



Proposed Flip Teaching Framework Based on Multi-Tier Architecture

Asst. Prof. Dr. Mazin S. Al-Hakeem

Head of Information Technology Department
Lebanese French University -KR- Iraq

Prof. Dr. Ala'a H. AL-Hamami

Dean of Computer Sciences and Informatics College
Amman Arab University - Jordan

Abstract - *The tenets of flipping teaching are not new, and lecturers already use a variety of methods based technology to address learner needs with different points of view. The aim of integrating technology in teaching is to establish effective teaching environment with particular attention to activities that generate awareness, initiative, inquire, collaborate, and contribute new knowledge in observable ways. Although Information and Communication Technology are the cornerstone of flip teaching framework, but the extensive use of educational technologies may be disrupt the aim of establish effective teaching environment.*

This paper has examined the concept of the flip teaching design from this perspectives, and have proposed a design for effective teaching framework based on the modern paradigm of flip teaching, for assist the lectures to implement the flip teaching styles easily.

The proposed flipped teaching framework consists of two main parts; Out-Class part which includes create and share the instructional materials and online-interactive with students based interaction among the technological solutions at various levels. The other part is In-Class part which includes the learning activates. The Out-Class part was design based on multi-tier architecture, which includes presentation, application processing, and data storage and access tiers. This architecture allows developers to create flexible and reusable layers and functions with independency.

Keywords - *Effective Teaching, Flip Teaching, Technology-Enhanced Teaching Environment, Instructional Video, Information and Communication Technology.*

I. INTRODUCTION

Based on the facts that say “Not every student learns in the same way” and “Students need their teachers present to answer questions or to provide help if they get stuck on an assignment; they don’t need their teachers present to listen to a lecture or review content” [1]. The alternative model of flip teaching approach is simply a new teaching approach that engages the students to be independent learners by flipping what happens in the classroom with home [2, 3].

Rather than lecture live, the lecturers make videos for their students to watch at home. Class time is spent working with students to better understand the material covered in the videos [2, 3]. Students watched recorded lectures for homework and completed their assignments, labs, and tests in class with the available lecturer. Rather than expecting all students to work at the same pace, flipping the classroom allows lecturers to spend more one-on-one time with each of their students for conversation, not dissemination [3].

While often defined simplistically as “school work at home and home work at school,” Flipped teaching is an approach that allows lecturers to implement a various methodologies, in their classrooms [1].

In the end, the researchers found the benefits of the flipped approach as a technology-enhanced teaching approach are considerable; their students demonstrated a deeper understanding of the material than ever before [3], students take more responsibility for their own learning. Working in class along with a lecturer, students learn to think more critically, communicate more effectively, and have a greater appreciation for the unique importance and logic of the subject. Students experience at least some of the satisfaction of learning how to think in a new and, in some cases, life changing way [4].

The literature review reinforces the sense that the flipping technique approach, that combines the benefits of direct instruction and active learning, is useful when seeking to optimize class time, support the development of higher-order thinking skills, and enhance lecturer-student and student peer-to-peer interactions.

II. LITERATURE REVIEW

Flip teaching as a term was largely unknown prior to the 2011, became a buzz word in higher education during the 2000s, and has largely been replaced by other terms, such as inverted classroom, reverse teaching, flipped classroom, and the Thayer method.

Lage, Platt and Treglia discussed how they can inverting the classroom with the introductory courses at the University of Miami, and explained how education can be reversed to accommodate a variety of teaching and learning styles, although no reference to flip teaching [5]. Tenneson and McGlasson presented an approach for teachers considering whether to flip their classrooms and how various approaches could enhance their teaching process, along [6].

"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" has been discussed by Strayer [7]. The author highlighted the importance of attending the ways for the coordination of out-of-class and in-class activities can positively and negatively influence how students engage course tasks.

Hallberg [2] explained that the flip teaching as a form of formal education is based on blended learning. Student learns at least in part through online delivery of content and instruction with normal attending a school structure and the face-to-face classroom methods are combined with computer-mediated activities. Two centres at Wisconsin Collaboratory for Enhanced Learning [8] were built to focus on flipped and blended teaching to challenge traditional ideas about effective instructional models, course design, and learning environments.

Nowadays, the top world universities [9] like University of Wisconsin Madison (World Rank: 12), Ohio State University (World Rank: 42), University of Queensland (World Rank: 98), California State University (World Rank: 668), University of Hawaii at Manoa (World Rank: 682), James Madison University (World Rank: 752) and many others already created flip teaching environments in order to affect real change in today's classroom. While researchers at Harvard University (World Rank: 1) have launched a new global social network community for users of novel teaching methods, to connect with other innovative educators, share experiences and resources, and learn how to transform teaching and learning using research-based methods [10].

