

Evaluating Experiences and Perceptions of Undergraduate Zimbabwean Nutrition Students on Flipped-Classroom Learning: A Mixed Methods Approach

M.P. Dembedza^{1*} and B. Chipurura¹

¹Department of Food, Nutrition and Family Sciences, University of Zimbabwe, P.O. Box MPI67 Mt Pleasant, Harare, Zimbabwe

Abstract:

Background: The “flipped classroom” model is a teaching approach where traditional lectures are conducted out of class, mainly through pre-recorded videos and other teaching material packaged prior to in-class sessions. The conduct time between the teacher and students is replaced by more student-centred, active learning activities such as discussions, presentations and debates. The study aimed to examine how the use of a flipped classroom approach affects the teaching and learning experiences of students and teachers, when compared to the traditional approach, from the perspective of students and lecturer in a Zimbabwean urban university.

Materials and Methods: A prospective cohort study was carried out with a class of 56 students who were taking a specified course in nutrition science at the University of Zimbabwe from August to December 2019. The students received 12 weeks of flipped classroom teaching which mixed pre-recorded lecture videos, class discussions, study material preloaded onto an e-learning platform, debates, quizzes and short regular lectures. Qualitative responses were collected through focus-group discussions (FGDs) with students. Quantitative data was collected by issuance of an individual respondent survey at the beginning of the course with questions on demographic information, perceptions of active learning activities, preferred mode of learning and typical academic engagement behavior. The same instrument was administered again at the end of the course examining the same concepts. SPSS and NVivo data analysis software were used to analyze quantitative and qualitative data respectively.

Results: Most of the Nutrition students at the University of Zimbabwe preferred the flipped classroom learning method, reporting that learning key material prior to class significantly enhanced their learning. Furthermore, it encouraged their engagement in in-class active learning activities with more confidence, motivation and responsibility.

Conclusion: The flipped classroom teaching approach is an effective method that significantly improves students’ learning outcomes. Its efficiency is also highly depended on the quality of the teaching plan, availability and access of resources to both the students and the instructor.

Key Words: Flipped classroom; Students; Perceptions; Zimbabwe; Nutrition

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I. Introduction

With the significant increase of interest in student-centred active learning in higher and tertiary education in recent years, the flipped classroom teaching methodology has drawn interest among educators worldwide^(1,2). The “flipped classroom” model is a teaching approach where traditional lectures are conducted out of class, mainly through pre-recorded videos and other teaching material packaged prior to in-class sessions. The conduct time between the teacher and students is replaced by more student-centred, active learning activities such as discussions, presentations and debates⁽³⁾. This teaching methodology entices students to learn at their own pace outside class using mainly electronic resources and reserves class time for interactive activities and exercises. By so doing, students are more likely to be more active, engaged and enthusiastic during learning⁽¹⁾.

The effectiveness of the flipped classroom approach has been tested in courses of different disciplines in tertiary institutions including the health professions^(4,5). Considerable evidence has shown that the flipped-classroom approach has been well received by students and teachers alike in Asia and America^(6,7). Despite a range of studies having been conducted to examine the efficacy of flipped classroom delivery, to our knowledge, there has been no published studies from a discipline-specific setting in Zimbabwean higher learning institutes.

The most important factors that determine the success of a flipped class is students' level of motivation to undertake substantial out-of-class work including reading pre-class materials and watching videos⁽⁸⁾. The Self-Determination Theory (SDT) framework argues that for one to feel effective and motivated, there are three basic psychological needs that should be fulfilled: need for competence, need for autonomy and need for relatedness^(9,10). The need for competence refers to the feeling of having the ability to complete a task. The need for autonomy refers to the feeling of determination by will when doing a task. The need for relatedness refers to a sense of belonging and support from a group or fellow classmates. It has been suggested that the SDT represents a useful theoretical lens for exploring flipped classrooms⁽¹¹⁾. In the current study, the SDT framework was used in developing interview questions, guide the analyses of qualitative findings and to identify practical implementation strategies. The current study aimed to examine how the use of a flipped classroom approach affects the teaching and learning experiences of students and teachers, when compared to the traditional approach, from the perspective of students and lecturer in a Zimbabwean urban university.

