretical underpinnings that could explain and justify the perceived success of this approach. The goal of this paper is to address this gap in the literature by presenting how learning theories connect with the concept of flipped learning and how components of these theories are operationalized.

3.1 Bloom's taxonomy

Bloom developed a concept of learning, which is often depicted as a pyramid with various levels of learning. This is commonly referred to as "Bloom's taxonomy". This framework can often be used as a lens through which to view the various stages of learning. The process of learning from a knowledge acquisition to critical thinking activities was amended by Lorin Anderson in the 1990's. This revised version of Bloom's Taxonomy is relevant to flipped learning in that the transmission of information, which is the basis for learning, is obtained independently and outside of class; while the assimilation of information, which requires greater critical reasoning occurs during class under the guidance of an instructor or mentor. The higher the tier portrayed on the pyramid, the more assimilation is required; whereas, the lower the level, the more transmission of information occurs somewhat independently, but not completely, of assimilation. The areas in the middle may require a more balanced or less skewed combination of the two. The notion of describing flipped learning in terms of assimilation and transmission was highlighted by Talbert (2012).

While Bloom's taxonomy is valuable at showing the stages of learning and the type of learning that occurs at each stage, it does not explain best practices in how to master each level in a given context. The benefit of flipped learning as it relates to Bloom's taxonomy is that students are actively helped supported during some of the activities that require higher order thinking. Other models and theories explain how learning occurs at the various stages as explained by Bloom's Taxonomy these include: Bloom's Mastery Learning, Cognitive Constructivism and Social Constructivism.

Indeed, most research on the flipped classroom employs group-based learning activities inside the classroom, based on student centered learning theories grounded in the works of Piaget (1967) and Vygotsky (1930-1934/1978). In addition, flipped learning as a pedagogical approach lends itself to the Mastery Model as outlined by Bloom (1968) and described by Block and Anderson (1975) which also shows some relation to the work of Skinner and operational conditioning.

3.2 Constructivism

Vygotsky viewed learning as a process that occurs when a learner is assisted by others who are more competent in the skills being learnt, and that learning is optimized by collaboration within the learner's zone of proximal development. Vygotsky (1978) defines the zone of proximal development (ZDP) as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers". In other words, learning occurs when a student works either with a more skilled adult or peer to solve problems that are just beyond her/his actual abilities. Hence, while using the flipped classroom technique, students are assigned problem-solving tasks where they need to utilize the information they learnt through watching the video outside of the classroom. To solve these tasks students either work individually or in groups under the supervision of the teacher.

Research shows that students learn best when taught according to their particular learning style that may be dependent, collaborative or independents. Piaget's theory of cognitive development is based on a belief

that learners are like scientists trying to make sense of reality. Learners, in order to acquire new knowledge, are not directly presented with information they are supposed to immediately understand and use. Instead, learners must "construct" their own knowledge. They build their knowledge through experience. Experiences enable them to create schemas or mental models in their heads. These schemas are changed, enlarged, and made more sophisticated through two complementary processes namely assimilation and accommodation. According to the Piagetian cognitive constructivist theory, to reach a higher level of learning, students need to interact with peers with the main mechanism driving development being "cognitive conflict" to reach accommodation of knowledge.

These two key principles of cognitive constructivism are practiced in the flipped classroom. The first principle is that learning is active. Practically, prior to attending class, the teacher gives the students a video that introduces the information that needs to be learned. This information is introduced as an aid to problem solving. It is a tool that furthers and facilitates.

Gannod (2008) conducted a study in which they investigated the use of the flipped classroom in a software engineering class. They made 65 podcasts available to students and they devoted class time to collaborative learning where students collaborated to create, analyze and evaluate software. They designed in-class activities that require students to work in pairs or in groups and to utilize the information gained from the video to solve real problems. Their methodology reflects the precepts of a Vygotskian approach to learning.

Lage, Platt and Treglia (2000) carried a study where they explored the use of the inverted classroom to teach economics. Lage, Platt and Treglia (2000) designed in-class activities where students worked in groups under the supervision of the instructor to conduct economic experiments. During the activities, the students brought to the task their different understandings of the information presented, and worked together through continuous assimilation and accommodation of new information to reach an understanding of the information. The results of the study showed that students positively perceived the use of that methodology.

