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Upside Down: A “Flipped” Design Thinking Course

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Upside Down: A *Flipped* Design Thinking Course

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Abstract: In constructivist learning, learners are responsible for their own learning process in order to acquire specific professional and personal skills. Constructivist learning methods based on prior knowledge of the learner and learning objects (LOs) of the constructivist approach are the conductors and activators of learners' insider knowledge. In such a learning approach, the planning of effective learning needs to be questioned and restructured. The use of LOs in learning planning is of great importance in encouraging learners to be self-learners. This paper presents a case study conducted in an interdisciplinary Design Thinking course conducted with 16 students, one instructor, and one researcher in a Department of Industrial Design. The case study aims to explore the efficiency of flipped classroom in course planning, information transfer, process management, and student motivation and participation. This explorative case study included three projects during the semester, focusing on the use of LOs in alternative ways depending on the learning process. Three different models were experimented with for the delivery and usage of LOs. These models were compared and evaluated by facilitators' observation and reflection, as well as students' reflection and feedback.

Keywords: *design thinking; learning objects; flipped classroom*

1 Introduction

This paper focuses on the pedagogic application of a Design Thinking mindset and the flipped classroom model as a set of pedagogical approaches. Education has been going through a transition in order to catch up with developments and shifts, as well as to fulfil the future needs, in the professions. Education, in that sense, can be framed both as a game changer and as a tool that has to adapt itself to social, economic, environmental, and technological developments. Within this perspective, a Design Thinking mindset, which is based on problem solving and creation process of creative industries, is of great potential when integrated into different educational approaches (Wringley, 2015), since this mindset has already been used in diverse contexts due to its comprehensive approach.



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From a constructivist point-of-view, learning is an active process, in which students are responsible for their learning, constructing knowledge built on their past and existing knowledge and experiences, with no didactic transmission of knowledge (Piaget, 1970; Olssen, 1996). The flipped classroom model, as one of the constructivist educational models, suggests an inverted class structure for the delivery and usage of LOs, compared to traditional teaching, as well as the use of technology. In this paper, the literature on Design Thinking pedagogy and the flipped classroom model is presented in order to create a theoretical framework for the case study conducted in a Design Thinking course.

2 Theoretical Framework

2.1 Design Thinking Pedagogy

Education models are changing from the teacher-led approach to learner-based approaches (Biggs & Tang, 2007). Design thinking education can be accepted as a model for enhancing creativity, endurance, engagement and innovation (Dolak, 2013). It aims to act as a model for design-led change in the world by solving daily life problems through interdisciplinary learning processes (Rauth, Köppen, Jobst & Meinel, 2010). Group work is essential in these processes and aim to increase students' motivation to learn from one another by enabling collaborative working and engaging in constructive dialogues (Luka, 2014). In order to facilitate Design Thinking learning processes, learning tools are developed with the aim of enabling participants to develop solution proposals to untraditional innovative tasks and develop their problem-solving abilities. The Institute of Design at Stanford has created teaching/learning aids and designed LOs for different activities developing design thinking skills (Plattner, 2009; Plattner, 2010). The tools are in compliance with the seven principles that design thinking follows: (1) focus on human values; (2) showing not telling; (3) creating clarity from complexity; (4) getting experimental and experiential; (5) being mindful of processes; (6) bias towards action; (7) collaborating across boundaries (Plattner, 2009). Design Thinking education focuses on the process, and students experience all Design Thinking phases as Understand - Observe - Define POV (Point-of-View) - Ideate - Prototype - Test throughout their learning journeys. The instructor makes some emphases on the learning goals, individual needs, and content of the project, as well as acting as a facilitator, giving support and guidance to students. The learning process is designed in the frame of the constructivist learning approach, which focuses on the individual learning journey. The Design Thinking learning journey at Stanford encourages using design principles in learning activities: (1) inviting multiple audiences; (2) extending nature of classes; (3) diversifying learning opportunities; (4) encouraging diversity of students; (5) extending contact beyond physical walls (Plattner, 2010).

