Implementing flipped classroom using digital media: A comparison of two demographically different groups perceptions

Babak Sohrabi*, Hamideh Iraj

Department of Information Technology Management, University of Tehran, Jalal Al Ahmad Street, Nasr Bridge, P.O. Box: 14155-6311, Tehran, Iran

Abstract

Flipped classroom is a relatively new model in education that primarily focuses on learner-centered instructions. In other words, the model allows both management and teachers to build a more active and dynamic learning environment on the campus. The current paper tries to document the implementation of the flipped classroom model in two big data courses. Here, the course contents have been curated from a couple of websites with different contents including videos and short books as well as reports. The mixed-method approach was applied while analyzing the student perceptions in demographically two different groups. It was found that students of both groups responded positively to the flipped classroom, with each focusing on their specific goals. Consequently, the first group focused on the academic achievement whereas the second group with managerial jobs focused on solving problems in their workplaces. Students of both groups, although preferred TED talks and documentaries, they were opposed to university-like videos and O’Reilly short books and reports. Meanwhile, the use of English language contents turned out to be both a challenge and an opportunity for students.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Over the past few decades, there has been a surge of new innovations and improvements in the field of Information Technology. The advent of the internet, cheaper and more accessible storage, increasing computing power, new devices such as smartphones, tablets and other mobile apparatus are some of the breakthroughs that helped boost only new digital experience but guided the new generation to change their daily lives and learning habits.

In the present era, there are wider emphases on environments that support multitasking and augment social aspects of learning. However, evidences show that millennial students (those born between 1982 and 2002) have been relying on technologies more than ever while at the same time demonstrating an ever-decreased tolerance for lecture-style presentations. In other words, students have completely different needs and expectations from an educational system, it unsurprisingly necessitates a change in our thinking style. In that given scenario, the aforementioned tools allow us to think about education from scratch and redesign the built-in concepts we used to live with. In other words, this idea necessitated a paradigm shift from the traditional teaching and learning to the active learning strategies and help students in better engaging with their learning environment (Roehl, Reddy, & Shannon, 2013).

2. Background of the study

2.1. Background of flipped classroom

The flipped classroom is a new instructional model that has been widely used in recent years. The simplest definition for this model is: what has been traditionally done during class time i.e. class presentations is shifted to home activities and what has been traditionally done at home i.e. homework and projects are transferred to as class activities. Accordingly, students watch educational videos at home and do their homework during the class hours with the help of classmates and under the supervision of instructors (Chen, Wang, Kinshuk, & Chen, 2014; Lage, Platt, & Treglia, 2000).

The flipped classroom was initiated by two high school teachers-Jonathan Bergmann and Aaron Sams in 2007. The duo recorded the lectures to help absent students keep up with their classmates. For that matter, they also used software and PowerPoint to record the lessons and made them accessible via YouTube. Soon after, they...
observed an unexpected change in their classroom activities: not only had the students who missed the class (Abeysekera & Dawson, 2015) but others too could use the recorded videos. The process helped educators better understand and guide the students with their teachings and assignments. Their role changed as well: now, instead of focusing on teaching, they started observing students in smaller groups and ascertained which group and student need more help and guidance (Johnson, Adams Becker, Estrada, & Freeman, 2014).

The flipped classroom, as a learning model, was brought into the mass attention by Salman Khan who spread the idea through his TED talk (Khan, 2011) and provided educational videos on a broad range of topics through the Khan Academy. Students were instructed to watch course videos at home and do homework in schools, all on a fixed schedule (Chen et al., 2014). Soon, the Khan Academy became one of the main resources for instructors implementing the flipped classroom. In other words, instructors did not need to produce educational videos from scratch rather could curate their flipped classrooms with the help of these videos (Johnson et al., 2014).

Other resources for the flipped classroom include Code Academy, Learners TV (Johnson et al., 2014) TED Talks and a new branch of the TED organization called TED-Ed (Purse & Ziegenfuss, 2015; Roach, 2014). YouTube, Teacher YouTube, Vimeo, itunesU, PBS media, Annenberg Learner and Open Education Resources (OER) are some other popular resources for educational materials (Purse & Ziegenfuss, 2015).

In 2012, the Flipped Learning Network (FLN) was established to provide educators with knowledge, skills, and resources to successfully implement the aforementioned models (Hamdan, McKnight, McKnight, & Arfstrom, 2013). Thereafter, FLN’s Professional Learning Community (formerly called the Ning) started working in this arena. It is a community for instructors who flipped or wish to flip their classes. The interest in the flipped learning can be easily measured by the number of participants in this community i.e. in January 2012, there were 2500 members that rose to 10,000 by June 2013 and more than 23,000 signed up for the website as of February last year (Flipped Learning Network, 2015; Yarbro, Arfstrom, McKnight, & McKnight, 2014).

The concept of the flipped classroom has been implemented and adopted in many different schools and universities around the world. The idea was first triggered in schools and later brought into universities (Johnson et al., 2014). During a literature review on this subject in June 2012, Bishop and Verleger found 24 studies related to the flipped classroom where student perceptions were quite positive and persistent (Bishop & Verleger, 2013). In 2014, yet another study by the Flipped Learning Network listed universities that could incorporate the flipped learning model in different field of studies. That list includes the University of British Columbia, the University of Memphis, the University of North Carolina, Chapel Hill, Texas A&M University, the Capital University, the Georgia Institute of Technology and Harvey Mudd College. In most of these cases, students were found not only scoring better in exams but were satisfied with the new model (Yarbro et al., 2014). In addition, the flipped classrooms helped develop the Information Literacy and Critical Thinking skills which are considered two important parts of the 21st century teaching (Kong, 2014).