3.3 Mastery Learning

Benjamin Bloom popularized Mastery Learning in the 1960s. Instead of being a theory that supports the use of flipped learning in general, it highlights the importance of using flipped learning in a meaningful and structured manner. Using mastery learning, students learn at their own pace. Therefore learning is differentiated. Based on the tenets of Mastery Learning, all students are required to learn common, well-structured objectives. When a student does not master an objective, remediation is required. Bergman and Sams (2012) argue that Mastery Learning supports flipped learning because it provides instruction that is differentiated, asynchronous and student-centered; and it provides a context for remediation and efficient feedback. This aligns with flipped learning where students have the potential to learn in their own time with a certain amount of autonomy in regards to time management. Mason, Shuman and Cook (2013) used a semi-Mastery Learning model in their study of flipped learning in engineering courses. They used a mixture of project work, group work and quizzes during the class. While the study had elements of Piaget and Vygotsky, there were quizzes and elements of assessments which resembled Mastery Learning. They found that the students' performance overall did not change from traditional learning but that there were benefits to using flipped learning techniques in the classroom such as greater student autonomy and differentiated and active learning.

The concept of reinforcement as part of behaviorism and the ideas of operant conditioning, is related to Mastery Learning and the study of flipped learning in several different ways. For one, akin to mastery learning, students have a stimulus, making a good grade or obtaining knowledge, and based on the theory, they will continue to study until they have mastered the concept to an acceptable extent. Using the flipped classroom scenario, not only do the students need to study the materials (i.e. the videos), they need to be able to study in such a way as to prepare for the classroom activities. According to Skinner, in the initial phase students may be confused but over time they understand the concept or at least the process needed to understand the stimuli. Like mastery learning, a learner will produce a certain output, based on formative or summative assessments that will determine whether he needs to relearn or move on to another stage or topic. According to Skinner after a period of time, students will be trained to respond appropriately if they want the intended reward or if they do not want the opposite – a bad grade, lack of understanding. So, while, the reinforcement theory may not be the main theory supporting the pedagogical underpinnings of flipped learning, it could explain the successful transition from traditional style learning environments to one that is supported by flipped classrooms; and also the conditioning-stimuli relationship of flipped learning and to some extent mastery learning.

4. A THEORETICAL FRAMEWORK FOR THE FLIPPED CLASSROOM

The theories mentioned explain aspects of flipped learning and could account for its perceived success as an instructional methodology. In this paper, we propose a possible theoretical framework that encapsulated the various aspects of the theories reviewed and how they are operationalized in flipped learning. indeed, though quantitative and rigorous qualitative data about the flipped classroom is limited, there is a consistent body of research that reports improvements in students’ achievements as well as their perceptions of the learning environment, their engagement and their motivation while utilizing the flipped classroom. from our perspective, a source of confusion when trying to explain the effectiveness of flipped learning is if we view it as a didactic method that is separate from and independent of models and theories of learning, and that can account for learning in and of itself. We propose that the effectiveness of flipped learning as an instructional methodology and flipped learning as a process could be explained and accounted for through the juxtaposition and the dynamic interaction of different learning theories and models.

Figure 2 provides a visualization of the information provided in this article and is a synthesis of the way in which the theory and frameworks connect to flipped learning based on previous studies and theoretical underpinnings. In the middle of the image is the pyramid associated with Bloom’s taxonomy. This version of Bloom’s Taxonomy is a new version as developed by Anderson, et al (2001). Based on this version, the items listed in the taxonomy refer to the following:

1. remembering - retrieving, recognizing, and recalling relevant knowledge from long-term memory;
2. understanding - constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining;
3. applying - carrying out or using a procedure through executing, or implementing; analyzing - breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing;
4. evaluating - making judgments based on criteria and standards through checking and critiquing; creating - putting elements together to form a coherent or functional whole;
5. reorganizing elements into a new pattern or structure through generating, planning, or producing (p. 67-68).

