Research Article

Learning-by-Teaching based Framework for Flipped Classroom

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Abstract

Flipped Classroom has emerged as a promising instructional innovation, and academia shows a keen interest in research related to it, as evidenced by the spurt in related studies. Simultaneously the experts and the research community caution against the flipping of the classroom with an unfounded belief that it is simply a matter of reversal of the roles of the students and teachers at home and in class without due consideration of the theoretical aspects of the flipping process. Researchers recommend using empirically validated design models when shifting their classroom from the traditional to the flipped structure. However, there is a need to boost the research related to the Instructional Design Model for a flipped classroom since such studies are quite rare Vis the growing literature on Flipped Classroom. The present study, a part of a broader funded project to validate an Instructional Design Model for a Flipped Classroom in a Teacher Education Institute in India, proposes a prospective framework to design a flipped classroom based on the theoretical inputs frequently identified in the related literature synthesized with the theory of learning by teaching. The instructional model developers or designers and the teachers are the prospective audience of the proposed framework. The framework is robust and can be used across various disciplines. The framework is, in particular, relevant to those disciplines that demand frequent application of the knowledge and skills in practical situations like that of pre-service teacher programs.

Keywords: Filliped learning, Self-learning, Collaborative learning, learning by teaching, Instructional Framework

Introduction

Flipped Learning (FL) as a blended format for classroom learning is a 'transformative' and innovative 'pedagogical' approach wherein "direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter." (Flipped Learning Network (FLN), 2014). FL is believed to achieve the educational goals of collaborative, communication, creativity, and critical thinking skills (Jacqueline, 2015; Long et al., 2017; leRoux & Nagel, 2018; Zhao et al., 2021; Padugupati et al., 2021) even though certain studies reported no effect of FL on students' performance (Akcayir & Akcayir, 2018; Yin & Leighton, 2020). However, the studies unanimously reported learners' satisfaction with the engaging experiences created in the flipped format of learning (Almodaires et al., 2018) with greater control of their learning in the asynchronous phase, (Shao & Liu, 2021).

Recently there has been a spurt of interest in flipped learning-related instructional design models and frameworks (Lee et al., 2017; Hastuti

et al., 2022) as a "systematic tool..... in understanding related instructional variables" (Lee et al., 2017, p. 434), as a guide for designing a flipped class, and as a valuable resource for the teachers willing to flip their classroom in the true sense (Lo, 2018; Lawson et al., 2019) across all disciplines including that of teacher education (Almodaires et al., 2018; Cabero-Almenara et al., 2021; Candas & Altun, 2023). The primary author of this paper, a teacher, has been using the presentation of course-based content by the students as an instructional strategy for a long time in undergraduate and postgraduate programs. This strategy is linked directly to the theory of learning by teaching. However, integrating the principle of learning-by-teaching in flipped learning frameworks is underrepresented in the literature. This paper is embedded in the theoretical premises related to instructional design models for a flipped class and the operationalisation of learning by teaching. The purpose of the paper is to identify the core principles of flipping the class particularly those related to the pre-class learning space, the in-class learning space and the principles related to the synthesis of the two learning spaces. A thematic review of the literature was done using ERIC and SCOPUS databases along with Google Search to achieve the purposes. The analysis of the literature was done to identify the key principles that were synthesized to ideate a prescriptive framework to model the flipped class.

Structure of Flipped Classroom

Flipped learning marks a paradigm shift in the structure of the learning space. There is a minimum of two learning spaces, viz., the asynchronous online learning space called the pre-class learning space (PCLS) and the synchronous face-to-face actual classroom learning space or the in-class learning space (ICLS) (Diningrat et al., 2023). Some researchers include a third learning space as an asynchronous post-class learning space (PoCLS) (Ma et al., 2018; Chiang & Wu, 2021; Xiao, 2022).

