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Investigating Effects of the Flipped Classroom on the Development of Inferential reading comprehension

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Abstract

The present study aims to investigate effects of the flipped classroom on the development of inferential comprehension at Ibn Tofail University. It also explores students' perceptions of this innovative model. It is worth noting that research on the correlation between the flipped model and inferential comprehension at the university level remains exceedingly limited, not only in the context of Morocco but also in similar research environments. The study employs a quasi-experimental mixed method design, specifically an explanatory sequential approach. In the initial phase, pre- and post-reading comprehension tests are performed to compare the flipped and non-flipped classrooms for any significant differences. In the second phase, a semi-structured interview is carried out to examine students' perceptions of the flipped model. The study comprised 81 undergraduate semester one students from the English department, divided into experimental and control groups. The post-test results have showcased statistically significant advantages in favour of the experimental group. The qualitative results have revealed that the interviewees expressed positive opinions about this innovative teaching model. In conclusion, this study suggests that the flipped model may create a conducive environment for students to actively participate in discussions, engage in critical thinking, and solve problems.

1. INTRODUCTION

Research has shown that reading skills play an important role in helping ESL/EFL learners acquire the English language (Carell et al., 1989). Reading is important not only for understanding but also for broader learning, academic success, and employment (Oakhill et al., 2015). Previous research on reading has emphasized the significance of appropriate inference generation for achieving effective reading comprehension (Cain & Oakhill, 1999; McNamara, 2007; Grabe, 2009). Effective reading entails constructing a coherent mental model of the text, thereby developing a clear understanding of its content. A large body of literature has suggested that both L1 and L2 learners across various educational levels encounter challenges in generating inferences during reading comprehension. It has also indicated that inference deficiency is attributed to different factors. For instance, traditional teacher-centred settings

often limit students' opportunities for deeper cognitive processing of reading materials because students do not have enough time to build schemas for active engagement. To address this issue and improve students' inference generation skills, we propose that implementing the flipped classroom model, emphasizing student-centred learning could effectively foster the development of inference skills in reading comprehension. Research has documented the positive impacts of this model on developing students' engagement (Alsowat, 2016), creative thinking (AL Zahrani, 2015), higher-order thinking skills (Supiandi et al., 2018), collaboration, and problem-solving (O'Flaherty & Phillips, 2015). Nevertheless, a significant research gap remains in the literature regarding the effects of the flipped classroom on improving students' inferential reading comprehension at the university level, not only in Morocco but also in similar educational contexts. The primary objectives of this study are to investigate the effects of the flipped model on the development of inference generation in reading comprehension and to explore students' perspectives towards this innovative model. This mixed-methods study seeks to answer two research questions:

RQ1: Does the flipped classroom model impact students' development of inference generation?

RQ2: What are students' perceptions about the flipped classroom model to enhance inference generation in reading comprehension courses?

1.1. Theoretical Framework

The present study employs Bloom's taxonomy to structure both classroom and homework activities. In their seminal work, *Taxonomy of Educational Objectives*, Bloom et al. (1956) categorize educational goals by complexity levels. Later revised by Anderson and Krathwohl (2001), Bloom's taxonomy divides learning objectives into lower-order thinking skills (knowledge, comprehension, and application) and higher-order thinking skills (analysis, synthesis, and evaluation). These levels are designed to be sequential, meaning that mastery of each level is required before advancing to the next (Nappi, 2017). Using this framework, students are assigned readings and low-cognitive tasks for homework, while class time is dedicated to problem-solving activities, such as answering inferential questions and participating in discussions.

2. REVIEW OF LITERATURE

2.1. The flipped classroom

The flipped classroom model, also known as the "inverted classroom" (Lage et al., 2000) or "classroom flip" (Baker, 2000), is a student-centered approach. It involves moving lectures

and classroom activities outside the classroom, allowing in-class time for problem-solving and direct interaction. Based on constructivist theory, the flipped classroom model consists of two main phases. In the first phase (*content attainment phase*), students gain knowledge at home. In this study, students are assigned to read at home and respond to a set of low-order thinking questions. Accordingly, self-directed learning is emphasized, with learners held accountable for preparing for the in-class activities. In the second phase (*concept application phase*), students apply and evaluate the concepts learned in the first phase under the guidance of the instructor in the classroom. At this stage, students engage in active and cooperative learning (Jensen et al., 2015). The role of the teacher shifts from being the "sage on the stage" (King, 1993) and primary source of knowledge to a guide and facilitator of learning. "This change in function is embedded within the more general shift from what might be termed a 'teacher-centred' model of education to a 'student-centred' model" (Morrison & Navarro, 2014, p. 1). The flipped classroom allows teachers to provide personalized support and address students' learning needs (Bergmann & Sams, 2012).