Massachusetts Institute of Technology MIT (World Rank: 2) focused on improving education on MIT's campus by deliver online OCW (Open Course-Ware) course lessons, where students can potentially benefit from both online material and in-person interactions [11]. At University of Michigan (World Rank: 5), there are a number of faculty who use a range of teaching methods to partial or full flip their class, and employ a range of methods to provide first exposure, create accountability, and engage students in the classroom [12].

However, the authors of this paper can define *the flip teaching approach as a blended teaching approach based on switch roles with lecturers using information and communication technologies. The students learn content online by watching video lectures (usually at home) and what used to be homework is done in class with lecturers and students discussing and solving questions more personalized guidance and interaction with students, instead of lecturing.*

The success of a flipped approach hinges on the synergy between lecturer and students and requires sustained motivation and contribution before, during, and after live lecture [13].

III. FLIP TEACHING FRAMEWORK

In general, the flip teaching framework consists of the following: two main parts (Out-Class Part) and (In-Class Part) [14] as shown in Fig. 1.

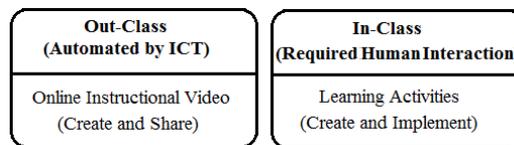


Fig. 1: The General Flip Teaching Framework.

The Out-Class part includes create and share the online instructional videos, usually done by the lectures. While In-Class part includes learning activities that implementing by lecturer during class time, these activities are include 'Peer-Assisted', 'Collaborative and Cooperative Learning' and 'Problem-Based Learning' activities, which required human (lecturer and students) interaction.

So, the lecturers are able to implement the flipping with the following steps [15]:

- First Step: 'Create' and 'Share' a web-based video to deliver instruction to watching by students during home time (usually).
- Second Step: 'Create' learning activities to implement during class time.

IV. TYPES OF INSTRUCTIONAL VIDEO

The flip teaching approach is an instructional video centered, there are many type of instructional video like the following [16]:

- 1) Online Videos: A wide range of instructional videos are currently available online from homemade videos to recorded lectures from top universities. Using online video to deliver lessons does not require any additional software.
- 2) Narrated Screencasts: Create a lesson directly from computer with simple software that captures the events on screen. It needs to intermediate technical skills, beside Computer, Broadband Internet, Microphone (internal or external), Web cam (Optional) and Interactive Tablet (Optional). Using Narrated Screencasts to deliver lessons does require software like Screenr.com or Compare Camtasia for capturing the movements on screen along with an audio narrative requires.
- 3) Videotaped Lectures: Create a lesson by recording the lesson using camera; though there are a few technical issues to iron out with editing, compression and upload. This approach has been the default method for many years. It needs for intermediate technical skills, beside Computer, Broadband Internet, Microphone (internal or external), Digital Video Camera and Tripod (Optional). Using Videotaped Lectures to deliver lessons does require to video editing software like iMovie, Windows Movie Maker, Adobe Premiere Pro or Final Cut Pro are sufficient to accomplish the task,

V. OPTIONS OF SHARE VIDEO

First of all, to share a video with students should be upload it at web service that allows videos to be shared with remote locations. These web services like social media network (YouTube, Facebook, ...), could store service (OneDrive, Dropbox, iCloud, Google Drive, ...) or web-based video. However, there are two main options to share video [15]:

- 1) Linking: To LINK an uploaded video, locate the "URL" section, copy the URL and paste it on a printed assignment sheet, email or class website.
- 2) Embedding: To EMBED an uploaded video, locate the "Embed" section, set the appropriate customizations, then copy the HTML code shown, and paste directly into your class website.

VI. THE PROPOSED FLIP TEACHING FRAMEWORK DESIGN

The proposed flipped teaching framework consists of the following parts: the conceptual framework, the proposed framework, the proposed Multi-Tier Architecture, and the proposed Layers and their Main Functions.

A. The Conceptual Framework

The conceptual framework which arranged according to Fig. 2 for investigating learning activity in a classroom that is structured using the classroom flip.

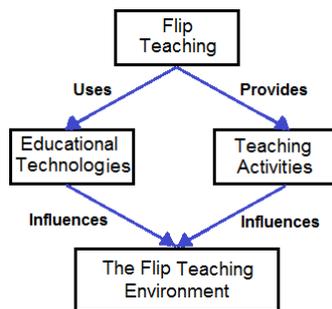


Fig. 2: The Conceptual Framework.