Intentionally, the PCLS aims at achieving lower-level learning outcomes. The in-class and post-class learning spaces aim at achieving higher-level complex learning outcomes. Functionally, the two spaces have different roles and responsibilities for the teacher and the students (Crișan & Albulescu, 2018). The presentation and lecturing aspects of the conventional classroom are assigned as self-learning tasks in the PCLS. The basic knowledge and understanding related to the content are meant to be self-learned through self-regulation by the students at their own pace. The teacher provides the learning resources in variegated forms for self-learning. The in-class time thus spared by shifting the learning of the basics in the PCLS is used to engage students in complex learning tasks involving collaboration, communication, and problem-solving skills in the ICLS (Lee et al., 2017; Li et al., 2020; Zhao et al., 2021; Diningrat et al., 2023).

A third component in the structure of a flipped class is the Integration component. Integration refers to some instructional task(s) that can help the learners link their learning in the PCLS and the ICLS. Further, the design decisions for FL are well informed by the learning theories and principles.

Principles Guiding Pre-class Learning Space

Behaviourism and Cognitivism are the overall theoretical inputs into the design of PCLS (Lo, 2018; Diningrat et al., 2023), emphasizing knowledge acquisition and retention. The principle of self-learning informs the PCLS design decisions (Zainuddin & Perera, 2018; Kim et al. 2021) and is considered a significant

determiner of the effectiveness of learning in the ICLS and PoCLS (Sletten, 2017; Huang & Hew, 2021; Kim et al., 2021). Self-learning is key to promoting self-regulation capabilities among the learners where self-regulation is defined as an active learner initiative to "monitor, regulate and control their cognition" (Pintrich, 2000).

Another theoretical input is the principles of multimedia instruction (Mayer, 2014) based on the Dual Coding Theory (Clark & Paivio, 1991). It asserts that the retention of learning is directly related to the use of multiple channels in communication. Mayer recommends presenting the learning materials (in the PCLS) through different channels of communication (audio, visual and textual) making the materials more accessible to the students according to their preference for learning modality (Capone et al., 2017; Lage et al., 2000) along with graphical representations (Concept Maps for example) in several cases (Kaye & Kim, 2023) providing greater flexibility for learners to choose their preferred modality (Yasar & Polat, 2021). Video Lectures (VL) are invariably used as a learning resource in the PCLS (Arslan, 2020).

VLs are flexible learning resources that allow learners to stop and play at their own pace and time (Xiu et al., 2019). Further, VLs make learning interactive through embedded quizzes as perceived by the students (Scagnoli et al., 2019) and increase their learning motivation (Tse et al., 2019). The video and text materials as learning resources are prepared following the principles of Segmentation, Personalization, and Signaling (Mayer, 2014). The complexity and size of the learning material are recommended to match the ability of the learner to process the materials i.e. the cognitive load that the students can handle (Mayer et al., 2003). The VLs are consequently, chunked to make them manageable for the students and sustain their learning motivation (Crawford & Senecal, 2017; Lee et al., 2017; Petre, 2020). The video lectures and textual materials are presented using personalized ways of communication and employ different ways to highlight the key ideas in the learning material (Zainuddin & Attaran, 2016; Lo, 2018). Personalized communication in the PCLS is believed to compensate for the actual presence of the teacher. Signalling, or highlighting the key ideas in the learning materials helps the learner retain the learning material for a longer time.

Principles Guiding In-class Learning Space

The raison d'etre of the flipped class is to create more time and space for students' active engagement. The actual face-to-face time and space spared by the asynchronous PCLS is used to engage students in deep learning tasks and active knowledge construction. Accordingly, the constructivist perspective in general and social constructivism in particular inform the design of learning tasks in the ICLS (Yelamarthi et al., 2016). Constructivism is a woolly term (Woolfolk, 2013) that includes any activity or method that promotes students' construction of knowledge in an active and engaged manner. Constructivism presents learning as a meaningful engagement of the learners.

