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# Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research

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Flipped classroom approaches remove the traditional transmissive lecture and replace it with active in-class tasks and pre-/post-class work. Despite the popularity of these approaches in the media, Google search, and casual hallway chats, there is very little evidence of effectiveness or consistency in understanding what a flipped classroom actually is. Although the flipped terminology is new, some of the approaches being labelled 'flipped' are actually much older. In this paper, we provide a catch-all definition for the flipped classroom, and attempt to retrofit it with a pedagogical rationale, which we articulate through six testable propositions. These propositions provide a potential agenda for research about flipped approaches and form the structure of our investigation. We construct a theoretical argument that flipped approaches might improve student motivation and help manage cognitive load. We conclude with a call for more specific types of research into the effectiveness of the flipped classroom approach.

**Keywords:** cognitive load theory; flipped classroom; motivation; self-determination theory



## Background

Flipped classroom approaches have been the subject of much popular attention recently; since the inception of the term around 2011 its popularity as a Google (2013) search term has risen exponentially. In a flipped classroom, the information-transmission component of a traditional face-to-face lecture (hereafter referred to as the 'traditional lecture') is moved out of class time. In its place are active, collaborative tasks. Students prepare for class by engaging with resources that cover what would have been in a traditional lecture. After class they follow up and consolidate their knowledge.

Very little research has been undertaken into flipped classroom approaches; this is not unusual, as Tamim, Bernard, Borokhovski, Abrami, and Schmid's (2011) second-order meta-analysis found high-level, detailed research evaluating the efficacy of specific approaches of blended learning to be rare. Flipped approaches could, however, be thought of as building upon sound theory and evidence from elsewhere. Removing the traditional lecture is in many cases an evidence-based move: synthesis of research on the effectiveness of lectures shows they are not very effective for teaching skills, values or personal development; unless a lecture has the sole goal of transmitting information, it is probably not the best approach (Bligh, 2000). From a

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cognitive load perspective, self-paced preparatory work might better manage working memory than traditional lectures (Clark, Nguyen, & Sweller, 2005). More troubling are issues of student motivation; flipped classroom approaches wager the success of in-class activities on the likelihood of students completing their pre-class assigned work. This leads to the perennial problems of student preparation: how do teachers know if students have prepared, what they know and if the preparation was useful?

Despite popular enthusiasm and a somewhat reasonable rationale, flipped classroom approaches could not yet be considered an evidence-based (Pawson, 2006) approach; there is little research on the flipped classroom approach and none of it relies on particularly rigorous designs. Contrasting the amazing Google popularity, a search of the ERIC database finds only eight articles that use the phrase in their title, abstract or keywords, and only two are peer reviewed (ERIC, 2013). The flipped classroom approach is under-evaluated, under-theorised and under-researched in general. In this article, we synthesise a definition of the flipped classroom from the scholarly and popular literature and analyse the rationale for this approach against theories of motivation and cognitive load. We propose six testable propositions about the flipped classroom, which form the basis of the structure for the later parts of this paper. We conclude with a call for certain types of empirical research into the efficacy of the flipped classroom around those propositions.



## What is a flipped classroom?

According to Andrews, Leonard, Colgrove, and Kalinowski (2011), many of the learning difficulties experienced by students in undergraduate courses can be attributed to the passive role played by them during traditional lectures; they advocate for active learning as a remedy. Andrews and colleagues (2011, p. 394) define active learning as when 'an instructor stops lecturing and students work on a question or task designed to help them understand a concept'. There is much support for active learning in the literature because of evidence that it leads to improved learning (Andrews et al., 2011). Meta-analysis by Richardson, Abraham, and Bond (2012) found characteristics we associate with active learning, such as conscientiousness, concentration and a deep approach to learning, to have a positive impact on student achievement, whereas characteristics we consider passive, such as procrastination or surface approaches to learning to be associated with a negative impact on performance. One such learning environment that enables students to engage in active learning is the flipped classroom approach (Berrett, 2012; Milman, 2012; Strayer, 2012). According to Berrett's (2012) piece in *The Chronicle of Higher Education*, 'flipping' implies the inversion of expectations in the traditional lecture. That is, through the use of computer technology and the Internet (e.g., video-recorded lecture available online or on a CD/DVD), the information-transmission component of a traditional lecture is moved out of class time and replaced by a range of interactive activities designed to entice active learning.