Design thinking education is based on constructivist learning. Scheer, Noweski and Meinel (2012, p. 11) describe three fundamental steps to realize in Design Thinking teaching methodology in their dissertation *Transforming Constructivist Learning into Action Design Thinking*:

- challenges situated in a real-life environment of the learner;
- action – the interaction of thinking and action plus interaction and sharing of knowledge between learner and teacher;
- application – solving the problem and applying the insights, reflecting and understanding through applying ideas.

Learning is an active process, which is highly related to making meaning individually, socially, and continuously in order to construct knowledge instead of an accumulation of knowledge (Piaget, 1970; Olssen, 1996). A constructivist view in education does not focus on behaviours or skills, but rather on cognitive development and deep understanding that is in the centre of the learning and teaching processes (Fosnot & Perry, 1996). From this point-of-view, learning is an "interpretive, recursive and non-linear" process accomplished by active learners (Fosnot & Perry, 1996). In that sense, there is no passive transmission of knowledge from the instructor to the learner, but rather the learner's insider knowledge is valued and built upon. Individuals construct their existing knowledge by interacting with others socially and are responsible for their learning processes. Reflecting on these interactions enables the individual to make sense of them and accomplish the individual (private) aspect of construction (Henriques, 1997). Considering Design Thinking pedagogy, reflection is a fundamental part of design education as well. Schön describes two critical notions: reflection-in-action, implying to thinking on feet, and reflection-on-action, implying to thinking on previous actions. Therefore, whereas the first notion signifies considering experiences, feelings, and theories in use, the second notion requires revisiting one's actions and practices later (Schön, 1982; 1984). Reflection is also essential in assessing the individual learning process by incorporating reflective tools/objects, either digital or non-digital, in learning environments (Coombs & Smith, 1998).

A learner's engagement with learning and reflection play a significant role in contextualizing learning (Banks, 2001), which requires learning objects (LO) to be designed accordingly. LOs are the artefacts that are shaped by learning objectives, learning goals, and learning methodology. They are a collection of content items, practice items, and

assessment items that are combined, based on a single learning objective (Cisco System, 2013). In the constructivist approach, the learning objectives depend on the context of learning, so must be definable in the context of use of the learning object (Banks, 2001). The deliverables have to be described and planned while planning the learning journey. Ritland (2000) describes three types of LOs used in Constructivist learning approach: micro-level LOs (fundamental LOs), combined information objects (generative-instructional LOs), and macro-level scaffolding (frameworks). In a full object-based learning environment, such objects might be embedded in an appropriate sequence with information objects, assessment objects, etc. (Banks, 2001, p. 9). Banks (2001) explains that the user interacts with LOs as following: evaluating the LO in practice within the scope of expectations from LOs, meeting the essential prerequisites or necessities to use the LO, adapting to the sequence of the learning journey.

There are different educational models, adopting the constructivist point-of-view, which propose different classroom structures. With the introduction of technology in education, digital tools and environments have started to be used. Considering the integration of technology and the sequence and delivery of LOs, the flipped classroom model was experimented with in this study.

2.2 Flipped Classroom Model

The flipped (inverted) classroom methodology is a learner-centred, constructivist teaching approach, facilitating students' active engagement in learning through delivering learning materials outside the class and using class hours for collaborative and interactive learning activities related to those materials with a focus on what students actively do (Baker, 2000; Lage, Platt, & Treglia, 2000; Butt, 2014). It is a form of active learning, requiring students to engage in meaningful learning activities as they think and make sense of what they are doing (Prince, 2004). In the flipped classroom model, active and collaborative learning activities (case studies, problem-solving, deepening and advancing concepts, etc.) are conducted during class hours and the passive learning activities that focus on information transmission (reading, watching instructional videos, etc.) outside the classroom, unlike traditional didactic teaching, and students are required to complete pre- and/or post-class activities to benefit from the in-class work (Butt, 2014; Abeysekera & Dawson, 2015). Therefore, a flipped classroom is not very different from a traditional classroom in terms of the syllabus and LOs used, but the form of delivering and accessing them is different from providing a less structured and inquiry-based learning environment (Hmelo-Silver, 2004; cited in Butt, 2014).