An important principle guiding the design decisions for ICLS is the Principle of Active Engagement. This principle demands creating learning tasks that are engaging for the students. Students are engaged when they are interactively involved in the learning tasks. Students are involved in the learning tasks at the affective, behavioural, and cognitive levels in engaging learning tasks (Archambault et al., 2009; Fredricks et al., 2004). Collaborative learning

approaches, an operational implication of the social-constructivist perspective on learning, are frequently used in FL as an engaged learning task. The principle of CL thus advocates peer interaction and teacher-student interaction as a primary source for meaningful learning and knowledge construction. The collaborative interactions are significant for the development of critical social and communication skills ((Akçayır & Akçayır, 2018; Gomez-Lanier, 2018; Karabulut-Ilgu et al., 2018). The principle is translated during FL into peer collaboration and student-teacher collaboration. The collaborations are achieved through a range of learning tasks in the flipped class such as small group discussion (Gomez-Lanier, 2018; Lo, 2018; Arslan, 2020; Diningrat et al., 2023) project-based learning (Deng, 2018; Yin & Leighton, 2020; Hastuti et al., 2022), collaborative problem solving (Laoha & Piriyasurawong, 2018).

The principle of scaffolding is another important principle that underpins the design of ICLS. ICLS in the flipped class learning spaces redefines the roles and responsibilities of the teacher and learners. The students are promoted to self-learn, and the teachers are expected to guide and facilitate their learning. Scaffolding is temporary assistance by which a teacher helps the learner to know how to do something "so that the learner will be able to complete a similar task alone" (Gibbons, 2015). Scaffolding is an important responsibility for the teachers. Thus, the teachers are creators of learning tasks and facilitators of students' learning (Guo, 2019). In other words, the most significant role of the teacher is to provide scaffolds to promote deep learning. The scaffolds can take various forms during in-class learning, such as providing hints or prompts to students, giving feedback on their ongoing tasks, and responding to students' queries across all the learning spaces (Guo, 2019).

Principles related to Motivational Needs

Motivation is important to sustain students' active engagement in the learning task. Self-determination theory (SDT) (Cole et al., n.d.) is an important theoretical input for consideration in a flipped classroom (Lo, 2018). According to the SDT, autonomy, competence, and relatedness are the three significant psychological and cognitive needs that determine students' engagement. The principle of Self-learning (described above) addresses the need for autonomy in learning. The principles of student engagement and collaborative learning (described above) guide tasks that enable students to construct their knowledge. The principle of scaffolding (described above) infuses the sense of autonomy and belongingness with learning among the learners. Teachers' feedback is vital as a scaffold to steer students' movement along the learning path. It promotes self-efficacy among learners and boosts their confidence (Narendran et al., 2018). Teachers' feedback as a scaffold satisfies the motivational need for competence (Akçayır & Akcayır, 2018; Diningrat et al., 2023). The motivational need for relatedness is addressed through the provision of social interaction in the form of peer interaction and teacher-student interaction. The reviewed studies used a range of small-group collaborative learning tasks, such as solving a problem or completing a project (Chis &

Muntean, 2018) or small-group discussion tasks (Akcayır & Akcayır, 2018) based on the principle of Collaborative Learning. These interactions create opportunities for learners to associate with each other and with the learning task, fostering a sense of relatedness.

Principles related to the Integration of pre-class and in-class learning space

Integration of the learning and assessment tasks across the different learning spaces is an essential requirement for a flipped class (Lee et al., 2017; Wang et al., 2019). The link between different learning spaces is explicitly or implicitly established. Several principles are discernible and are used by researchers and designers to establish a link between the learning spaces in the flipped classroom.

The principle of objective clarification is used to relate, delineate, and communicate the objectives based on certain classification systems (Revised Bloom's Taxonomy, for example). The objectives, it is assumed, establish the links between the different learning spaces of the flipped class and consider the communication of information about the goals of learning and behavioural expectations from the students out of learning as a scaffold that can help the students see the link between the activities in the pre-class and ICLSs. Generally, the lower-level objectives in the taxonomy are used as the overall guide to design learning materials for the PCLS, and the higher-level objectives are used to guide the design of the ICLS (Yelamarthi et al., 2016; Guo, 2019; Hall & Lei, 2020; Sivakumar, 2023).