Extensive use of educational technologies to deliver course content Out-Class is central to the classroom flip idea. Active learning like ('peer-assisted', 'collaborative and cooperative learning' and 'problem-based learning') activates during In-Class is the other necessary feature of the classroom flip. These two foci together influence flip teaching learning environment in fundamental ways.

B. The Proposed Framework

The proposed framework which arranged according to Fig. 3 is structured for effective flip teaching.

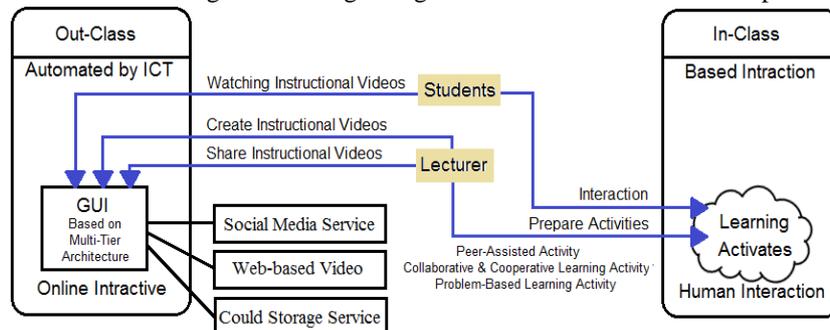


Fig. 3: The Proposed Framework.

At Out-Class, the lecturers make (create and share) the instructional videos for their students to watch (usually) at home; while at In-Class, the lecturer employs a range of learning activities to provide first exposure, create accountability, and engage students in the classroom.

The social media service like (YouTube, Facebook,...), web-based video like (MyHomeworkApp) or storage service (OneDrive, Dropbox, iCloud, Google Drive,..) will integrate to complete the online interaction between lecturers and their students.

At In-Class, the class time is spent working with students to better understand the materials covered in the videos. Students watched recorded lectures for homework at Out-Class, and at In-Class, completed their assignments, labs, and tests in class with their lecturer available.

C. The Proposed Multi-Tier Architecture

The Proposed multi-tier architecture represents the core of the proposed flip teaching framework. It specifies the interaction among the educational technological solutions at various levels. With the proposed multi-tier architecture, the ability to change any logical layer or their functions is independent. This means that the changing of structure of tables,

integrated online interaction applications, social media, storage space, type of instructional video recorder, type of some data can change for optimization reasons, etc., can be done without changing the extra layers, functions or application programs.

In software engineering, multi-tier architecture is a Client-Server model in which presentation, application, and data functions are physically separated. Multi-tier architecture provides a model by which developers can create flexible and reusable layers and functions with independency, for assist the lectures to implement them flip teaching styles easily.

The proposed multi-tier architecture is composed of a presentation tier, application processing tier and data storage, and access tier. Fig. 4 shows the proposed multi-tier architecture:

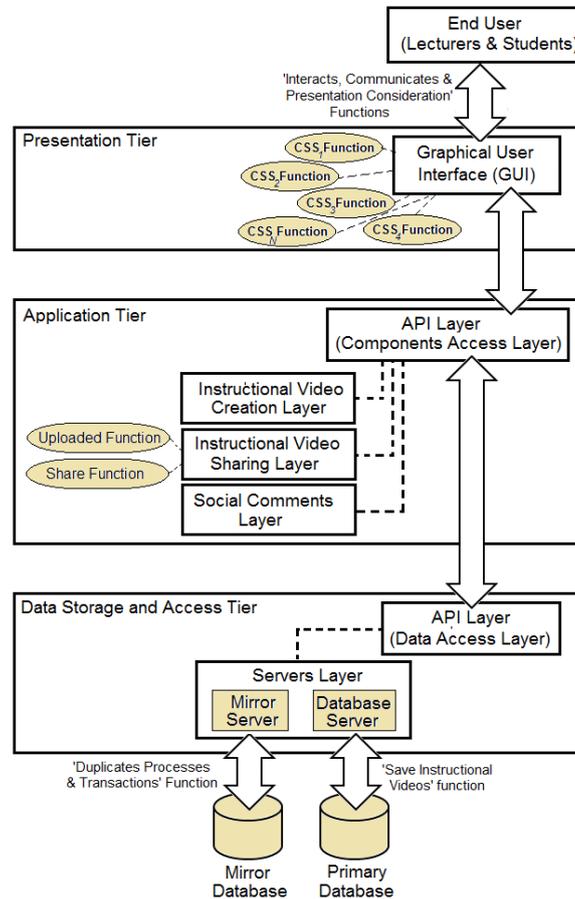


Fig. 4: The Proposed Multi-Tier Architecture.