However, the idea of a flipped classroom has roots in earlier times before the term “flipped classroom” was coined. The National Center for Academic Transformation (NCAT) had implemented similar ideas in different disciplines over the past years (Findlay-Thompson & Mombourquette, 2014). A seminal paper to mention is “From Sage on the Stage to Guide on the Side” by Alison King in 1993. In this paper, problems and inadequacies of the transmittal model for teaching were discussed and a constructivist model was proposed as an alternative. Moreover, she elaborated on the process of transformation from a typical lecture-base course to adding active learning activities and finally implementing cooperative learning as an alternative to lectures (King, 1993).

Lage, Platt and Treglia implemented a similar model back in 2000 which they referred to as “the inverted classroom”. They used this model for five sections of an economics course. The final survey revealed that the student perceptions were positive: they enjoyed asking questions, learning from peers and studying video lectures at their own pace (Lage et al., 2000). As early as 1982, Baker also had an idea of flipping the classroom but for accomplishing his goal, there had been delivery barriers which could disappear with the advent of the learning management and content management systems in the later stage. Baker presented his works to conferences between 1996 and 1998 and he called the new model “the Classroom Flip” (Baker, 2000).

2.2. Theories and concepts behind flipped classroom

Student-centered learning is a set of theories and methods behind the flipped classroom. They shift the focus and responsibility of learning from educators to students. Students partake actively in the learning and for doing so; they rely on developing their autonomy and independence. The educators’ role is more a facilitator than being a mere instructor (Jones, 2007, p. 44).

The student-centered learning is based on the constructivism learning theory that postulates the learning as an active constructive process. In constructivism view, knowledge is constructed by learners as they attempt to understand their experiences i.e. learning is acquired when new information is linked to prior knowledge. In other words, learning is an active contextualized process of constructing the knowledge rather than acquiring it. Since learners are active organisms looking for meaning regardless of the subject being learned, consequently, this theory contrasts behavioral and cognitive information processing learning theories which have an objective view on knowledge. On the learning process, learners are forming, elaborating and testing mental structures until a satisfactory one emerges. In the meanwhile, an instructor has the responsibility to provide complex and realistic learning environment to support learners’ efforts and challenge them to identify and solve them.

This theory has multiple roots in psychology and philosophy including cognitive and developmental perspectives of Piaget, interactional and cultural emphases of Bruner and Vygotsky, the philosophies of Dewey and Goodman and the ecological psychology of Gibson (Driscoll, 2004).

Bishop and Verleger described the student-centered learning as a set of theories including constructivism, active learning, peer-assisted learning which is described as follows (Bishop & Verleger, 2013):

Active learning is defined as “any instructional method that engages students in the learning process. In short, the active learning requires students to do meaningful learning activities and think about what they are doing”. To differentiate activities from the traditional ones such as homework are systematically dismissed by explicit exclusion (Prince, 2004).

The Peer-Assisted Learning is defined as: “the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions”. One of the pioneers of this theory is Eric Mazur from the Harvard University (Hamdan et al., 2013). In one of his works entitled “Peer Instruction: Getting Students to Think in Class”, Mazur used peer learning in order to help students understand the course materials better and give quick
feedback to the instructor (Mazur, 1997).

Hamdan et al. considered priming, pre-training and diverse learners as well as active learning and peer instruction as foundations of the flipped classrooms (Hamdan et al., 2013).

The priming theory explains retrieving information from memory. When the priming stimulus exists in learners’ minds and associated with a set of events i.e. previously learned concepts; learners can better recall the new concept hence, the prime and target concept can work together as a compound cue and produce familiarity via interacting with memory (Bodie, Powers, & Fitch-Hauser, 2006). The relationship between the priming and the flipped classroom is based on direct instruction out of classroom in which learners are primed for active learning tasks done in the flipped classroom (Hamdan et al., 2013).

The idea of the pre-training is to reduce the cognitive load on learners and by doing so enabling them to process information efficiently. Studies found a significant relationship between mental effort and pre-training for students arguing that in the case of receiving pre-training; students need fewer cognitive resources to learn new concepts (Hamdan et al., 2013). The idea of diverse learners seeks the ways in which implementing the flipped classroom can make a difference in learning experience for different subgroups. In other words, the question is: does struggling learners benefit from flipped classrooms? Although this idea is under-researched, a probable scenario is that it helps learners with lower proficiency in course subjects to improve their understanding before class. They can pause, rewind and review the lesson at any time so they will enter the class more prepared (Hamdan et al., 2013; Davies, Dean, & Ball, 2013).

One of the early works on this topic belongs to Lage et al. They discovered that the inverted environment offers more affordances to students and ameliorates the learning environment for varying learner types (Lage et al., 2000). Another work by Strayer showed that students perceived their personal learning types were being met (Strayer, 2012).

Abeysekera and Dawson, in their 2015 research, analyzed the flipped classroom through two pedagogical theories: self-determination and cognitive load. Since the flipped classroom success depends on learners’ out of class performance, they should stay motivated to perform well independently. Using the flipped classroom approach, students’ level of motivation as an outcome of the learning environment plays an important role in the satisfaction of their basic cognitive needs. Therefore, applying the self-determination theory helps students keep motivated for creating a better learning experience.

The Cognitive Load Theory suggests that our working memory is under certain types of load and overloading impedes learning. The flipped classroom can be used to manage the cognitive load and improve learning. In the simplest and most explicit form, being exposed to course materials before the class can mitigate the cognitive load in the classroom time which can be used for active learning activities (Abeysekera & Dawson, 2015).

For designing the flipped classroom in this study, the constructivism learning theory and concepts such as the active learning and the peer-assisted learning have been considered which are discussed in Section 3.3 entitled course activities. Also, the idea of diverse learners i.e. using the flipped classroom for demographically diverse learners has been the basis of the current research which is elaborated in Section 3.1 as research design. Moreover, the use of video contents enabled the researchers to prime and pre-train students before the class time.