The first scholarly discussion of the 'flipped' classroom we have been able to locate is Strayer's (2007) doctoral dissertation on the topic. Strayer cites earlier work by Baker (2000) about the 'classroom flip' and work by Lage, Platt, and Treglia (2000) about the 'inverted classroom'. At its core, these approaches rely on 'flipping' or 'inverting' what is done inside the classroom and what is done outside the classroom. This puts the focus on moving tasks in space and time, rather than focusing on increasing engagement, autonomy or student centredness.

The flipping of the traditional lecture can take many forms. One strategy is where the instructor directs students to a video lecture, screencast or vodcast to teach them key concepts of a particular topic as part of their homework. In the actual lecture the instructor acts as a facilitator to students who engage in a range of problem-solving activities which require them to apply the knowledge they had acquired through the completion of their homework (Milman, 2012). These problem-solving activities are generally done in small groups, ideally resulting in the creation of small communities of peer learners (Sweet & Michaelsen, 2012). Flipped classroom teachers might also use 'just-in-time teaching' to tailor any direct instruction to areas of student need, often based on web-based questions prior to class (Berrett, 2012).

Our tentative language above about what flipped classrooms might be like is the result of diverse definitions and understandings of what the term means; in the popular literature, there are many meanings yet in the academic literature there is little discussion (Pierce & Fox, 2012). While published research at times refers to teaching and learning approaches which could potentially be classified as flipped classroom approaches, they rarely label it as such. Despite the lack of a single agreed definition of the flipped classroom approach, a number of common themes can be identified from existing definitions in popular literature. Flipped classroom approaches are characterised by:

- a change in use of classroom time
- a change in use of out-of-class time
- doing activities traditionally considered 'homework' in class
- doing activities traditionally considered as in-class work out of class
- in-class activities that emphasise active learning, peer learning, problem-solving
- pre-class activities
- post-class activities and
- use of technology, especially video.

For the purpose of this study, we define the flipped classroom as a set of pedagogical approaches that:

(1) move most information-transmission teaching out of class
(2) use class time for learning activities that are active and social and
(3) require students to complete pre- and/or post-class activities to fully benefit from in-class work.

Ours is a lowest common denominator definition: all approaches that meet the requirements of existing definitions also meet the requirements of our definition; ours is the superset of those definitions. Notably absent from our definition are:

- claims about the merit or efficacy of the flipped classroom approach
- condemnation of existing modes of teaching
- assumptions about the motivations of those implementing the flipped classroom approach and
- specification of which technologies (if any) are to be used to implement it.

Given research on the flipped classroom approach is in its infancy, there is limited evidence of studies that have examined the approach under a pedagogical microscope.

Our paper aims to address this gap in the higher education literature by critically analysing the flipped classroom approach through two pedagogical theories: self-determination theory (SDT) and cognitive load theory (CLT).

## Self-determination theory

Cole, Feild, and Harris (2004, p. 67) define motivation to learn as 'the willingness to attend and learn material in a development program'. They argue that while ability and intellect influence what students can do, it is the level of motivation that influences their focus and level of effort expended on a given learning activity. The flipped classroom's success relies upon students undertaking substantial out-of-class work – and being motivated to do so independently. Existing higher education pedagogy and policy already expects substantial out-of-class work, for example, expectations of 10 or 12 hours of work per subject per week. Yet when students are surveyed about how much time they actually spend on their studies the results are much lower: in Australia, around 10 hours per week in total across multiple subjects is the norm (ACER, 2010). For our active in-class activities to work, students need to do their homework, which we view partially as a problem of motivation that is self-determined.

SDT proposed by Deci and Ryan (1985) has influenced more than 200 empirical studies undertaken within the education literature (Guay, Ratelle, & Chanal, 2008) and represents a useful theoretical lens for musing about flipped classrooms. The application of SDT to the flipped classroom approach lies in the emphasis it places on students' level of motivation to be an outcome of their learning environment which can either promote or impede the satisfaction of their basic cognitive needs (Deci & Ryan, 2008).