The following research questions were addressed:

1. Were there any differences in the students' learning outcomes between flipped-classroom learning and conventional learning teaching methods
2. What were the participants' overall flipped classroom learning experiences?
3. What were the elements of the flipped classroom approach that students recognized as challenging and require modification; why were these elements challenging and what are some practical solutions?

II. Materials And Methods

This prospective cohort study was carried out with 56 second year students taking the Principles of Nutrition: Micronutrients course while studying towards Bachelor of Science Honors degree in Nutrition Science or Bachelor of Science Honors degree in Food Science and Technology. The course was conducted in the Department of Food, Nutrition and Family Sciences at the University of Zimbabwe between August and December 2019.

Study Design: Prospective cohort study.

Study Location: This study was done at the University of Zimbabwe, Department of Food, Nutrition and Family Sciences.

Study Duration: August 2019 to December 2019.

Sample size: 56 students.

Sample size calculation: The sample size was estimated on the basis of similar studies where a class of students taking the same specified course was selected to participate in such a study regardless of the size of the class.

Subjects & selection method: The study population was drawn from students in their second year of study in the department of Food, Nutrition and Family Sciences who were taking a particular course that semester (Principles of Nutrition: Micronutrients).

Inclusion criteria:

1. University of Zimbabwe student
2. In the Department of Food, Nutrition and Family Sciences
3. Taking Principles of Nutrition: Micronutrients course
4. Either sex
5. Any age

Exclusion criteria:

1. Part-time students
2. Students who were not fully registered

Procedure methodology

The students received 12 weeks of flipped classroom teaching which mixed pre-recorded lecture videos, regular lectures, study material preloaded onto an e-learning platform, debates, quizzes and class discussions. For the online interaction, the researchers chose the TSIME online platform that is indigenous to the University of Zimbabwe. TSIME online could be accessed on computers and both Android and iOS mobile phones whether the user was on or off campus. The online platform also provided text messaging between individual students and the lecturer as well as group messaging. It enabled uploading of audio files, video files and text files in any format. The students were highly familiar with TSIME as they received inception training on its use by the university's computer science department. Other platforms used included the WhatsApp, Quizlet and Google Classroom platforms.

Qualitative responses were collected through focus-group discussions (FGDs) with students. The focus group discussions aimed to probe students' views on flipped classroom sections in four areas: course materials,

class activities, assessment, and how it is compared with the conventional teaching method. Five FGDs, in which the 56 students were divided across, were conducted at the end of the 12 weeks of learning. The discussions were conducted in a university setting and lasted for about 60 minutes each. Quantitative data was collected by issuance of an individual respondent survey at the beginning of the course with questions on demographic information, perceptions of active learning activities, preferred mode of learning and typical academic engagement behavior. The same instrument was administered again at the end of the course examining the same concepts. The individual questionnaire was developed based on the SDT.

Data analysis

The instruments used in the study provided both quantitative and qualitative data hence a mixed methods analysis plan was used. All interviews were audio-taped and transcribed verbatim. Confidentiality was maintained by creating pseudonyms for each participant. Data was analysed by thematic analysis by NVivo 10 software (QSR International, 2013). Select quotes from student responses are reported to reflect findings from the qualitative analysis. Quantitative data was analysed using the Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp, Armonk, NY). Because of the small sample size and use of a 5-point Likert scale, nonparametric tests were done to analyze all data associated with the pre-course survey, post-course survey, and course evaluation instruments.

III. Results

Quantitative Findings

All 56 students completed the pre- and post-course evaluation form. Of the 56 participants, 38 were female and 18 male. The mean participant age was 20.2±1.8 years. To better understand student experiences and perceptions of the flipped classroom, results were analyzed from pre- and post-course surveys. As illustrated by Table 1, there was a significant increase in students’ belief that learning foundational content of a topic prior to coming to class greatly boosted their learning and understanding of the topic in class ($p=0.003$). Similarly, there was a significant increase in students’ acceptance of interactive learning and involvement on in-class activities such as debates and presentations to enhance their learning outcomes ($p=0.01$). Students also reported an improvement of reading assigned study material before attending class under the flipped classroom [4(3-5)] teaching compared to the conventional method of learning [2(1-4)] ($p=0.01$). In the post-course survey, all students reported viewing uploaded pre-recorded lectures or videos at least once weekly, with 7 students viewing video material up to 4 times per week. Student preferences for overall course delivery method demonstrated a significant difference between conventional teaching method and the flipped classroom methodology. At the end of the semester, when the students had experienced the flipped classroom model, 49 students (87.5%) reported that they perceived the flipped classroom to be a more effective and efficient way of learning ($p=0.04$).