2.3. Background of measuring perception in flipped classrooms

Previous researches took into account different aspects of flipped classrooms such as perception, engagement, motivation, active learning and achievement. Furthermore, researchers could also explore the relationships among these variables. For instance, Snowden’s findings show no significant difference between the student perception and achievement in the traditional and the flipped learning experience (Osman, Jamaludin, & Mokhtar, 2014).

In his graduate review, Bormann grouped what he called the flipped learning affordances and classified them into three groups consisting of the flipped learning versus the traditional learning (measuring perceptions), the flipped learning and the engagement and the flipped learning and the achievement. In other words, he enlisted studies that measured student perceptions between a traditional classroom and a flipped one. Of the five quantitative studies in the list, a majority of students preferred the flipped classroom versus the traditional model with a minimum of 80% and a maximum of 88.2% among the five studies and the remaining six studies showed a significant preference for the flipped environment (Bormann, 2014).

Chen, Yang and Hsiao explored two student perceptions in a flipped pre-calculus course: situational interest (consisting of feeling, value and topic interest) and course satisfaction (consisting of course design, system quality, course arrangement and online assessments). They also evaluated students’ feedback and gender differences to complement their research and gain a better understanding of the flipped class. The results showed that both females and males performed equally well in this course even though they had different topic interests. Moreover, feelings turned out to be a predictor of final grades in males whereas the course design happened to predict the final grades in females (Chen, Yang, & Hsiao, 2015).

The current research aims to investigate student perceptions to get an understanding of the flipped model in students’ eyes.

2.4. Flipped classroom in different disciplines and courses

Student perceptions of the flipped classroom are generally positive. However, a few studies reported some negative opinions too, which on the other hand, raise the hypothesis that the flipped classroom may not be applicable to all subjects (O’Flaherty & Phillips, 2015).

The flipped classroom approach has been used for years in some disciplines, most notably within the humanities and the sciences (Saunlir, 2014). Some other examples are: systems analysis & design course (Saunlir, 2014), economics (Roach, 2014), pharmaceutics (McLaughlin et al., 2014), calculus (Sahin, Cavlazoglu, & Zeytuncu, 2015), nutrition (Beth Gilboy, Heinerichs, & Pazzaglia, 2015), electronic systems engineering (Wagner, Lafortune, & Cripps, 2013) and a spreadsheets course in information systems (Davies et al., 2013; Furse & Ziegenfuss, 2015).

However, in the IT domain, there are only a handful of papers that have reported the implementation of the flipped classroom such as Murray, Koziniec and McGill’s work in the Introduction to Server Environments and Architectures (ISEA) (Murray, Koziniec, & McGill, 2015). The research is the first effort to implement the flipped classroom model in a big data class.

2.5. Designing content in flipped classrooms

Course contents in previous studies were created using different ways. Some instructors used their own class lecture videos, but many others did not consider them to be the best method for flipped classes (Coley, Hanita, & Cobb, 2013). In majority of courses, video contents are designed from scratch including (Johnson, 2013). However, a researcher used intelligent tutoring systems (Strayer, 2012) and in another case, a researcher curated the
contents from online resources (Roach, 2014).

Curating makes the designing process faster and more cost-effective. Moreover, it enables researchers to compare various resources with different teaching styles. However, it adds challenges to homogeneity and integrity of contents which are essential to building a coherent course.

3. Research methodology

3.1. Research design

Implementing the flipped classroom was an effort to bring in new methods of teaching and learning. The newness of the model and the diversity in students’ demographics were the reasons the researchers embarked on the current study. In other words, the research was aimed at exploring the effects of unique features of this study including the type of course contents, English language and belonging to two demographic groups. A demographic summary of these two groups is demonstrated in Table 1:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Gender</td>
<td>5 Male, 7 Female</td>
<td>11 Male, 1 Female</td>
</tr>
<tr>
<td>Program level</td>
<td>Postgraduate, Second year</td>
<td>Postgraduate, Second year</td>
</tr>
<tr>
<td>Age</td>
<td>23–28</td>
<td>35–60</td>
</tr>
<tr>
<td>Work experience</td>
<td>Three to six years in operational level jobs</td>
<td>More than twenty years in managerial jobs</td>
</tr>
</tbody>
</table>

Research questions:

1. How student perceptions toward the flipped classroom differ between the two groups?
2. How students in both the groups respond to different resources?
3. What is the students’ attitude toward the course contents in English?

This is the first study in implementing the flipped classroom for two big data courses in Iran. It was conducted for two classes, each comprising 12 students: They were studying on-campus and traditionally had face to face classes. “Introduction to Big Data” course was taught to both the groups for a complete one semester (17 weeks) sharing the same instructor. Students of these two groups received the same course outline and contents with the same assignments and exams. Also, similar course loads and schedules were set for both.

All the students were asked to complete a questionnaire consisting of 18 Likert-type questions with five options ranging from Strongly Disagree (1) to Strongly Agree (5) which is the basis for quantitative analysis and three open-ended questions at the last session of the course. All students completed the questionnaire. The first 12 Likert-type questions were adapted from the Student Perception of Instruction Questionnaire (SPIQ) (Johnson & Renner, 2012). Reliability of the survey instrument was measured by Cronbach’s Alpha (Fraser, Tregust, & Dennis, 1986).