According to SDT, there are three basic cognitive needs that are universally applicable: the need for competence, autonomy and relatedness. Tertiary students need to feel competent to master the knowledge, skills and behaviours necessary to be successful in a given social context. Autonomy satisfies their need to feel in control and independent. A sense of relatedness comes from belonging or association with a social group in a given context (Pintrich, 2003; Ryan & Deci, 2000a). Using SDT, we argue that the flipped classroom might improve student motivation if it creates a sense of competence, autonomy and relatedness.

SDT focuses on the orientation of motivation (i.e., what type of motivation) and its impact on individual outcomes. Orientation of motivation relates to the underlying attitudes and goals that influence an individual's actions. Decades of research undertaken in education have found student orientations of motivation to significantly influence their performance, satisfaction and well-being (Flink, Boggiano, & Barrett, 1990; Guay et al., 2008; Ryan & Deci, 2000a; Vallerand, Fortier, & Guay, 1997). The validity and appropriateness of the flipped classroom approach would depend upon the extent to which it encourages or impedes the diverse orientations of student motivation.

SDT distinguishes between two main types of motivation: intrinsic and extrinsic. Intrinsic motivation refers to those actions that individuals engage in as they are inherently interesting and enjoyable, while extrinsic motivation refers to individuals engaging in actions because they lead to separable outcomes (e.g., reward) (Deci & Ryan, 2008; Ryan & Deci, 2000a, 2000b).

### *Intrinsic motivation*

According to SDT, social contexts that enhance feelings of competence during action will enhance intrinsic motivation for that action. However, feelings of competence will

only enhance intrinsic motivation when accompanied by a sense of autonomy (Ryan & Deci, 2000a, 2000b); the student who chooses to undertake out-of-class work and masters that work will be more intrinsically motivated than the student who is compelled to do the work. While the facilitation of competence and autonomy are critical to enticing and supporting intrinsic motivation in students, there is some empirical evidence to suggest that in addition to these, intrinsic motivation is more likely to flourish in social contexts that also foster a sense of security and relatedness (Niemiec & Ryan, 2009; Van Nuland, Taris, Boekaerts, & Martens, 2012); perhaps following up that self-determined out-of-class work with some small group work in a safe context might further improve motivation – and 'engagement'.

It is difficult to discuss student motivation and popular new pedagogies without the terms 'engage', 'engagement' or 'student engagement' surfacing. We recognise that student engagement encompasses a contested set of ideas that are 'often fragmented, contradictory and confused' (Baron & Corbin, 2012, p. 759). For our purposes, we use Baron and Corbin's (2012) definition:

> the engaged student is the student who has a positive, fulfilling and work-related state of mind that is characterised by vigour, dedication and absorption and who views him or herself as belonging to, and an active participant in, his or her learning communities. (p. 763)

The traditional lecture is caricatured as a passive, transmissive experience, effectively eliminating any sense of autonomy or competence in students. In fact, feelings of autonomy and competence are most likely to be experienced by the teacher within a learning environment created through this approach (Gauci, Dantas, Williams, & Kemm, 2009; Haak, HilleRisLambers, Pitre, & Freeman, 2011; Huba & Freed, 2000). Students subjected to controlling learning environments have been found to learn less effectively, especially when learning is complex or requires conceptual, creative processing (Amabile, 1996; Utman, 1997). The flipped classroom approach is designed to utilise in-class time to encourage students to be active participants, hence, may be more likely to facilitate student needs for autonomy and competence. Furthermore, by being active participants, students are more likely to experience greater levels of relatedness between them and the instructor as well as between themselves. Therefore, given its ability to create learning environments that allow for the satisfaction of student needs for autonomy, competence and relatedness, the flipped classroom approach is likely to facilitate and generate intrinsic motivation in students. As such, it is reasonable to postulate the following:

> *Proposition 1*: Learning environments created by the flipped classroom approach are likely to satisfy student needs for competence, autonomy and relatedness and, thus, entice greater levels of intrinsic motivation.

It is vital to remember that in order for students to experience intrinsic motivation they must find engaging in a given learning activity inherently satisfying. That is, intrinsic motivation will only occur for those learning activities that are novel, challenging or provide an aesthetic value for students (Ryan & Deci, 2000a, 2000b). The freedom to be intrinsically motivated is found to decline as students move up from primary to tertiary education. Only a minority of students enrolled in contemporary higher education institutions are found to be intrinsically motivated. The vast majority are found to comprise students who are driven by extrinsic motivations due to increasing social demands

from their personal and work lives (Leach & Zepke, 2011; Sheard, Carbone, & Hurst, 2010). Thus, to fully understand the true potential of the flipped classroom approach, it is necessary to explore the nature and dynamics of extrinsic motivation.