Further, learning is context-specific. The contextual learning theory suggests that "learning occurs only when students process new information or knowledge in such a way that it makes sense in their frame of reference" (Hull, 1995). The principle of Contextualizing Learning is employed in designing learning tasks that relate the theoretical knowledge and skills to be learned in the flipped classroom with the real-world problems wherein the knowledge and skills are to be used. Merrill, (n.d.) recommended the inclusion of some problems as a context for learning since learning is promoted when the (a) learners solve real-world problems through (b) activation of prior knowledge and by providing an opportunity for learners to (c) demonstrate their knowledge, (d) apply knowledge and (e) integrate knowledge (Hall & Lei, 2020). Thus, learning is contextualized in some real-life problems that can help the students integrate, organize, and translate their learnings in real-world situations (Donaldson, 2017; Hall & Lei, 2020) enabling them to see the learning tasks in different learning spaces as linked and associated (Hall & Lei, 2020; Park & Suh, 2021; Rusnayati et al., 2023).

Another important idea, relevant to FL is the concept of Just-In-Time-Teaching (JiTT). JiTT is a pedagogical technique (Novak, 2011; Novak & Patterson, 2010) that acts as a feedback loop. In a flipped classroom, the JiTT "creates a direct link between the pre-and in-class activities" (Rowley & Green, 2015, p. 15). As the name suggests, it is meant to provide a situation in which the student can demonstrate their learning, and based on their response, some further learning tasks are introduced immediately to overcome their misconceptions or any lacuna in their learning. JiTT, in the context of the FL, consists of 'JiTT exercises' in the PCLS and a 'JiTT response' in the ICLS (Rowley & Green, 2015, p.15). The JiTT exercise frequently includes a video-embedded quiz and an overall quiz based on the learning materials presented in the PCLS. In these exercises, students usually have to read, watch, or carry out an activity and then answer questions related to the task. The students' performance on the JiTT tasks in the PCLS (often in the form of video-embedded quizzes, writing the summary of the video lectures or text materials etc.) are used as learning analytics by the teacher to identify topics or problems for group activities in the ICLS. These tasks based

on the students' learning analytics are thus used as a JiTT Response in the ICLS (Rowley & Green, 2015; Lee et al., 2017; Shiau et al., 2018). JiTT tasks based on the learning materials (video lectures and reading text materials) in the PCLS are more engaging and interactive.

Principle of Learning by Explicit Teaching

The idea of involving students in teaching tasks evolved out of the general theory of Learning by Teaching (LbT) by Jean-Paul Martin (Stollhans, 2016). LbT is considered a strategic way to engage students in complex cognitive tasks following the social and developmental learning theories and can be achieved in variegated forms (Grzega & Schöner, 2008; Chis & Muntean, 2018; Gao & Wang (2019) consider it as an active learning strategy since the students learn to verbalize. Since it involves active student engagement in knowledge organization, presentation, and clarification, it is deemed a constructivist strategy. Teaching experience provides richer learning experiences to the learners. It provides opportunities for learners to reflect on their understanding.

LbT acquires a range of forms. One of the earliest forms of learning qualified as LbT is peer tutoring in which individuals in a cohort learn by teaching each other (Goodlad and Hist, 1989; Topping, 1996; Duran, 2017). Collaborative peer group tasks (for example think-Pair-Share Task) are another form of LbT. In this case, the peers in the groups interact and teach each other.