The flipped classroom model suggests the use of a variety of technologies for preparing and sharing the course content and materials (Roehl, Reddy, & Shannon, 2013). It allows the delivery of information and learning objects prior to class and to make use of class hours for students to engage in interactive activities with an intention "to create a more collaborative learning environment where students are focused on working through problems with both the guidance of their instructors and the support of their peers" (Findlay-Thompson & Mombourquette, 2014, p. 64). Therefore, students are provided with the opportunity to explore the content on their own and to prepare for individual and/or collaborative activities focusing on skill development in the class (Roehl et al., 2013). This allows focusing on individual learning paths, skill levels, and needs in the class during peer-to-peer and/or instructor-student interaction or collaborative activities. Similarly, the use of multiple media enables instructors to meet the individual needs of students with diverse learning styles and provide them the relevant guidance and support (Bryant & Hunton, 2000). Instructional videos are considered an essential part of the flipped classroom model, especially for lecture-based courses. However, using instructional videos or another form of computer-aided instruction is not enough for a practical application of the flipped classroom model. How the classroom is restructured and how well the technology is integrated within the overall approach through regular and systematic use are the key to making the model active and successful (Strayer, 2012; Tucker, 2012).

The inverted structure of a flipped classroom enables students to interact with the course content and LOs as needed, according to their learning styles, and become more aware of their learning process. Students are responsible for gaining a basic understanding of the course content before the class in order to be able to engage in in-class activities and the challenging interactive experiences and comments, insights, and feedback from the instructor complement, facilitate, and guide their learning (McLaughlin et al., 2014). In order to make sense of what has been learned, reflection is an integral part of the learning process. Therefore, the instructor is responsible for planning a component for the course for student reflection to be commented on by the instructor, which is crucial for assessing students' learning (Roehl et al., 2013). In summary, in order to provide a compelling experience, a flipped classroom needs to involve highly-structured pre-class assignments to introduce new theoretical concepts, means of accountability to ensure that students complete pre-class assignments and out-of-class works, well-designed in-class activities for students to make sense of activities, and open lines of communication for free student-instructor interaction (Talbert, 2014; cited in Canina & Bruno, 2018).

Considering the effects of the flipped classroom model on student learning and despite the limited studies providing quantitative results on the effectiveness of flipped classroom, the findings from the research conducted in various disciplines reveal that the students' perception towards the flipped classroom and its effects on learning is positive in general (Bishop & Verleger, 2013; Butt, 2014; Findlay-Thompson & Mombourquette, 2014; Canina & Bruno, 2018). Although some studies show that a traditional approach is more preferred, it is stated that the students showed increased collaborative skills and tendency towards cooperation and innovation as the semester progressed (Strayer, 2012). Disciplines that predominantly require lectures, readings, etc. seem to be more suitable for applying the flipped classroom model, considering course contents, ways of delivering information and developing skills. However, it "could be easily adapted to multiple disciplines such as textile design, apparel design and construction, interior design, and nutrition" (Roehl et al., 2013, p. 46) that utilize lectures for providing instruction as well. In that sense, the flipped classroom model could also be beneficial in design education, including all design fields, which are practice-based by nature. In terms of the feedback cycle and inquiry-based learning environment of a flipped classroom, there is already a similar educational approach with design education. Within this perspective, the flipped classroom model is applicable in Design Thinking courses, in which a variety of LOs are used. Canina and Bruno (2018) report the findings of their experimental study on "Design Thinking via flipped classroom," comparing traditional and flipped Design Thinking teaching, and point out the potentials of the model:

1. Pre-class activities are beneficial for providing an overview of the Design Thinking phases and allow an in-depth understanding and awareness.
2. Giving more responsibilities to students for their learning through well-structured guidance to facilitate the interaction among students in the development of a design project.
3. Technological tools help following and to assess students' process and progress.