2.2. Inferential reading comprehension

Existing literature has shown that effective reading comprehension is more than the decoding of printed words; it is a cognitive process of reasoning and thinking (Thorndike, 1917). Rivers (2000) argues that reading comprehension is a "problem-solving behaviour that actively involves the reader in the process of deriving and assigning meaning, drawing on contextual information" (p. 70). The traditional view, rooted in behaviourism, posits that meaning resides in the text itself; readers need to acquire a set of skills for reproducing the content verbatim (Dole et al., 1991). In this case, the reader is a passive recipient of information. Cognitivists, conversely, claim that effective reading comprehension involves using textual clues and background knowledge to construct a model of meaning (Dole et al., 1991). Reading comprehension is then "the construction of the meaning of a written or spoken communication through a reciprocal, holistic interchange of ideas between the interpreter and the message in a particular communicative context" (Harris & Hodges, 1995, p. 39). 'Construction' means the active participation of the reader in constructing meaning. Proficient readers recognize words, link new information to already-acquired knowledge, and employ effective reading strategies such as prediction, inference, and question generation (Westwood, 2008). Reading, in this case, is "purposeful and rational, dependent on the prior knowledge and expectations of the reader (a learner)" (Smith, 1995, p. 22).

Inference generation skill, a fundamental aspect of critical thinking, is the ability to draw conclusions and make educated guesses by utilizing both textual clues and background

knowledge (Lee, 2013). Within the context of reading comprehension, "an inference is information that is retrieved or generated during reading to fill in information that is left implicit in a text" (Kendeou, 2015, p. 161). Essentially, generating inferences necessitates activating one's background knowledge and combining it with textual cues to construct a mental representation of the text's meaning (Nahatame, 2014). Research has documented that the ability to make inferences results in effective reading competence (Cain & Oakhill, 1999). Oakhill (1982) distinguishes between two types of readers: the less-skilled *comprehender* and the skilled *comprehender*. The former lacks the same ability to engage in active cognitive processing as the latter. According to Oakhill (1982), good readers can generate the inferences necessary to understand the implied meaning.

Research has documented that L2 learners generally struggle to construct essential mental representations required for a deep understanding of texts (Yoshida, 2012). However, some studies posit that training students in inference generation could improve their inferential comprehension (Kern, 1989). Nahatame (2014) experimented to assess the predictive inference generation skills of Japanese L2 students using narrative passages. The subjects received effective guidance on generating predictive inferences using a think-aloud methodology. Notably, the results indicated that these subjects could generate inferences only once they were explicitly instructed to do so. When participants were simply tasked with reading the text and completing comprehension exercises, their ability to generate this form of inference diminished.

2.3. Empirical studies on the effects of the flipped classroom on inference skills

While the number of studies on the effects of the flipped classroom on inferential comprehension in L2 contexts is limited, those available demonstrate positive outcomes. One such study conducted by Samiei and Ebadi (2021) in Iran focused on the effects of Webquest-based flipped classrooms in enhancing students' inferential reading comprehension skills. The research, which employed a mixed-methods design featuring IELTS reading test samples and semi-structured interviews, revealed that the flipped model not only deepened students' understanding of reading passages but also offered more time for meaningful classroom engagement, interaction, and problem-solving activities. Furthermore, it facilitated a collaborative and student-centred learning environment. In another study, Ibian (2019) carried out a study in Jordan with EFL students enrolled in the 101 English Communication Skills course at the World Islamic Sciences and Education University in Amman. Using a mixed-methods approach involving pre-and post-tests, a questionnaire, and semi-structured interviews, the study aimed to assess the impact of the flipped classroom model on improving

students' reading comprehension skills and to explore their attitudes towards this approach. The results indicated that implementing the flipped classroom approach resulted in positive outcomes in improving students' reading comprehension abilities. The study also documented favourable perceptions of this instructional method.