### *Extrinsic motivation*

When a student is motivated by an external reward, such as a specified task being required to get a certain grade in an assignment, they are motivated extrinsically (Ryan & Deci, 2000a). In contrast to other theoretical perspectives that view extrinsic motivation as inherently non-autonomous, SDT provides a framework that distinguishes between the relative autonomy of extrinsically motivated behaviour (Ryan & Deci, 2000a, 2000b). For example, a student may complete homework as they understand it is important to do so to meet the requirements of the academic qualification necessary to obtain a job within their selected career. In contrast, another student may complete the same homework to adhere to the directions provided by the instructor. The behaviour of both students is influenced by the instrumentality of the homework rather than any inherent enjoyment associated with it. However, the former is derived from personal choice, while the latter is a result of the need to comply with an external authority. Both cases represent extrinsically motivated behaviour, yet differ in their relative autonomy.

Motivating students to self-regulate their learning behaviour without rewards (i.e., high grades, course prizes, etc.) or punishment (i.e., failure, expulsion, etc.) is challenging (Ryan & Deci, 2000a), and these might be seen as a necessary evil for flipped approaches to work; grades for attending class or hurdle requirements to complete all pre-class activities to pass the subject have been observed in practice. As an alternative, SDT advocates the creation of learning environments that encourage students to integrate values associated with a given course as their own (Deci & Ryan, 1985). This process is treated as a continuum within SDT, with the level of integration ranging from unwillingness (i.e., lack of motivation) to active commitment. At one extreme of the motivation continuum is unwillingness or the lack of intention to engage in a given learning activity. In this state, students do not act at all or merely go through the motions (e.g., attending a traditional lecture solely to receive marks for attending). At the other extreme of the continuum lies intrinsic motivation. Extrinsically motivated behaviours fall in between these two extremes and vary in the extent to which their integration is autonomous, with the degree of autonomy increasing as students move along the continuum from unwillingness to intrinsic motivation (Ryan & Deci, 2000a, 2000b).

The most autonomous type of extrinsic motivation according to SDT is integrated regulation. In this type of extrinsic motivation, students have identified values associated with a given course and fully assimilated them to their self (Ryan & Deci, 2000a, 2000b). Therefore, their actions are self-determined and do not have an external locus of causality (Ryan & Connell, 1989; Ryan & Deci, 2000a, 2000b). Actions derived through integrated regulation are similar to those derived through intrinsic motivation as both are autonomous. However, the former remains extrinsic as actions derived from it are undertaken for the instrumental value associated with an outcome that is separate from the behaviour itself (Ryan & Deci, 2000a, 2000b). For example, a student who is motivated by integrated regulation might participate in class discussion because it satisfies their need to be heard, with the enjoyment from the discussion being only a secondary motivator.

According to SDT, in order for students to fully integrate the values promoted within a given course (i.e., to be motivated through integrated regulation), the learning environment relating to the course must satisfy students' need for autonomy (Ryan & Deci, 2000a, 2000b). This has been empirically supported by research undertaken by Deci, Eghrari, Patrick, and Leone (1994) and Williams and Deci (1996). The flipped classroom approach through its treatment of students as active participants is likely to satisfy students' need for autonomy and, thus, influence their learning behaviour through integrated regulation. As such, it is reasonable to postulate the following:

> *Proposition 2*: Learning environments created by the flipped classroom approach are likely to satisfy students' need for autonomy and, thus, entice greater levels of extrinsic motivation.