Reviewing the literature, a "flipped" Design Thinking course experimented with the aim of exploring the potentials of the flipped classroom model in a practice-based course.

3 Application Background

In this case study, it was intended to reconsider the teaching and learning process and the delivery and usage of LOs in Design Thinking courses and to discuss the results of the application of the flipped classroom model by comparing three experimented models in three consequent projects. The Design Thinking Course, Roles of Actors (instructor, researcher, and students), LOs/Technologies and Data Collection methods used within the scope of this study are explained in this section.

It is also important to note that this study was planned and approached as a part of the researcher's Ph.D. dissertation and aimed at making use of the results in his research.

3.1 Design Thinking Course at the University

The Design Thinking course, which has been in the curriculum since 2016, conducted in the 2017-2018 spring semester at the University, has been chosen for the experiment. The course is a one-semester elective course, which is open for 3rd and 4th year students from all departments at the University. This interdisciplinary practice-based course is 4 hours a week and consists of three projects, durations of which are 3, 4, and 8 weeks.

The learning process of this course was planned in the perspective of the Constructivist Approach, that instructors are responsible for the action and reflection process of students, who are responsible for their learning (Schön, 1982; 1984). The learner-centred approach based on knowledge and application includes theories, methods, philosophies and also practices that students can construct knowledge by applying the knowledge in practice while solving daily life problems. Students are able to use or apply knowledge, put theory into practice, use knowledge in response to real circumstances, reflection, ideation, design process, design history, defining design, creative thinking (idea generation), group dynamics, wicked problems, design contexts, visualisation, experimentation, prototyping, and short collaborative design thinking projects. The applications of the course are workshops, lectures, tutorials, field study, individual and group challenges (Wrigley & Straker, 2015).

The learning outcome of a student at the end of the Design Thinking course is to experience the process and gain a Design Thinking mindset so that the student can infer and recall the Design Thinking process, plan, and co-lead the process, and organize the tools.

3.2 Roles of Actors

Three main actors - instructor, researcher, and students - were present within the course and their roles are described below.

Instructor

The instructor was responsible for leading the learning journey of the course in terms of the learning planning, giving direction to action and reflection processes of students, and controlling their learning. As suggested in the literature, the primary responsibilities of the instructor were guiding students to handle complex design problems, adapt insider knowledge to action and establish a dialogue, and focus on their making experience (Schön, 1982; cited in Waks, 2001)

Researcher

The researcher in this study was responsible for reporting the research process, archiving the reflection and feedback of the instructor, giving direction to application and co-planning of the course content, based on the research planning, through structured meetings with the instructor.

Students

16 3rd year students (13 female, 3 male) enrolled in the course. The students were from five different departments: Visual Communication Design (6), Computer Engineering (3), Interior Architecture and Environmental Design (5), Industrial Design (1), and Architecture (1). The students were responsible for realizing the action which is described by the instructor, preparing course submission before their deadlines, and attending the courses to participate in individual or group-based projects.

3.3 Learning Objects and Technologies

Google Classroom was used for communication throughout the course for sharing learning materials, making announcements, and collecting project submissions. The researcher followed the course flow and submissions via this application.

The LOs used in the course are the course syllabus, project briefs, and templates. Project presentations and project documentation can also be accepted as LOs for reflection. Within this context, the Templates are accepted as Micro LO, the Syllabus and Project Briefs as Combined LO, and the Documentation tools as Macro LO.