3. METHODOLOGY

3.1. Research design

This study examines the effects of the flipped classroom model on the development of inferential comprehension. To conduct this research, a mixed-methods sequential explanatory research design was employed. According to Saunders et al. (2012), the research design is "a framework for data collection and the analysis of data to answer the research questions and meet research objectives, providing reasoned justification for the choice of data sources, data collection methods, and analysis techniques" (p. 680). The present study consists of two main phases: a quantitative phase that makes use of pre-and post-test control groups and aims at investigating the causal relationship between the flipped classroom and inference generation skills, and a qualitative phase that explores students' perspectives on how the flipped classroom model influences the development of inferential comprehension.

3.2. Participants

This study targeted two intact groups of first-semester students enrolled in the Department of English in Kenitra. A total number of 81 students participated in this study.

3.3. Data collection tools

Quantitative and qualitative data collection tools were employed. Reading comprehension pre-/post-tests were used to examine students' inferencing skills before and after the treatment. The tests comprised a set of lower-order and higher-order thinking questions, categorized following Bloom's Taxonomy (1956). The low-processing questions were meant to identify specific details in the text; the high-thinking questions emphasized inferential comprehension of the text as a whole. To enhance the validity and reliability of the quantitative finding and to reduce the potential limitations of adopting a single approach, a qualitative semi-structured interview was implemented as a follow-up. 8 open-ended questions adapted from Yang's (2017) study were used. A sample of 5 students participated in this study.

3.4. Data Analysis

To analyze the quantitative data, SPSS software version 21.0 was utilized. Initially, descriptive statistics were calculated to compare the means, medians (measures of central

tendency), and standard deviations (measures of dispersion or variation) of the control and experimental groups. Subsequently, inferential statistics were applied to determine significant differences between the two groups. To analyze the semi-structured interviews, a content analysis was applied.

4. RESULTS

4.1. Findings of pre-/ post-test study

Part 1 of this study answers the first research question, *does the flipped classroom model impact students' development of inference generation?* The Statistical Package for Social Sciences (SPSS) version 21.0 was employed to provide descriptive and inferential analyses of the results obtained. While the descriptive statistics aimed at comparing the means and standard deviation of pretest and post-test scores, the inferential statistics examined whether there were any significant differences between the experimental and control groups.

4.2. Descriptive statistics analysis of the data

4.1.1. Pre-test scores

Table 1 presents descriptive statistics of the pretest scores. The scores of the two groups are relatively similar for the control group (M=8.17, SD= 2.60) and the experimental group (M=8.26, SD=3.42). This indicates that the scores in the experimental group are more spread out or varied compared to the control group, where the scores are relatively more grouped together.

Table 1: means of pretest scores

Groups	N	Mean	Std. Deviation	Std. Error of Mean
Control group	40	8.17	2.60	.41
Experimental group	41	8.26	3.42	.53

4.1.2. Post-test scores

Table 2 displays the scores of the post-test. The results indicate that, on average, the experimental group achieved higher scores on the post-test (M=13.24, SD=2.27) compared to the control group (M=10.25, SD=3.24). This suggests that the scores in the control group are more spread out or varied compared to the experimental group, where the scores are relatively more assembled.

Table 2. Means of post-test scores

groups	N	Mean	Std. Deviation	Std. Error of Mean
Control group	40	10.25	3.24037	.51235
Experimental group	41	13.24	2.27794	.35575

4.3.Inferential statistics analysis of the data

Table 3 indicates that the independent T-test results for the pretest did not show any significant differences because the p-value was higher than 0.05. However, Levene's test for variance equality revealed a violation of the assumption of equal variances, as the p-value was less than 0.05. The t-test for mean equality, considering unequal variances, yielded a p-value of 0.89, indicating no significant difference between the means of the two groups for the pretest scores. Therefore, we fail to reject the null hypothesis.

Table 3. Independent T-test of the pretest.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
pretest	**Equal variances assumed**	5.422	.022	-.138	79	.891	-.09329	.67641	-1.4396	1.2530
	Equal variances not assumed			-.138	74.586	.890	-.09329	.67415	-1.4364	1.2498

Table 4 shows the results of the independent t-test for the post-test. The Levene's Test for equality of variances indicates that the assumption of equal variances is violated (p-value = 0.028 < 0.05). The t-test for mean equality, assuming equal variances, reveals a significant difference between the groups (p-value = 0.000 < 0.05). Specifically, the experimental group has a significantly higher mean post-test score (-2.993) compared to the control group. The 95% confidence interval for the difference in means ranges from -4.23 to -1.75.