To gain a better understanding of student perceptions about the research questions 1–3, a Mixed Method Study design was used. This method, in a way, represents a pragmatic approach: to take the advantage of similarities and differences between the qualitative and the quantitative methods (Yin, 2011, p. 289). According to Yin, “a mixed methods study must retain its identity as a single study addressing a set of research questions that deliberately requires complementary qualitative and quantitative evidence and methods” (Yin, 2011, p. 291). In order to understand the research design better, an outline of the above plan is demonstrated in Table 2:

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q11 I would choose to take another flipped course.</td>
<td>Added Questions.</td>
</tr>
<tr>
<td>Q12 Overall, I considered taking this flipped course.</td>
<td></td>
</tr>
<tr>
<td>Q13 I found university-like videos interesting and useful.</td>
<td></td>
</tr>
<tr>
<td>Q14 I found TED-talks interesting and useful.</td>
<td></td>
</tr>
<tr>
<td>Q15 I found documentaries interesting and useful.</td>
<td></td>
</tr>
<tr>
<td>Q16 I found O’Reilly books interesting and useful.</td>
<td></td>
</tr>
<tr>
<td>Q17 I found watching content in English easy.</td>
<td></td>
</tr>
<tr>
<td>Q18 I found watching content in English useful.</td>
<td></td>
</tr>
<tr>
<td>Q19 How can you describe your experience with the flipped classroom?</td>
<td></td>
</tr>
<tr>
<td>Q20 Which parts of the course contents were the most interesting for you and you learned more from that resource? (University-like videos, TED talks, documentaries, O’Reilly books) and why? How can you describe their advantages and disadvantages?</td>
<td></td>
</tr>
<tr>
<td>Q21 How did you feel about watching videos in English?</td>
<td></td>
</tr>
</tbody>
</table>

3.2. Course contents

The course contents were curated from multiple websites including Coursera, Big Data University and Udemy Courses, TED-talks, YouTube and Vimeo videos as well as books and reports published by O’Reilly media. Researchers tried to select each resource based on its alignment with the university course syllabus. During the course of the study, taking part in Coursera was optional and the researchers focused on its contents rather than the whole experience of taking part in an online course. The videos and books were watched and evaluated one by one through personal
judgment based on the following principles:

- Designing a video-based course to match students’ interests.
- Choosing contents that have enough companion stuff such as subtitles and presentation files in order to facilitate further references and studies.
- Choosing interesting and inspiring videos in order to engage students as much as possible.
- Choosing short and concise books in order to replace long textbooks.

For finding relevant contents, the following websites were explored:

3.2.1. Coursera

Coursera.org is the leader in providing massive open online courses (MOOCs). It holds the largest share of the MOOC market. We investigated Coursera based on their category. The videos were produced using picture-in-picture approach which overlays an instructor’s image and lecture slides. This approach presents an instructor’s recorded image and voice, PowerPoint slides, subtitles, and other flash animation features (Chen & Wu, 2015).

3.2.2. Big Data University

BigDataUniversity.com is an online educational site dedicated to databases, Big Data and Hadoop training. We used the contents related to text mining and cloud computing. The videos in this course were produced using a mixture of picture-in-picture, voice-over type videos and interviews (Chen & Wu, 2015).

3.2.3. Udemy

Udemy.com is an online educational website with more than 30,000 courses and over 7 million viewers. The courses are created by any interested individual or institution. We used a course called Scraping and Data Mining for Beginners and Pros. This Udemy course uses voice-over presentation type (Chen & Wu, 2015).

3.2.4. TED

TED stands for technology, entertainment and design. It is a conference where people share their ideas in a wide range of topics including science and business in a limited time, usually up to 20 min. The videos of the conference are available at TED.com. The idea of using TED-talks in classrooms was triggered by watching “30 days of TED” course (Murphy & Jensen, 2015). The researchers explored TED website based on keywords: data, big data, information, information technology, social network, visualization, statistics, machine learning, open source and so on. Also, a blog by the Berkeley University has a good collection of TED-talks related to data science (TED-Talk Tuesday, 2014).

3.2.5. YouTube and Vimeo websites

The researchers could explore YouTube.com and Vimeo.com with the same keywords used for finding TED-talks. This time, we were looking for documentaries (up to one hour of duration) and other types of videos that do not resemble university lectures.

3.2.6. O'Reilly publication red-covered series in data science

O’Reilly publication is one of the leaders in Information Technology through its technology books, online services, magazines, research, and tech conferences. We investigated OReilly.com and figured out that red-covered books and reports are short documents each explaining some aspect of Information Technology and Data Science. Finding them concise and interesting, we replaced our textbooks with these newly found books (Get Free Strata Reports, 2014).

In the following sections, the aforementioned six resources are named as university-like videos including Coursera, Big Data University and Udemy course contents, TED-talks, documentaries including YouTube and Vimeo website videos and O’Reilly books.

3.3. Course activities

The most important part of the flipped classroom is in-class activities, not the videos. In fact, these activities and peer-learning are at the center of the flipped classes where instructors can use the freed up in-class time to work closely with groups and students to figure out whether or not they understood the course contents (Coley et al., 2013).

According to Bloom’s revised taxonomy, students do the basic level of the cognitive process dimension (Remember, Understand and Apply) at home when they read or watch videos on their own whereas they do higher levels (Analyze, Evaluate and Create) when they are in class, supported by their peers and guided by instructors (Brante, 2013; Krathwohl, 2002).

The activities for the proposed course are divided into three parts: pre-session, during the session and post-session as depicted in Table 3. These activities are designed to align with a revised edition of Bloom’s Taxonomy (Krathwohl, 2002).

3.4. Data analysis

As mentioned, the current research primarily intended to compare the perceptions of the flipped classroom in two groups of students with different demographics as well as to understand the nature of the differences for improvement. Serving that purpose, a mixed-method was used according to what Yin had suggested: “An evaluation aimed at assessing whether or not an intervention is effective might call for a quantitative study; however, an evaluation aimed at assessing the nature of the intervention and its implementation might call for a qualitative study. And evaluations involving both types of questions might call for having both quantitative and qualitative components” (Yin, 2011, p. 287).