However, teaching in such contexts is implied, and hence, this form of LbT is termed in this paper as Learning by Implicit Teaching. A corollary phrase is coined viz Learning-by-Explicit-Teaching (LeT) by the authors to designate the learning tasks that involve students in preparing, presenting (or explaining), and clarifying a given content in the class in the form of mini-lectures. The rationale for the term emanates from the assumption that greater cognitive processing is involved when the student learns to explain or present for others (peers in this case) than when the student learns for himself or herself (Fiorella & Mayer, 2013; Duran, 2017; Stollhans, 2016). Teaching, as a LeT task, is approached by the students as a problem, and solving the problem includes preparing and presenting the content that, in turn, promotes their learning (Merrill, 2002; Stollhans, 2016; Hall & Lei, 2020; Yin & Leighton, 2020).

LbT is consequently assumed to be a potential theoretical input in the overall framework for FL. An initial activity recommended by several researchers in the ICLS is the mini-lectures for the activation of prior knowledge and as a link between the two spaces of learning (Talbert, 2017). The proposed framework capitalizes on the attached significance of mini-lectures in the classroom and the opportunities for self-regulated learning (in the PCLS) to transform the mini-lecture into a student activity in the form of LeT based on the theory of LbT (Crouch & Mazur, 2001; Stollhans, 2016). Finally, the evaluation of the LeT task provides a sort of analytics on learning that the teacher can use in the small group collaborative learning tasks for the ICLS and helps in the remediation of learning errors.

Synthesis of the Principles: APPLE Framework for Flipped Class

The innovative framework for flipping the classroom (A-P-P-L-E) in Higher Education is rationally proposed through a juxtaposition of the various principles identified through a review of the literature and the additional principle of learning by explicit teaching.

Assimilation: Flipped Class includes the PCLS and the ICLS. The PCLS involves assimilating the basic knowledge and

skills related to the target content through self-paced and self-regulated learning. This stage is appropriate for achieving the lower level cognitive goals like knowing and understanding. Video lectures with embedded quizzes, reading materials, and references for further reading are plausible learning materials used in this phase. The embedded quiz and/or some overall assessment task (taking notes, writing a summary or even a quiz) can be used as the JiTT exercise in the PCLS.

Preparation and Presentation: It is a small group learning task. A small group of students from the larger cohort is assigned a teaching task in each cycle of the flipped class. Each cycle of flipped class can be a weekly cycle. The learning task includes preparing a small chunk of the content for presentation in the ICLS. The presentation is a mini-lecture. The role of the members in the small group in each teaching task is pre-decided. The preparation phase of the LeT task is completed in the PCLS in collaboration with the teacher. The presentation phase is carried out in the ICLS as the initial activity of each cycle of the flipped class. The presentation is done for the whole class. It is followed by an interactive question-answer session for the class with the teacher as the moderator.

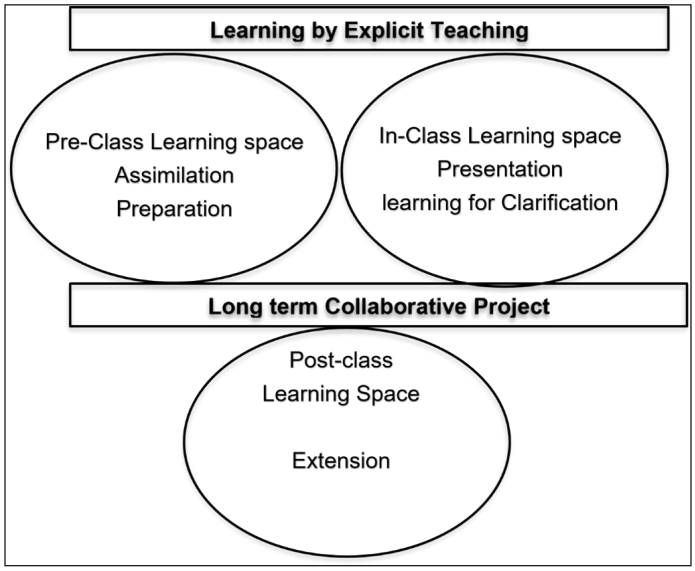
The teaching task as described above helps in the activation of the prior knowledge among the students. It also prepares the background for peer group interaction. The interactions following the teaching task provide feedback on students' learning. Further, the teacher uses the feedback to create different in-class group learning tasks.