Table 4 Post-test Independent t-test

	Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	5.014	.028	-4.82	79	.000	-2.993	.621	-4.23	-1.75
posttest	**Equal variances not assumed**			-4.80	69.84	.000	-2.993	.623	-4.23	-1.74

4.4.Findings of the semi-structured interviews

To understand students' experience in this study, individual semi-structured interviews were conducted to explore students' reactions to and opinions about the flipped classroom model and its effects on enhancing inference skills. The interviews were meant to answer the second research question, *what are students' opinions about the flipped classroom to enhance inference generation in reading comprehension courses?* The sample incorporated 5 interviewees from the experimental group. The interviews were scheduled before the end of semester 2. Participants experienced both the flipped classroom model in semester one with the researcher and the traditional classroom with another teacher in semester two. The purpose behind this choice was to explore students' reactions and opinions about both experiences. According to Kvale (1996), qualitative research interviews are "attempts to understand the world from the subjects' point of view, [and]to unfold the meaning of peoples' experiences" (p.1). The interview questions were adapted from Yang's (2017).

The interviews were recorded using a smartphone, and the recordings were then stored in a computer database for reviewing and analyzing. After coding and analyzing the interviews, four main themes emerged: Satisfaction, responsibility, engagement, and preference. The satisfaction theme includes terms such as enjoyment, and freedom. The responsibility theme involved students' accountability, preparedness, and autonomy. The engagement terms incorporated terms such as in-class discussions, interactions with teachers, and the development of critical thinking and communication skills. The preference theme was associated with students' preference for the flipped classroom over the traditional classroom.

Overall, the interviewees had positive opinions about the flipped classroom. When asked about their general feelings toward the flipped classroom model, all respondents said that they have enjoyed reading comprehension classes using this innovative model. For instance, Rayhane stated that *"the reading comprehension sessions were enjoyable."* Zaynab added, *"I was very pleased with the way we were taught reading comprehension."* In addition, when asked about their points of view about the flipped classroom, the interviewees mentioned terms such as preparedness, autonomy, and responsibility. One interviewee (Sanae) responded, *"Thanks to the flipped classes, I developed skills of active learning. I developed a sense of responsibility and autonomous learning."* Moreover, the flipped model is found to enhance students' active engagement in the learning process. For example, one interviewee said, *"I had enough time to discuss with my peers and teachers in class. I was offered an opportunity to express different opinions. In-class discussions helped me activate background information*" (Rayhane). Another interview stated, *"Thanks to this way of teaching, I have become an active person. I could read texts and do tasks on my own"* (Zaynab). The flipped classroom also improved students' speaking skills. Asmae said, *"I have developed my speaking skills in class. I can speak freely thanks to the information I bring to class."*

When asked to choose between their experience in semester one (a flipped classroom) or semester two (a traditional classroom), the responses indicate that all participants preferred the first over the second. One participant stated, *"I can say that my experience in semester 1 reading comprehension (flipped classroom) was different from semester 2. In semester 1, I felt that I could understand the texts and react to the ideas being discussed."* (Rayhane).

5. DISCUSSION

5.1. Effects of the flipped classroom model on inference generation

RQ1: ***Does flipped classroom impact students' development of inference making?***

The flipped classroom model has gained considerable attention in recent years and has been the focus of numerous studies across various disciplines. However, research on its impact on inference generation in L2 reading comprehension is still in its early stages. Post-test results indicated that students in the flipped classroom group performed better than those in the non-flipped classroom. Descriptive statistics revealed a significant increase in the mean scores of the experimental group (M=13.24, SD=2.27) compared to the control group (M=10.25, SD=3.24). Furthermore, the independent sample t-test showed statistically significant differences between the treatment group and the control group. This highlights the positive effect of this mode of instruction on students' development of inference generation in reading

comprehension, consistent with existing literature (Samiei & Ebadi, 2021; Karimi & Hamzavi, 2017; Kim et al., 2017; Abaeian & Samadi, 2016).