The data analysis started by analyzing quantitative data then continued by qualitative ones which is an iterative process of examining and coding to find the underlying themes in student’s answers. The researchers integrated the quantitative and qualitative results in order to interpret the data.

For analyzing the quantitative data, the researchers used

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Questionnaire items</th>
<th>Analysis method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 How student perceptions toward flipped classroom differ between the two groups?</td>
<td>Questions 1–12 (Likert-type) and Question 19 (Open-ended)</td>
<td>Quantitative method (Mann–Whitney U test) Qualitative method (Thematic Analysis)</td>
</tr>
<tr>
<td>2 How students in both the groups respond to different resources?</td>
<td>Questions 13–16 (Likert-type) and Question 20 (Open-ended)</td>
<td>Quantitative method (Mann–Whitney U test) Qualitative method (Thematic Analysis)</td>
</tr>
<tr>
<td>3 What is the students’ attitude toward the course contents in English?</td>
<td>Question 17–18 (Likert-type) and Question 21 (Open-ended)</td>
<td>Quantitative method (Mann–Whitney U test) Qualitative Method (Thematic Analysis)</td>
</tr>
</tbody>
</table>

Table 2
The research outline.
Nonparametric Statistics that are defined as: “A large number of techniques of inference which do not make numerous or stringent assumptions about parameters. These newer “distribution-free” or nonparametric techniques result in conclusions which require fewer qualifications,” (Siegel & Castellan, 1988, p. 3).

Further, the current study used the Wilcoxon—Mann—Whitney (WMW) Test also known as Mann—Whitney U Test, Mann—Whitney—Wilcoxon Test, or Wilcoxon rank-sum Test. It is a nonparametric test for assessing whether two samples come from the same distribution when at least ordinal measurement has been achieved. It is the most useful alternative to the parametric t-test when a researcher wishes to avoid the t-test’s assumptions or when the measurement in a research is weaker than interval scaling (Siegel & Castellan, 1988, p. 116). In the case of the current study, the Mann—Whitney U Test was used because the study employs two independent and small samples and ordinal data has been collected from Likert-type questions.

Investigating the qualitative data, students’ responses to three open-ended questions were analyzed thematically that emerged during the research to the point at which no more themes were derived (Lacey & Luff, 2001).

The coding process started by gathering data, coding responses and grouping by the similarity in an iterative manner until the point that themes represent the qualitative data properly. Moreover, quotes from original texts were added to support the final themes and give a better understanding of the theme being discussed.

Meanwhile, to ensure that the analysis process including coding remains systematic and homogeneous, the researchers analyzed a 20 percent sample independently in the beginning of the coding process. A percentage agreement based on Cohen’s Kappa was calculated afterward which turned out to be 0.85 (Cohen, 1960). That helped the researchers review their coding and do the whole analysis systematically and accurately.

As Patton states, “triangulation within a qualitative inquiry strategy can be attained by combining both interviews and observations” (Patton, 2002, p. 248). Another definition of triangulation is “combining several qualitative methods but it also means combining qualitative and quantitative methods. Here, different methodological perspectives complement each other in the study of an issue and this is conceived as the complementary compensation of the weaknesses and blind spots of each single method” (Flick, 2009, pp. 26–27).

Here, the qualitative data was triangulated by the instructor observations during face-to-face sessions, re-listening to audio records of the sessions and interviewing students two months after the course was over and grades were published. The other researcher interviewed the students during the semester to gain insight and feedback and improve the class environment. In other words, the data is triangulated by both definitions: combining several qualitative methods or combining both qualitative and quantitative methods.

In addition to the triangulating qualitative data, these independent interviews helped the researchers in mitigating the probable students’ inclination for pleasing the instructor in answering more positively thus leading to bias outcomes.

4. Results

4.1. Quantitative results

This study contains a quantitative analysis to compare student perceptions in two independent groups (answering the research question 1). The Mann—Whitney U test (Siegel & Castellan, 1988) was employed to check the following set of hypotheses for each question:

H0. Student perceptions do not differ between Group1 and Group2.

H1. Student perceptions differ between Group1 and Group2.

Calculations were done using coined package (Hothorn, Hornik, Van de Wiel, & Zeileis, 2015) in R statistical software version 3.2.0 for Windows. Because of the ordinal type of the data captured by Likert-style questions, median and range were applied to represent data for each question per group. Exact p-values were calculated through the Mann—Whitney U test method. The results are summarized in Table 4:

As Table 4 suggests, in the case of Questions 2, 4 and 5, P-value is smaller than ten percent hence, we can reject the null hypothesis and conclude that student perceptions differ between Group1 and Group 2. In other cases, the perceptions of the two groups are not significantly different.

In the case of Question 2, the two groups turned out to be different, showing a P-value of 0.08. This, in turn, raises the question that which group believed that they communicated more with the instructor. To answer this question, the following set of one-sided hypotheses is defined:

H0. Students of Group 1 and Group 2 communicated equally with the instructor.

H1. Students of Group 2 communicated with the instructor more than the students of Group 1.

The same Mann—Whitney U test, this time with a one-sided hypothesis was used and P-value of 0.04 was observed. As such, Group 2 students of were found communicating more with the instructor than the students of the Group 1.

Similarly, in case of Questions 4 and 5, a one-sided hypothesis was tested to figure out if any of the groups holds higher values. The result of Question 4 shows that the Group 1 students held higher values (P-value = 0.04) whereas the Group 2 students held higher values (P-value = 0.05) according to the result of Question 5.