Learning for Clarification: Misconception is a common event in any learning situation. The learners in the ICLS work collaboratively to identify and remedy their misconceptions or learning errors. The time and space of ICLS are used to address the students' misconceptions and to expand their cognitive processing. The teacher can analyze the students' presentations in conjunction with the post-presentation interactions in the class and the student's responses to the quizzes in the PCLS. The analysis yields important data as additional input into the learning tasks in ICLS. The small-group learning tasks are completed collaboratively and hence help in the development of social skills. The collaborative learning tasks help enrich students' abilities and skills, including social skills, communication skills, and critical thinking skills.

Extension: The ability to use the learned concepts and skills in variegated real-life contexts is the raison d'etre of all instructional efforts. The proposed framework advocates a problem-based assignment to be communicated to the students at the beginning of each cycle of FL. The problem is created by the teacher and shared with students in small groups. The students are expected to complete the learning task based on the learning achieved in the PCLS and ICLSs in small groups. A post-class learning space is thus visualized in which the students collaboratively complete the assigned task generally as a long-term project related to a unit/sub-unit of the course targeted in each cycle of flipped classes. Problem-based learning tasks are recommended and used by other researchers as well particularly for their potential to enhance the learning of low achievers (Chis & Muntean, 2018) and the general ability to foster critical thinking skills (Listiqowati et al., 2022). Further, if the problem task is provided in advance it serves as a context for the learners to integrate and organize their learning in the pre-class and ICLSs.

A representation of the framework ideated in this paper is presented in Figure 1.

Figure-1: APPLE Framework for Flipped Class



Concluding Remarks

Flipping the class is not merely a shift of the learning tasks in space and time. It is a matter of deliberation and planning. The design of FL is advocated to be supported by appropriate theoretical premises and the creation of a framework is the initial step towards adopting a flipped learning approach. Several frameworks have been proposed recently. The ADDIE framework was used to develop and validate the instructional design model for flipped learning (Lee, Lim and Kim, 2017). Similarly, the Flipped Learning Wheel Framework was developed with a focus on collaborative learning and peer feedback (Luo, et al, 2020). The Apple framework proposed in this paper is unique in that it integrates the principle of learning by explicit teaching with the established principles of flipped learning.

The salience of the proposed framework to innovative instructional practices is substantiated by the opportunities for learners (one small group at a time) to engage in deep learning through the preparation and presentation learning task and is thus in compliance with the nature of the constructivist class. The framework also creates opportunities through the collaborative project to apply their knowledge in real-life situations. The framework is useful for courses that demand the application of learned knowledge and skills in a real-world problem is desirable. The general applicability of the framework in the context of all practical-based courses makes it a robust framework. Simultaneously, the framework is flexible enough to allow for changes in the format of learning tasks in the actual classroom situation as per the course requirement and the constraints of the educational situation. This flexibility makes it relevant across a wide range of disciplines and fields of study, with practical courses in their program of study. Nevertheless, the readers are expected to interpret the framework in light of the validity of the principles reportedly used in designing the Flipped Classroom and the notion of LeT.

The framework is based entirely on the review of the literature and the authors' personal experiences with Learning-by-Explicit-Teaching (LeT)

in their classrooms. The principles guiding flipped learning identified from the literature were synthesized with the notion of LeT to create the framework. The framework is prescriptive and its empirical validity is to be established through actual translation of the different phases into instructional tasks. The framework is a knowledge artefact and since it includes a technology-integrated approach to instruction, the contextual factors and the stakeholders' (students') perspective are important in translating the framework into instructional practice. Any instructional translation of the framework needs to be tested and retested, revised and refined through inputs from repeated piloting of the instruction based on the approach. Consequently, design educational research as a development research approach is the recommended method for instructional design for flipped learning based on the framework and validate the same (van Den Akker, 1997).

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