The LOs were the same in each project, only with small revisions that had been found necessary based on the reflections and depending on the project content. Among the various LOs, this study is mainly focused on the various usage of templates and their effects on learning, since they are essential educational tools for facilitating and keeping track of students' learning and enabling students to focus on the relative phases and tasks within allocated time periods in Design Thinking courses.

3.4 Data Collection

Structured and semi-structured reflection forms were used for data collection. Structured reflection forms were designed based on the reflective writing methodology (Table 1). The reflections (Figure 1) among the actors are described below:

Instructor/Researcher

The researcher received the instructor's reflections on the course (Affection, Cognition and Metacognition levels) after each class through interviews and in written formats and then archived them. The researcher and the instructor planned the following class depending on the research and learning plan after the course reflections.

Students/Instructor

The instructor asked the students to reflect on their action process during the course and project at the beginning and end of the course verbally. The instructor forwarded these reflections to the researcher. In addition to these reflections, the students' reflections on the semester were collected in written format at the end of the semester. In Project 03, written reflections were also collected online each week. These reflections were used both for assessment and as written material for the research.

Table 1. Templates for the teacher and the student in the structured reflective diaries (Gelmez, 2016).

Structured Reflective Diaries, Part I A template for teacher	Structured Reflective Diaries, Part II A template for student
General thoughts and emotions (Affection and cognition)	What are my feelings and thoughts about today's class?
Reflections on curriculum content and pedagogy (Cognition)	What did I learn today? How did today's class contribute to my learning process? What couldn't I understand in today's class? Why not?
Reflections on the learning process (Metacognition)	How have my ideas changed? What is the link between the things that I have learned in today's class and the things that I have learned previously? What would I want to change if today's class was repeated? Why?

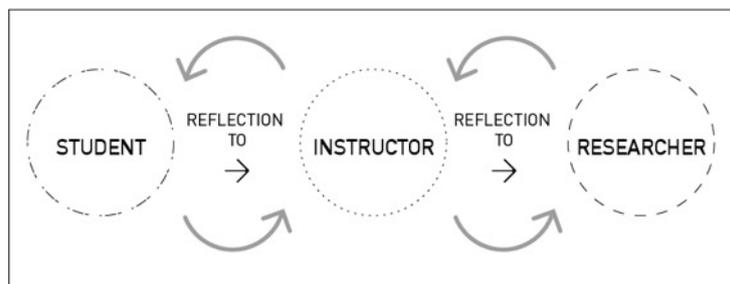


Figure 1. Reflection Structure

4 Test and Analysis

Within the scope of the study, three projects were conducted with the application of three different models with the test structure presented in Figure 2. The experimented models are described below in detail, in terms of the course flow as well as the application and evaluation of the models, with a particular focus on the delivery and usage of templates within the projects.