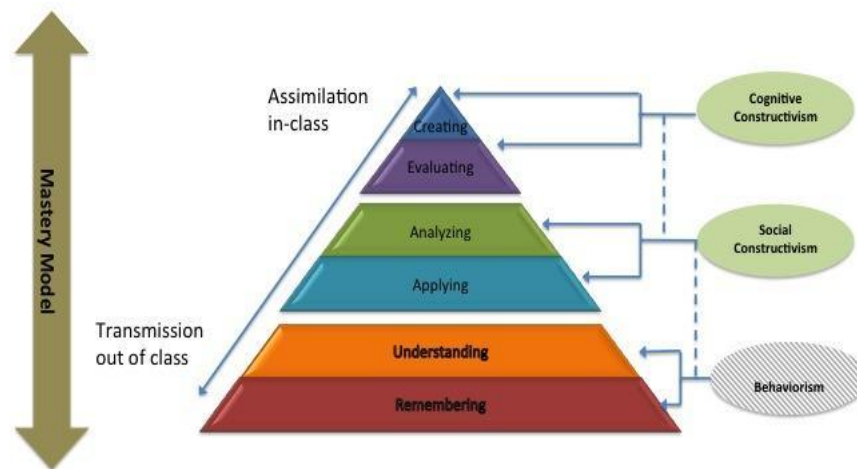


Figure 2. Synthesis of the models and theories associated with Flipped Learning.

When viewing flipped learning through Bloom’s taxonomy, the skills highlighted at the base of the triangle (remembering and understanding) occur outside of class without teacher supervision. Students can watch videos as many times as needed to remember information and to understand concepts. The stimuli being the information that is needed to function in class appropriately; a reversal in the way students view learning and the actions of those participating in the learning environment and a change in the way students’ approach a new learning environment learning (Skinner, 1974). During the beginning of adopting a flipped learning environment, this is especially significant. The middle levels of the pyramid – analyzing and applying – occur in class with the help of a teacher or peers and is more collaborative than the bottom levels. The top levels – evaluating and creating – while can still be collaborative they are moving toward student

autonomy. They would still occur in class but as students master a concept, theoretically they should be able to complete tasks independently and accurately. Theoretically, at least, students can re-watch presentations as often as needed and at their own pace in order to master the first two levels. The top four levels will be mastered under the supervision of instructor with possible peer influence at varies times.

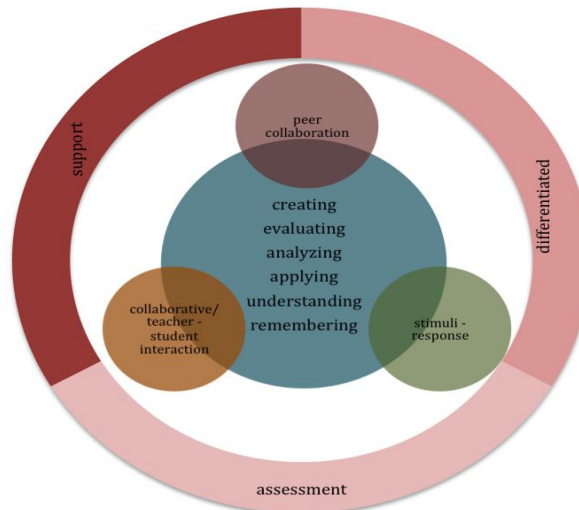


Figure 3. Synthesis of learning processes in flipped learning.

Figure 3 is an attempt to design a framework that has the potential to depict the dynamic nature of Flipped learning and to illustrate how the various learning theories can apply to different stages in the learning process. Much of this depends on the teacher, the students' needs and the content of the course being flipped. In this framework, flipped learning is viewed as a flexible concept where there is a certain amount of fluidity in the way theories can be utilized.

5. CONCLUSION

It is difficult to capture all of the methodologies incorporated into a flipped classroom context. There is a lot of freedom in the manner in which teachers present information and plan lessons, and students synthesize the content. This is both a benefit and a drawback to the field of flipped learning. It is a benefit because it provides a vehicle for differentiated teaching and learning. However, it is a drawback, because it is difficult to research which factors, if any, contribute to its effectiveness or lack thereof. In the future, research should be conducted into the connection between differentiated learning (DL) and flipped learning.

DL refers to the process of designing different instructional material to meet the needs of student with varying levels and abilities. DL involves offering individualized and meaning content through multiple modalities of instruction where students have flexibility to study at their own pace (Keefe, 2007). Flipped learning does not necessarily target differentiated learning. It is a tool that could be used for achieving differentiated instruction. A research study could look at the effectiveness of flipped learning in a classroom where students have mixed abilities. Students with lower abilities would be given support material such as instructional videos and recorded lectures that can be accessed outside the class in a flipped learning format. The goal of this support material is to help students achieve parity with the rest of the class. The performance of the students that were given the videos would be compared to the rest of the class.

Research into the fields of learning styles and personality types and their role in the way materials are presented and assimilated in a flipped learning scenario might be beneficial. In addition to differentiated learning, more research attention needs to be given to subjects outside of the STEM arena. This could possibly increase our understanding of how flipped learning could be used successfully across and within subject areas.

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