Samiei and Ebadi found that WebQuest-based flipped classrooms improved EFL students' inferential reading comprehension skills with the treatment group outperforming the control group. Similarly, Karimi and Hamzavi observed development of L2 reading comprehension among Iranian EFL learners in the flipped group compared to the non-flipped group. The coauthors suggested that the success of the flipped model may be attributed to its facilitation of meaningful discussion and problem-solving time. Ebadi and Rahimi (2017) emphasized the positive impact of the WebQuest-based model on high-order thinking skills, such as critical thinking, by providing students with additional time and space for reflection and problem-solving before class. This contributed to the development of inferential reading comprehension skills. In the same line, Kim et al. (2017) indicated that students in flipped classrooms "produced significantly more cognitive comments and demonstrated increased use of reasoning skills involving deeper information processing (e.g., inference) compared to traditional classroom students" (p. 279). As highlighted above, background knowledge plays a pivotal role in generating the inferences necessary for effective reading comprehension. In this study, the extended time offered to students to read texts at their own pace and activate their schema before coming to class likely had a positive effect on their inferential reading skills.

The results also contribute to the existing literature that suggests a positive correlation between the use of the flipped classroom model and the development of high-order thinking skills (Alsowat, 2016; Supiandi et al., 2018), creative thinking (Al-Zahrani, 2015), critical thinking dispositions (Dehghanzadeh & Jafaraghaien, 2018), problem-solving (O'Flaherty & Philips, 2015), and critical thinking skills (Munzil et al., 2020). However, it's important to note that the results obtained in this study appear to contradict some previous research that found no significant differences in students' academic achievements. For example, Smallhorn (2017) found there was no evidence that the flipped classroom contributed to students' scores. The subsequent section discusses the findings of the semi-structured interviews.

5.2.students' opinions about the effectiveness of the flipped classroom

RQ2: ***what are students' opinions about the flipped classroom model to develop inference generation in reading comprehension courses?***

Based on the semi-structured interview findings, the flipped classroom model gained positive opinions, with four key themes emerging: satisfaction, responsibility, engagement, and preference. Students expressed increased satisfaction, aligning with prior studies (Martínez-

Jiménez & Ruiz-Jiménez, 2020). The model also enhanced students' sense of responsibility, promoting self-directed learning and effective preparation (Zainuddin & Perera, 2018; Han, 2015). However, some studies, like LaFee's (2013), questioned its impact on responsibility.

The flipped classroom model enhanced students' active participation and fostered engagement at-home and in-class. Research suggests a link between increased engagement and positive outcomes (Nouri, 2016). This model facilitated more teacher-student interactions, allowing students to communicate, share opinions, and receive personalized feedback (Zappe et al., 2009). Some empirical studies indicated potential improvements in higher-order thinking skills (Alsowat, 2016).

Generally, interviewees favoured the flipped classroom model, reporting a more beneficial experience than traditional classrooms in developing inferential reading comprehension. This aligns with previous research (Kugler et al., 2019; Rothman, 2022). However, not all studies showed a preference for this model. For example, Strayer (2007) conducted a study examining students' attitudes towards the flipped classroom and found that they were less satisfied with how the classroom's structure directed them to take on more active roles in their learning tasks.

In summary, the interview findings support the flipped classroom model's success in increasing student satisfaction, developing responsibility, fostering engagement, and enhancing active participation.

6. CONCLUSION

The purpose of this study was to explore the effects of the flipped classroom model on enhancing inferential comprehension. The quantitative analysis revealed a significant improvement in the reading comprehension test scores for the experimental group following their exposure to the flipped classroom. The results provided evidence of the importance of the flipped model in reading comprehension, aligning with previous research that showed positive effects of the flipped model on inferential comprehension (Karimi & Hamzavi, 2017; Semiei & Ebadi, 2021).

It was found that there is a significant relationship between using a flipped classroom and the development of inferential comprehension. Our results indicate that the experimental group ($M = 13.24$, $SD = 2.27794$) outperformed the control group ($M = 10.25$, $SD = 3.24037$), leading to the conclusion that the flipped classroom environment fosters effective learning.

The qualitative component of our study suggested positive opinions regarding the flipped classroom in the context of the reading comprehension course. The outcomes highlighted an enhancement in students' satisfaction, responsibility, and engagement, supporting the favourable impacts of the flipped model.

The main pedagogical implication drawn from this study is that the flipping model may create an appropriate setting for developing students' higher thinking skills through activities of discussion and problem-solving.

It's worth mentioning that additional factors may have impacted the outcomes of the present study. These factors incorporate aspects such as motivation, attitudes, learners' aptitude for reading texts, and English proficiency. Consequently, future research could explore the collective impact of these factors to generate more meaningful insights. In conclusion, a purely experimental design incorporating both random sampling and random assignment to different groups would have enhanced the study's value.

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