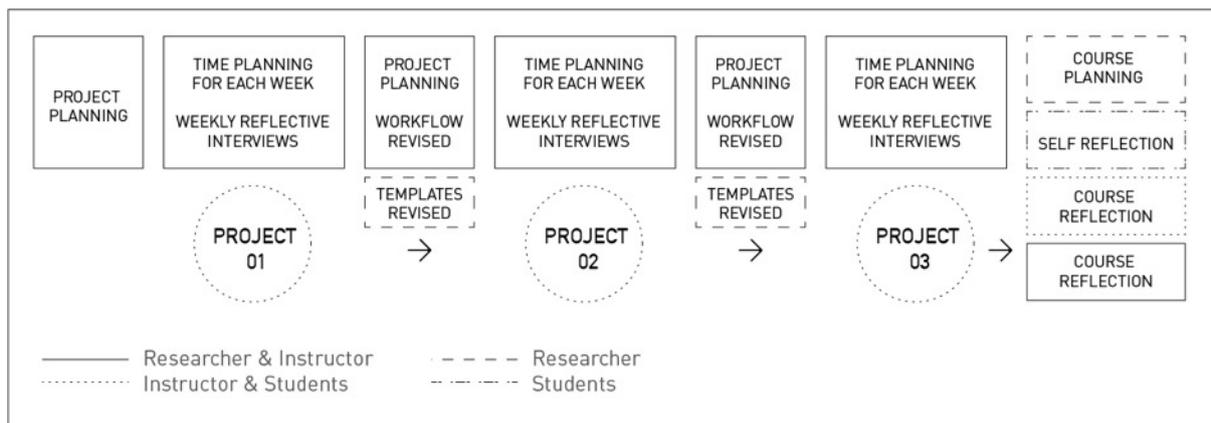


Figure 2. Test Structure

4.1 Case 01

Project 01_3-week individual work

“The project aims to develop social responsibility project ideas in order to make a difference about the subjects of disability, women rights, abandoned children, and elderly people, bring some solutions, and create social sensitivity.”

In Project 01, the brief was delivered to the students in the class (Figure 3). Each week, the templates to be used for the relevant phases of the Design Thinking process were presented in the class. The purpose of using these templates

and how they are used were explained in detail by the instructor. Then, each template was filled out together with the class as an example. After the class, the templates were shared online (Google Classroom), and the students were asked to fill them out as homework before the next class. This homework aimed at enabling students to practice what they had learned in the class and complete the previous class' tasks in order to be prepared for presenting their ideas and move onto the next phases in the next class following the introduction of the new templates. At the end of the project, each student presented their work in the class.

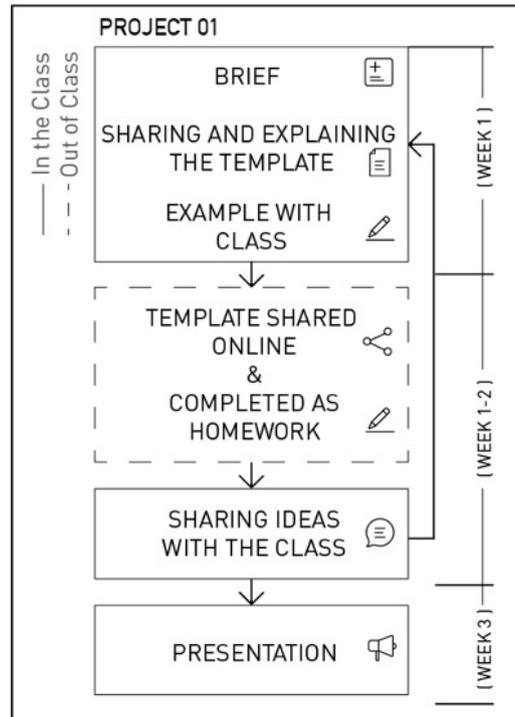


Figure 3. Case 01 Course Flow

Working with the templates allowed students to progress; however, they remained in a passive role during class hours, despite the expectation of creative project outcomes through a creative process. Moreover, moving onto the next phases with new templates each week made it difficult for them to make sense of what they were doing and why they were doing it, even though each template was explained in detail and practiced by the instructor in the class and the students completed the necessary tasks for the project at the end. It was observed that they only completed the tasks as homework, not for developing an understanding of the content and context for deep learning.

Based on the students' and the instructor's reflections, the course flow was revised for Project 02, in terms of the design, delivery, and usage of templates.

4.2 Case 02

Project 02_4-week individual work

"How might we enhance the university experience of students at the University they belong to by identifying their needs and the problems they face with and generate feasible, realistic solutions using Design Thinking methods?"

Similar to Project 01, the brief and the templates were delivered to the students in the class (Figure 4). The templates had the same content as the previous ones, so the students were familiar with them. Differently, they included short explanations as guidance. Unlike the previous project, the students worked on the templates in groups of four with a focus on their works. This cooperative exercise allowed them to support each of their learning and clarify each other's uncertainties and questions relevant to the templates through peer interaction in small groups. The students were also allowed to make field research (in the campus) during the class hours, which provided them the opportunity to cross-check their ideas, thoughts, and opinions on the tasks by visiting places, interviewing university authorities and students, etc. The instructor visited each group for desk critiques, and each student presented his/her work via their templates-in-progress. The students revised their templates, if they needed to, as homework. At the end of the project, each student made a presentation to the whole class with the participation of university authorities.