The degree to which learning behaviours are influenced by integrated regulation is also dependent on the satisfaction of students' need for competence (Ryan & Deci, 2000a, 2000b). The flipped classroom approach focuses on creating learning environments that support students to be the centre of the learning process. That is, students are provided with an opportunity to be in charge of the creation and dissemination of knowledge through active participation. According to research undertaken over the past decade (Gauci et al., 2009; Lord, Prince, Stefanou, Stolk, & Chen, 2012; Prince, 2004; Thaman, Dhillon, Saggar, Gupta, & Kaur, 2013) students feel more competent when they are active participants in the creation and dissemination of knowledge than when they are passive recipients of knowledge dictated by an instructor, as done through traditional lectures. Through the satisfaction of students' need for competence, the flipped classroom approach enables students to integrate values promoted within a given course. That is, student learning behaviours are likely to be extrinsically motivated through integrated regulation rather than the instructor-coerced mechanisms of reward or punishment. Therefore, it is reasonable to postulate the following:

> *Proposition 3:* Learning environments created by the flipped classroom approach are likely to satisfy students' need for competence and, thus, entice greater levels of extrinsic motivation.

Students in tertiary education engage in learning behaviours that are encouraged and valued by significant others (e.g., instructors, peers, parents, etc.) to whom they feel (or would prefer to feel) an affinity (Ryan & Deci, 2000a, 2000b). Therefore, the degree to which the learning environment used in a given course satisfies students' need for relatedness is central to determining the extent to which the values promoted by it are fully integrated by students (Beachboard, Beachboard, Li, & Adkison, 2011; Niemiec & Ryan, 2009; Ryan, Stiller, & Lynch, 1994). Through the encouragement of active participation and autonomy, the flipped classroom approach is likely to provide learning environments that encourage students to establish small learning groups, increasing the level of peer-to-peer relatedness they experience. In addition, given the need for a large lecture theatre to transmit content is non-existent, smaller classes (and classrooms) might be explored, allowing for far greater interaction between the instructor and students, enhancing students' experience of relatedness to the instructor. These increased experiences of relatedness to their peers and instructor in turn are likely to entice students to integrate values promoted within a given course. As such, it is reasonable to postulate the following:

*Proposition 4:* Learning environments created by the flipped classroom approach are likely to satisfy students' need for relatedness and, thus, entice greater levels of extrinsic motivation.

If, as we hope, flipped classroom approaches help students become more motivated, they will undertake a substantial amount of work in and out of class. In the next section, we argue that flipped classroom approaches might provide special opportunities to make this work more manageable, achievable and tailored to each student through the management of cognitive load.

## A cognitive load perspective

The notion that we have a limited amount of 'working memory' to use when learning or problem-solving dates back to work undertaken in the 1950s by Miller (1956). Miller's (1956) conception that working memory consists of $7 \pm 2$ chunks turned out to be reasonably accurate. For example, seven random digits are possible to hold in memory relatively easily, but a dozen are harder without some cognitive tricks. Similarly, a random sequence of letters is difficult to remember, but when those letters form a familiar word it is easier to remember more of them. CLT extends those ideas to suggest that our working memory is subject to certain types of load and that overloading working memory impedes learning (Clark et al., 2005). Researchers have used a variety of techniques to manipulate cognitive load, tested them in randomised controlled trials and proposed various 'effects' that help or hurt learning (see, e.g., a review by Ginns, 2005). In this section, we propose that the flipped classroom approaches might provide additional opportunities to manage cognitive load, thus improving learning. Some of these are implicit in the flipped classroom approach; however, others will require educators to make certain choices when designing learning activities.

CLT is built around the notion that we experience different types of 'load' when learning: intrinsic, extraneous and germane (Clark et al., 2005). The intrinsic load of a task is the unchangeable core of a problem or concept; for example, the concept of a square being a shape with four equal sides and four equal angles carries with it an irreducible difficulty. Extraneous load is additional and can make a task more difficult in ways that do not lead to learning. To take the square example, presenting this concept exclusively in words introduces extraneous load if the instructional goal was to understand the geometric shape in two-dimensional space; it would have been simpler just to draw a square and label its features. Germane load is additional load that helps learning by leading to the production of schemas; with our square example, presenting squares of different sizes or rotations might lead to germane load, as would asking the learner to explain the concept to a friend. Empirical research has identified certain 'effects' that increase or decrease germane and extraneous load; these form the basis of our two propositions about the flipped classroom approach and CLT.