For measuring the internal consistency reliability of the quantitative Likert-type questions, Cronbach’s Alpha was calculated. The result was 2% above the 70% threshold and thus considered to be acceptable.

4.2. Qualitative results

The quantitative analysis was conducted with the aim to delve
deeper into the perceptions of both student groups, clarifying the results of quantitative analysis in answering the research question 1, 2 and 3. That was done by adding the following open-ended questions to the questionnaire:

Q19- How can you describe your experience with the flipped classroom? What you liked/disliked about the flipped class? What were your troubles and concerns regarding the new model? (Answering research Question 1)

Q20- Which parts of the course contents were the most interesting for you and you learned more from that resource? (University-like videos, TED talks, documentaries, O’Reilly books) and why? How can you describe their advantages and disadvantages? (Answering research Question 2)

Q21- How did you feel about watching videos in English? (Answering research Question 3)

### 4.2.1. Perceptions about flipped model

Answering Question 13 (perceptions about the flipped classroom), students had a wide variety of opinions toward the flipped model. In answering this question, the following themes were observed namely: positive opinions, independent learning, negative opinions and confusion.

#### 4.2.1.1. Positive opinions

A student from Group 1 wrote: “Watching videos before the class gave me an idea of the contents structure and helped me understand the contents better”. Another student from Group 1 added: “It was useful and interesting. Watching the videos encouraged me to learn them in my own way.” And an idea from a student of Group 2: “I think this transformation helps the students learn deeply. I consider the new model engaging.”

#### 4.2.1.2. Independent learning

And another idea from a student of Group 1: “During the class, I learned to study on my own and I am no longer dependent on my professor”. Another student of Group 2 enlisted some of the courses he/she was taking on different course providers to study on his/her own. The researchers can conclude that the new model gave students of both groups self-confidence to learn on their own and created the habit of using online resources for personal development. This theme is quite similar to “preparing students” and “student empowerment” in Bormann’s review of affordances of the flipped learning (Bormann, 2014).

#### 4.2.1.3. Negative opinions

However, some students expressed negative views about the new model. A student of Group 1 preferred lecture-based classes and said: “I think this method won’t work because students have different backgrounds. It is better that the professor explains the topics”. A student from Group 2 associated the success of the model to the time spent before the class: “This method works for younger students who have enough time to study before the sessions”. He/she added: “I was worried that the course contents were too diverse and inhomogeneous”.

#### 4.2.1.4. Confusion

Students of both groups were confused in the beginning of the semester mainly because of initial troubles and concerns. As one student from Group 1 wrote: “I was wondering how our final exam would be. I could not predict it. How are we going to study based on videos?” this concern happened to be a typical one among students of Group 1. As another example, one student wrote: “I was very worried about the new model but after two or three weeks I realized its advantages”. The confusion is consistent with results of (Baepler, Walker, & Driessen, 2014) and is roughly equivalent to “being lost” in the study by Strayer (Strayer, 2012).

Interestingly, this confusion was toward different directions. Students of Group 1 were worried about dealing with projects, exam and how to pass the course while students of Group 2 were more concerned with doing the activities and making sense of them. As one of the Group 2 students wrote: “We’ve never seen such a model and we didn’t know what we were expected to do in the class but we were excited that we had more time to ask questions and raise our issues.”

### 4.2.2. Perceptions about different resources

Answering Question 14, TED-talks were by far the most popular...
in both groups. Group 1 students were interested in these videos because they are interesting and concise and they gave them ideas for further study and research. A student from Group 1 mentioned: “One of TED-talks encouraged me to do my thesis relevant to the topic. After watching the video, I searched on the internet for the speaker and found insightful ideas on his blog and I spoke with my professor about my research thesis”. This is an evidence that the student was engaged in the course contents. Meanwhile, students of Group 2 did like TED-talks for improving their soft skills and helping them become more data-driven. A student from Group 2 wrote: “I learned how to think about data. We have been too obsessed with software, not data. Having watched TED talks, I learned to think about the value of data and how to ask for data when I receive organizational information from my employees and how to ask for data to test my intuition.”

Documentaries stood on the second place in both groups. 5 out of 12 responses in both the groups considered documentaries as interesting. Both liked documentaries for the same reason: they did not resemble university courses and students did not feel they were studying. They learned by entertaining themselves. One student from Group 1 wrote: “I never imagined I can learn from documentaries” while one student of Group 2 wrote: “The documentary about big data made me think about my job. How can I use data in my job?”

In the case of the current study, the students preferred TED-talks, documentaries and YouTube videos more than the videos resembling university lectures such as Coursera hence; complied with the findings of Roach (Roach, 2014).

The main concern amongst students of both groups regarding course contents was integrity. As one student of Group 1 wrote: “The resources were interesting but it was difficult for me to connect them” and another student of Group 2 wrote: “I was worried about the integrity of resources. They were confusing”.

4.2.3. Perceptions about course contents in English

While answering Question 15, (about the English language), students of both the groups shared similar views. Two themes were discovered in response to the question: English content as a challenge and English content as an opportunity.

4.2.3.1. English content as a challenge. It was a challenge for both groups as a student of Group 1 wrote: “I could not comprehend English videos well and re-watching them takes a lot of my time”. Another student from Group 2 wrote: “It reinforced my English listening but my learning became too slow and turtle-like in the beginning.” Or another idea from a student of Group 1: “It is necessary to learn in English but sometimes it lead to misunderstanding”. In order to facilitate English comprehension, the students of Group 1 proposed subtitles. On the other hand, the students of Group 2 asked for bilingual content i.e. content in both English and Persian.

4.2.3.2. English content as an opportunity. Contents in English was considered to be an opportunity for both groups as well. As an example, a student of Group 1 wrote: “I prefer contents in English because many new topics are not translated and the available translations do not tell the whole story.” Another student from Group 1 went on further suggesting: “I think the resources should be in English and students must practice English speaking as well.”