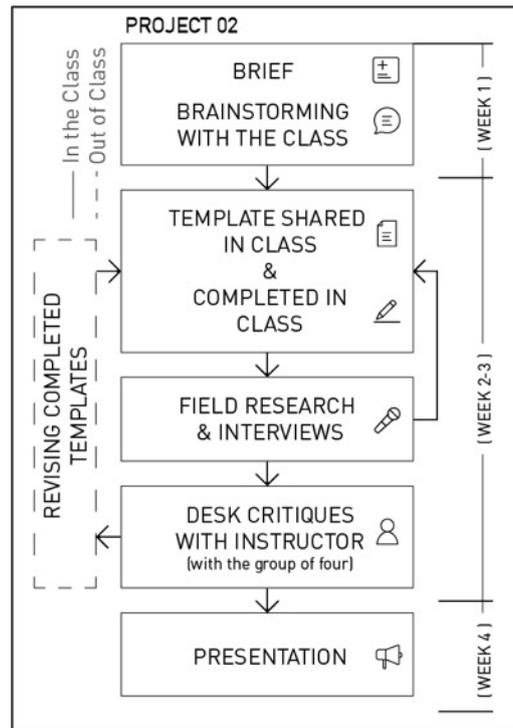


Figure 4. Case 02 Course Flow

The revision in the course flow helped the students show more progress and develop a deeper understanding of the project since it allowed them to take the initiative and interact with peers more. Even though the templates served as a catalyst in the process and the students engaged with them by themselves, spending more time on figuring out the role and contribution of the templates in the project and particularly in the learning process, the usage of the templates were not engaging and effective enough in terms of facilitating an independent learning process, in which the students took the responsibility of the process.

Based on the students' and the instructor's reflections, both the course flow and templates were revised for Project 03, and the flipped classroom model was chosen as a model for the application.

4.3 Case 03

Project 03_8-week group work

“The project aims to design an event for migrant children between the ages of 3-13 from different countries, using different languages and with diverse cultural backgrounds in İzmir. The main purpose of this event is to create meaningful memories via diverse experiences and a reminder of good memories. The physical, operational, and obligational constraints and opportunities, multicultural aspects and needs, and age issues have to be considered.”

In Project 03, an expert was invited to the class, and the brief was given to the students, following by a Q&A session and sharing of experiences related to the project content (Figure 5). Then, the groups were formed. In contrast to the previous experiments, there was no delivery of templates during class hours. The templates, which were revised after the previous project with the additions of more detailed explanations and examples, were shared online and filled out as homework individually beforehand. In the class, the group members shared and discussed their works via their completed templates in order to find a middle ground as a group. The group discussions involved the clarification of misunderstandings, etc., if needed, and collaborative decision-making about the project phases and tasks. Following the re-completion of the templates of each group, the works were presented to the instructor. Different from the previous projects, the students led the discussions with the instructor, who acted as an activator, asking questions to provoke further thinking on the tasks and the project as well as answering questions if the groups had any. Then, the groups revised their works. There were also classes, in which the groups shared their works-in-progress to other groups for class discussion. Before the presentation to the expert, each group prepared a presentation to practice in class and asked for feedback for improvement.