### *Can a flipped classroom approach perform transmissive teaching better?*

Certain bodies of knowledge require learning of foundational facts: the names of the bones in the hand in an anatomy class or the atomic weight of each element in the periodic table. Using Biggs and Collis' (1989) Structure of the Observed Learning Outcome (SOLO) taxonomy, these require unistructural or multistructural outcomes

from students: to be able to list, describe or identify. Although a traditional lecture might be as good as other approaches to perform transmissive teaching of this sort of information (Bligh, 2000), the flipped classroom approach of moving transmission teaching out of the classroom may allow better management of cognitive load.

Changing the mode of delivery of a transmissive class but changing nothing else is unlikely to result in significant gains in learning; when researchers have changed media but not pedagogy in the past, on average we see no significant difference (Russell, 2013). The move from a traditional lecture to presenting that same lecture online is unlikely to result in learning differences if nothing else changes. However, by encouraging students to manipulate the pace of these videos we argue there may be gains in learning, as learner pacing can help manage cognitive load (Clark et al., 2005). Learners can pause, rewind, fast forward or skip any parts of a lecture video in an attempt to better manage their working memory. Meta-analysis of 43 studies by Ginns (2005) found that learner pacing may even mitigate against some poor uses of text and graphics where poor media choices have been made. This leads us to our fifth proposition:

> *Proposition 5:* Student self-pacing of pre-recorded lectures may reduce cognitive load and help learning in a flipped classroom environment.

Little empirical work has been conducted on the prevalence of student use of self-pacing with recordings; however, a study by Owston, Lupshenyuk, and Wideman (2011) found substantial use of the feature. High-achieving students fast-forwarded through the parts they already understood, whereas struggling students re-watched videos multiple times. In their study, high achievers also benefited less from pre-recorded videos than low-achieving students; this is consistent with the expertise reversal effect of CLT, which finds that strategies that work for novices may have a negligible effect on experts – or even hurt their learning (Clark et al., 2005).

### *Can a flipped classroom accommodate a mixed class of novices and experts better?*

CLT experiments have found that expertise is the most meaningful individual difference between learners, and they suggest it is the most important consideration for instructional designers (Clark et al., 2005). The same strategies that help novice learners might hurt the learning of experts. Guiding the learning of a large class of mixed expertise is thus quite difficult, so traditional lectures require somewhat of a judgement call by the lecturer. By moving transmission teaching out of the classroom, using learning analytics, and carefully designing pre-class work, the flipped classroom approach may be able to better tailor online and face-to-face activities to the actual expertise of each individual in the class.

Expertise can be thought of as a set of schemas, an approach favoured by CLT researchers (Clark et al., 2005). An expert might have more schemas, which are of higher quality than a novice, and this has a substantial impact on learning. For example, if you have never played a guitar before, the shape of a single chord may occupy the entirety of your working memory; whereas after repetition you might develop a schema to easily play that chord and not even be conscious of the individual positions of your fingers. With practice you might develop more complex schemas consisting of series of chords in scales or songs. By moving transmission out of the classroom, flipped classroom educators can provide multiple versions of difficult material,

tailored to the diversity of prior knowledge of students – or, if they do not have time to make new materials, they can attempt to rely on learner pacing and repetition.

Learning analytics have rapidly progressed from mundane dashboards identifying students at risk into tools that analyse student performance in work that identifies learning issues. Even simple tools like pre-class quizzes can be used by flipped classroom educators to identify common areas of difficulty or clusters of expertise within the class. These sorts of pre-class analytics data can inform in-class activity design in a timely manner, and flipped classroom educators can tailor activities and guidance to suit expertise levels of students in class. Similarly, the most appropriate cognitive load management techniques can be chosen automatically based on analytics of student expertise. This reconfiguration of space and time for learning and the accompanying cognitive load management opportunities lead to our final proposition:

> *Proposition 6:* Flipped classroom approaches may provide more opportunities to tailor instruction to the expertise of students, enabling more appropriate management of cognitive load.



## A theoretical model for the flipped classroom

Based on the propositions developed from theories of motivation and cognitive load, we propose a possible theoretical model for empirical investigation (Figure 1).

We propose this model not as a set of axioms or facts, but as a series of questions to be investigated. Can the flipped classroom approach actually improve motivation and better manage cognitive load? We call for this sort of research, and other types, in the next section.