1. Presentation Tier: It is the closest tier to the end user (lecturers and students). The objective of this tier is to provide functions to display Graphical User Interface (GUI) for user; also to interact with software applications that implement communicating components like PC browser (Firefox, Mozilla, Chrome, IE, etc.), Smart device browser (Safari), etc.

The Cascading Style Sheets (CSS) functions will work beside GUI for considering the presentation space characteristics and limitations of each client device. Each CSS function provides specific style, for example CSS1 has smart device based iOS style while CSS2 has PC style, and so on.

2. Application Processing Tier: It is the middle tier and its objective is to control an application’s functionality related to, by performing detailed processing. In this layer, the work will partitioning into manageable, reusable, and discrete components to use by the following layers:

- API Layer (Components Access Layer): It includes an “Application Programming Interface (API)” that provides functions to connect, management and session support to the verity components in this tier; here, this layer also called components access layer.
- Instructional Video Creation Layer: The objective of this layer is to provide function to create instructional video by recording ‘Online Videos’ or capturing ‘Narrated Screencasts’ directly from client device (lecturer device). The capturing-function is connected and support capturing software like Screener to complete.
- Instructional Video Sharing Layer: The objective of this layer is to provide functions to upload the recorded ‘Online Videos’ or ‘Narrated Screencasts’ instructional videos from client device (lecturer device) to the server side and allow it to be share by other clients devices (student devices). The uploaded-function is responsible to upload the recorded instructional videos. While the share-function provides two options, either linking or embedding videos with one or more of media like (Facebook, Youtube, my homework app, cloud storages).
- Social Comments Layer: The objective of this layer is to provide functions to save, collect and managed the transactions and social comments (students’ comments or lecturers’ instructions).

3. C. Data Storage and Access Tier: The objective of this Tier is to provide functions to save data, backup data and operations, connect, management and session support of legacy information systems (from a relational database to a mainframe transaction processing system). This tier includes two logical layers:

- Servers Layer: It includes the “Database Server” with high capacity storage to save the instructional videos and “Mirror Servers” as a Backup Server to duplicates all the processes and transactions of the primary server. If, for any reason, the primary server fails, the backup server can immediately take its place without any down time.
- API Layer (Data Access Layer): It includes an “Application Programming Interface (API)” that provide functions to connect, management and session support to the application tier; here, this layer also called data access layer.

D. The Proposed Layers and Their Main Functions:

The main purpose of the proposed multi-tier architecture is to specify the interaction among the educational technological solutions at various levels, for assist the lectures to implement the flip teaching styles easily. To achieve this mission, the proposed architecture was designed with seven integrated layers, the main functions and the places of these layers are listed in Table 1.

TABLE I THE PROPOSED LAYERS AND THEIR MAIN FUNCTIONS

Layer #	Layer Name	Layer Functions	Layer Place
I	GUI Layer	Function 1: Displays graphical user interface (GUI) with specific style presentation for end user. Function 2: Interacts with communicating components of client software.	Presentation Tier
II	Components Access Layer	Connect, management and session support to the verity components in application tier	Application Tier
III	Instructional Video Creation Layer	Function 1: Create instructional video. Function 2: Connect and support capturing software.	Application Tier
IV	Instructional Video Sharing Layer	Function 1: Upload the recorded instructional videos. Function 2: Linking or embedding uploaded videos with one or more of media.	Application Tier
V	Social Comments Layer	Save, collect and managed the transactions and social comments.	Application Tier
VI	Data Access Layer	Connect, management and session support to the application tier.	Data Storage and Access Tier
VII	Server Layer	Function1: Save the instructional videos. Function 2: Duplicates all the processes and transactions of the primary server with the mirror server as a backup.	Data Storage and Access Tier

VII. CONCLUSIONS

The proposed work supports the faculty of universities and colleges to be able to implement a flip teaching paradigm easily and moved them out of the classroom and delivered online as means to free up class time for interaction and collaboration.

This research project tried to make the design of the Flip Teaching Framework comprehensive and complete. To achieve this objective the architecture of the Multi-tier has been implemented due to its specification as Client-Server model. Two main parts were implemented, these are, Out-Class and In-Class. These two parts contains all the functionality required by lecturers and students to specify the interaction among the educational technological solutions at various levels. Due to the flexibility of the design, it is possible to add more layers and functions for the frame work without the need to redesign the model or to change the extra layers, functions or application programs.

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