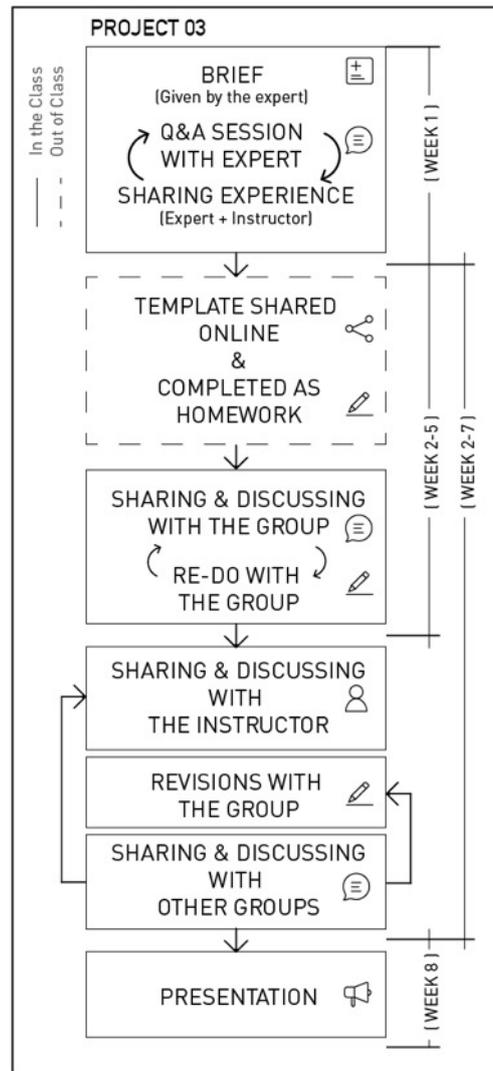


Figure 5. Case 03 Course Flow

Each student and the instructor completed an online reflection form prepared by the researcher both for self-assessment and course-assessment. Both the observations during the project and the reflections indicated that the flipped classroom model, in terms of the delivery and usage of the templates, helped the students engage in a more interactive process of learning during the project, independent of the instructor's dominance, and take the responsibility of their learning processes as well as that of their peers. Moreover, even though the students reflected on themselves and the projects verbally during the previous projects, the online and written reflections helped assess each student's progress and the course as well. The increased interaction in the course flow via the flipped usage of templates was also encouraging for the students to reveal insider knowledge and be more enthusiastic, willing, and open for participation and reflection freely and confidently. This was apparent in the end-of-semester reflections and project outcomes. The reflections contributed to the improvement of the course for the next semester (2017-2018 fall semester).

5 Conclusion

The literature on the Design Thinking pedagogy and the flipped classroom model as a constructivist teaching approach points out the potential of the model to be used in Design Thinking teaching, which is based heavily on practice. The study presented in this paper show that there is a high potential of using templates in projects with a flipped approach since it allows students to develop a deeper understanding and awareness of their insider knowledge and learning journeys and make sense of what they are doing while doing. They are also enabled to take the initiative and responsibility throughout the process through increased peer interaction and collaboration due to the usage of templates as a facilitating LO within groups. The use of technology eases the assessment of students' performances and reflections in the process and serves as an artefact for instructors to assess each student's learning process.

Moreover, the flipped approach in using templates in the course enables students to be prepared for interactive and collaborative in-class activities by exploring and working on tasks beforehand and conceptualizing the subject and tasks in question. Therefore, immediate action is taken in the class with a focus on learning activities and project content, rather than the template only as a LO to be filled out. This enhances the use of time in class hours and allows students to spare more time to understanding and active learning.

Even though none of the students had taken a Design Thinking course before, they were familiar with the design thinking process to a certain extent, since most of them were from design-related departments. Therefore, further work is needed to test how effective the flipped approach is in a Design Thinking course with a larger group of students, who are from a variety of departments that are not design-related and taking the course for the first time. The flipped course flow provided the most satisfactory results among the experimented models. However, qualitative research methods were used in this study. Using quantitative methods as complementary to measure learning might provide more comprehensive results. Despite these limitations, this study indicates the positive implications of the flipped classroom model in practice-based courses, particularly Design Thinking courses in this case. Hopefully, it will open up a new discussion on alternative approaches in this field and inspire researchers to explore future possibilities.

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