4.3. Interpreting results

Interpreting the results in a mixed-method study that has been explained by Robert Yin: “a mixed methods study is not being done if an initial set of interpretations and conclusions is drawn solely on the basis of either the qualitative or the quantitative method, apart from another initial set of interpretations and conclusions based solely on other type of method. In such situations, the ideal analysis also would reflect an integrated relationship between qualitative and quantitative components: Both the quantitative and the qualitative data would be analyzed and interpreted together, before arriving at a study’s main conclusion(s)” (Yin, 2011, p. 291). Therefore, in this section, the researchers intend to interpret data in answering research questions regarding quantitative and qualitative results.

4.3.1. Research question 1 – general perceptions

The synthesis of quantitative and qualitative results reveals that the target groups accepted the model quite well. As a matter of fact, Questions 11 and 12 had positive results. 10 out of 12 students in Group 1 and 12 out of 12 students of Group 2 (100%) agreed or strongly agreed that they considered taking this flipped course (Question 12). As one student of Group 1 wrote: “I got a lot of new ideas and new insights from this course. I learned a lot thanks to the new model”. Another student from Group 2 wrote: “We had a lot of boring and meaningless courses and we considered this course an instance of those previous ones. Unexpectedly, this course brought fresh air. I wish we could have more classes with this model. Moreover, “9 out of 12 students of Group 1 (75%) and 10 out of 12 students from Group 2 (83.3%) agreed or strongly agreed that they will choose to take another flipped course (Question 11).”

As demonstrated in the quantitative section, the students of Group 2 communicated more with the instructor (Question 2, P-value = 0.04) which is also confirmed by observations of the instructor and quotes from the students. Students of Group 2 were mainly concerned about practical applications of the course in their managerial jobs and looked at the flipped class (both the contents and class discussions) as an opportunity to raise their problems in the workplace and find solutions. They considered the flipped class a place to gather with other managers from different organizations (which could hardly be done in the out-of-class environment because of time limitations) and they looked at the instructor as a consultant and “a guide on the side” rather than “a sage on the stage”. As a result, they took advantage of the “loose atmosphere” as mentioned in Strayer’s paper created by the flipped classroom (Strayer, 2012).

An example is a quote about TED-talks restated here: “I learned how to think about data. We have been too obsessed with software, not data. Having watched TED talks, I learned to think about the value of data and how to ask for data when I receive organizational information from my employees and how to ask for data to test my intuition.” Another example is the quote about documentaries: “The documentary about big data made me think about my job. How can I use data in my job?”

For the same reason, they were more involved in learning activities and made sense of them as survey results reported higher attribution of learning activities to real life applications for group 2 students. This was measured by question five (the learning activities I worked on deal with real life applications and information in this course) in which a one-sided hypothesis test yielded a P-value of 0.05.

On the other hand, the students of Group 1 learned more in this course in comparison to students of Group 2 (Question 4, P-value = 0.04). The researchers attribute this to different perceptions of learning between these two groups. The first group perceived learning as getting skills for their academic achievements and haunting new jobs whereas the second group sought to solve real problems in their managerial jobs.
4.3.2. Research question 2 — different resources

This section focuses on students’ attitude toward the university-like videos, TED-talks, documentaries and O’Reilly books.

Surprisingly, university-like courses were not popular in any of the groups. Only four out of 12 students from Group 1 and three out of 12 in Group 2 found university-like videos interesting. A high P-value of 0.64 shows a unanimous non-positive attitude toward university-like courses. In addition, none of the students explained explicitly why university-like courses were not interesting. A few student mentioned inhomogeneous content (curated from different resources) was a barrier to a better understanding of the contents. However, it is questionable whether the homogeneous content in university-like formats would solve this problem.

Probable scenarios for future studies are first, using the Khan-style video lectures (Chen & Wu, 2015) (which were not used for this course) to see if they make a difference and second, using a fully online course to mitigate inhomogeneity in university-like contents.

Answering research Question 2, TED talks were by far the most popular in both groups. 10 out of 12 responses in the Group 1 and 9 out of 12 responses in the Group 2 considered the TED-talks interesting. As stated in Table 4, per each student of the two groups were not significantly different and both had their own use of the TED-talks according to the qualitative results. Both groups agreed that being interesting, concise and right to the point are some the distinguishing characteristic of the TED-talks.

As a result, this kind of under-researched online resource can be taken into account when designing university courses. However, we should keep in mind that the number of TED talks related to academic subjects is limited and finding, watching and filtering those videos and mapping them to the concepts taught in university is time-consuming.

Documentaries won the second place in learning resources popularity with both groups of students using them and perceiving roughly in the same way. This was clear base on quantitative results (P-value = 0.68) and almost the same themes in open-ended questions. Very much like the TED-talks, documentaries were one of the few cases that students watched and mentioned explicitly in the questionnaire. This resource can also be used for designing future courses but it too has some problems discusses in the TED-talks.

Although O’Reilly books were put into the course material for their low volume and being right to the point and practical, they did not work out for this course. They held a median of 3 and a range of 3–4 in both groups. Only three out of 12 students of the Group 1 (25%) and four out of 12 of the Group 2 (33.3%) agreed that O’Reilly books were interesting. More surprisingly, while responding to open-ended questions, none of the students explained why they liked/disliked O’Reilly books hence; these books were not successful in engaging students regardless of the group they belonged to. The researchers conclude that neither students of the Group 1 nor those of the Group 2 were interested in pre-class readings. Therefore, for designing future courses, we cannot rely on these books to engage students and we must find something more interesting.