## A call for further research

Flipped classroom approaches are being adopted with much enthusiasm despite the paucity of specific evidence about their efficacy. In the absence of evidence of the efficacy of flipped approaches in general, we have discussed evidence about particular components or features of the flipped approach: the potential to cater for motivation and cognitive load. Our first call for research is for studies to empirically test the propositions we have made in this paper, which are based on evidence from other contexts. Testing these propositions will require measuring cognitive load and motivation, which

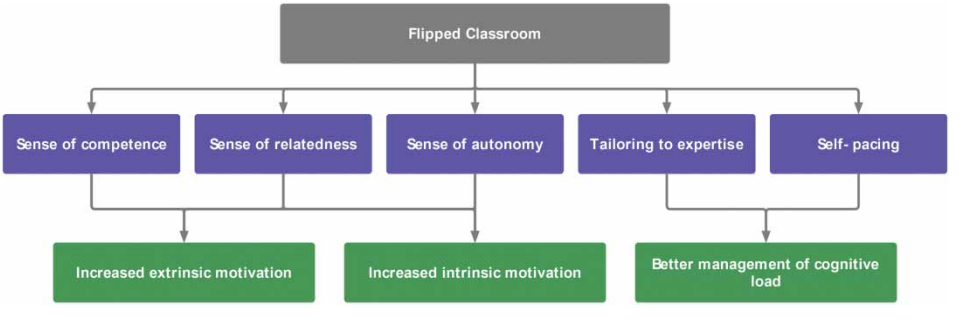


Figure 1. Theoretical model for the flipped classroom.

are useful mechanisms for learning but should not be seen as proxies; further research will need to investigate impact on student learning performance.

If a sufficiently broad definition, like the one proposed in this article, is popularly adopted for the flipped classroom approach, other more prescriptive models may be subsumed by it. Three very specific models that have been the subject of many evaluation studies are:

- Process-oriented guided inquiry learning (Moog & Spencer, 2008)
- Peer-led team learning (Gosser et al., 2001) and
- Peer instruction (Mazur, 1997).

These approaches have bodies of research to support their efficacy and fit within what our definition would consider a flipped classroom approach; in a sense these run counter to Tamim and colleagues' (2011) assertion that evidence for specific blended models is thin; however, we suspect that these approaches do not situate themselves in the educational technology literature and may not have been considered. Another alternative would be to focus on the literature that evaluates the effectiveness of particular components of the flipped classroom approach: pre-class activities, post-class activities, self-paced video lectures versus face-to-face lectures and so forth. There is some evidence for each, which could lead us to the assumption that an amalgamation of these approaches might be effective.

### *What evidence do we need for the flipped classroom to be considered for large-scale implementation?*

The theoretical antecedents of the flipped approach are somewhat solid; however, substantial research questions remain unanswered. For individual university teachers to be confident in the flipped approach, and university decision-makers to support them, the following types of investigations may be necessary:

- small-scale localised interventions, including experimental studies: what is the efficacy of the flipped classroom approach in this discipline, this classroom, with these students?
- larger scale meta-studies or systematic reviews are necessary, but these will depend on rigorous primary research into the efficacy of the flipped approach being published first
- qualitative work into student learning, and student experiences of the flipped classroom approach.

For each, it is important that a high-level uniform definition is adopted – we propose our lowest common denominator definition – and also that operational definitions of what the flipped classroom approach means in that context be provided. Our definition is broad, but the specific learning designs implemented under the banner of the flipped classroom need to be specified for an evaluation study to be valuable. A parallel can be drawn to a much older body of scholarship: the research literature on mentoring in higher education, which tells a story of what can happen when a common definition is not agreed on, and operational definitions are not provided. As of 2007 there were more than 50 definitions of mentoring in the research literature, yet few studies provide operational information on what happens on the ground in mentoring, which

makes it very difficult to apply the findings of evaluation studies (Crisp & Cruz, 2009). We hope that flipped classroom research works towards a common high-level definition, but is also very specific about the operationalisation of that definition.

Another caution as we head towards an 'evidence-based policy' approach to the implementation of the flipped classroom approach is that we may inadvertently end up with 'policy-based evidence' (Pawson, 2006), where university administrators guide positive evaluation research studies. We need to be wary of publication bias (Torgerson, 2006) and encourage publication of those cases where the flipped classroom approach did not work, and be open to the possibility that flipping the classroom might not actually be the panacea that we are promised.

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