This finding confirms previous results about the pre-class reading. As a matter of fact, about 70–80 percent of the students did not read the textbook before classes (Heiner, Banet, & Wieman, 2014). Another study came to the conclusion that college students do not generally complete reading assignments (Bishop & Verleger, 2013) and students in an introductory statistics course rarely read the book either prior to or after the class (Winquist & Carlson, 2014) as students reported that reading textbooks are sometimes boring (Hamdan et al., 2013).

4.3.3. Research question 3 — course contents in English

Taking into account the two themes discussed in Section 4.2.3 i.e. English content as a challenge and as an opportunity, the overall results were positive. 10 out of 12 students in the Group 1 (83.3%) and seven out of 12 in the Group 2 (58.3%) considered learning in English necessary and 10 out of 12 (83.3%) in each group found it useful.

As stated in the quantitative results, the perception does not differ significantly between these two groups (P-values of 0.80 and 0.30), nevertheless, the two dealt with the challenge of the English language differently: students of the Group 1 sought to find ways to use English contents easier whereas students of the Group 2 were most probably looking for alternative for English contents. An example is the aforementioned video subtitle and bilingual content.

These findings were very promising since videos and the English language entered the course contents simultaneously and the coincidence could sophisticate the learning process but the aforementioned results demonstrated that the English language was well-received by the students.

5. Challenges

Following are some of the challenges and concerns discussed in the literature:

5.1. Equal access to technology

A frequent concern about the flipped classroom model is that it widens the digital divide. Students who have access to digital devices will over-perform students that have less access to digital devices (Johnson, 2013).

For the sake of the current study, the researchers investigated the issue in two categories: access to computers and access to the high bandwidth internet. Access to computers was not an issue in these two classes. Students of both groups had laptop or PCs and this did not create a divide amongst them. However, access to the high bandwidth internet was a problem as not all students had such connection at home. To mitigate this problem, students received a DVD of all course material including high volume videos to let them concentrate on their learning, not on acquiring course contents.

5.2. Continuation of lecturing

Another concern about the flipped classroom is that it is a new form of lecturing. The differences are as reported by Johnson: In the flipped classroom, lectures are considerably shorter and students are able to watch them at their own pace in desired time and place, alone or with a learning partner (Johnson, 2013).

In spite of these differences, the study confirmed that the concern is a serious one. University-like videos were not popular among students according to Questions 13 (Likert-type) and 20 (open-ended). Students of both the groups preferred TED talks and documentaries which are not didactic and serve only as an indirect form of lecturing. The differences are as reported by Johnson: In the flipped classroom, lectures are considerably shorter and students are able to watch them at their own pace in desired time and place, alone or with a learning partner (Johnson, 2013).

And the rest of this section deals with specific challenges of this study:
5.3. Introducing the flipped classroom

Some of the researchers’ challenges in introducing the flipped classroom model to students were: to explain how to redesign the course to dedicate the in-class time to activities and how these activities will help them learn the course contents.

5.4. Inaccessibility to some websites

At the time of conducting the research, access to some websites was not possible including Coursera, YouTube and Vimeo websites. Logging in Coursera was not possible by an IP from Iran and YouTube and Vimeo were being banned because of governmental regulations. This was a huge barrier to conducting the study because students were supposed to experience different learning resources and the issue could have hindered them from doing so. The researchers finally appealed to offline content on DVD to solve this issue.

6. Limitations

The first limitation, in the course of the research, was the introduction of multiple variables for implementing the flipped classroom including curation as a method of content creation, the use of different resources for learning and English language which were not discussed in the research literature. In the current study, these variables were considered independently and their probable interactions were not measured and discussed so the results are valid on the premise that these variables turn out to be actually independent.

The second limitation pertains to the difference between the two student groups. Since these differences are demographic and could not be mutated by researchers, doing a random assignment was not possible hence: the results cannot be generalized to other students. In addition, the researchers believe that the success of the flipped classroom is a multi-dimensional topic. It depends on many factors including course contents, the percentage of students prepared to flipped classes, active learning strategies, the course in which flipped classroom has been implemented and how the instructor presents the course as a whole. Needless to say, these dimensions make the generalization difficult.

However, the study having been the first of its kind and done thoroughly can spark new ideas for educators and education researchers to use the flipped classroom model for diverse learners, doing customization according to their needs and meeting their expectations. Consequently, this study contributes to the current body of knowledge by proposing new dimensions in the flipped classroom implementation including demographics of course participants, considering curation as a method for content creation and using the English language for non-native students.

7. Conclusion

The two groups selected for this study were different not only in their demographics but also in their expectations and perceptions of learning. The mixed method analysis helped understand students of both the groups. Despite differences, both accepted the model well as shown by the figures and quotes in Section 4.3.1. The researchers conclude that this model can be used in diverse forms and circumstances that have been implemented in the past by different researchers.

According to the quantitative results, the first group reported the learning more from this course and the second group (students with managerial jobs) associated the learning activities with real life applications more than the first group. They also reported more communication with the instructor. In other aspects, being measured quantitatively, no significant difference was observed. Qualitative results demonstrated a new difference: Students of the Group 1 were concerned with their academic achievements (exam, grades, and research) and skills for job markets while students of the Group 2 who had managerial jobs were concerned with problems at their workplace.

The researchers conclude that the flipped classroom can be implemented for different groups of students and can be used as a means to improve the learning experience for students including those with managerial jobs. In the case of designing course contents, first, TED-talks and documentaries are qualified to enter university classes, even at postgraduate level. They can be considered as a candidate in designing courses. Second, doing reading assignments before classes are not well-practiced even with short books and reports and the third; university-like lectures curated from different resources did not gain popularity among students. All these findings indicate that students need to be engaged in learning. They are looking for new ways and environments different from the lecture-style classes.

References