Table no. 1: Student perceptions of learning enhancement and engagement activities before and after participation in the flipped-classroom (N=56)

Survey Question ^a	Responses Median, Range		P-value
	Pre-course	Post-course	
Lectures greatly enhance my learning/Pre-recorded lectures greatly enhanced my learning.	3 (2-4)	5 (3-5)	0.06
Studying fundamental content of a topic prior to coming for class greatly enhances(d) my understanding of the topic in class	2 (2-4)	5 (4-5)	0.003*
Interactive learning and in-class activities greatly enhance(d) my learning	4 (3-5)	5 (4-5)	0.01*
I read assigned material prior to coming to class ^b	2 (1-4)	4 (3-5)	0.01*
I think the flipped classroom is a more effective and efficient way to learn.	2 (1-3)	5 (4-5)	0.04*
I am motivated to put more effort in my studies	3 (3-5)	4 (3-5)	0.08
I participate(d) and engage(d) in in-class activities	3 (2-4)	5 (4-5)	0.02*
The time and effort I spent in the classroom is/was worthwhile	3 (2-4)	4 (4-5)	0.10

^aLikert scale items measured on a 5-point scale ranging from 1=strongly disagree to 5=strongly agree, unless otherwise specified,

^bFive-item Likert scale measured as 1=never, 2=rarely, 3=some of the time, 4=most of the time, 5=all the time.

*Denotes a statistically significant p-value, $p<0.05$

Qualitative Findings

The FGDs revealed that in general, the flipped-classroom method of learning was better than the conventional mode of learning. Students clearly expressed how the flipped-classroom method motivated and enhanced the participants to learn and improved their pro-activeness. However, the participants also expressed concern about the challenges they encountered along the semester. The findings in the current section, organized according to the research questions.

SQ1: *Were there any differences in the students' learning outcomes between flipped-classroom learning and conventional learning teaching methods?*

Measurement of learning outcomes was done by comparison of learning outcomes at the beginning of the semester and at the end of it. During the focus group discussions, students expressed how the flipped-classroom learning method pushed them to be pro-active in self-learning and group-learning. They learnt coordination and cooperation with their fellows especially in class activities that required such, for example when they were doing debates, presentations and group quizzes. Students scored better and better at each stage from the inception of the trial. They pointed out that it was due to appreciation and acceptance of the fundamentals of flipped-classroom learning hence they continuously put more and more effort at each stage. Respondent S12 had this to say:

“When we first heard about how we were going to use the flipped-classroom learning style this semester for this course, we thought it was going to be a disaster but as time moved, learning was very enjoyable. I would look forward to coming to class knowing that I had studied and was very knowledgeable on that day's topic. We would look forward to the group quizzes as we knew that our group had prepared very much for it and hoped to come out on top of the class. It did not feel like the lecturer was teaching us but that we were helping each other learn and in exciting ways”

The answer to research question one, therefore, is that students learnt more effectively through the flipped-classroom method resulting in better learning outcomes than the conventional teaching method. This shows that flipped learning met the instructional goal of the class, and proved to be superior to the conventional teaching method.

SQ2: *What were the participants' overall flipped classroom learning experiences?*

The results revealed that the three main themes that came out of the participants' responses were (1) motivation (2) engagement and (3) responsibility. Figure 1 illustrates how most frequently spoken words were distributed around these main themes.

Motivation.

In most cases, the students reported that the flipped method of learning was a good way of learning. The teaching/learning tools used largely motivated them and enticed voluntary participation. Outstanding tools were the in-class debates and group quizzes. Respondents also emphasized that the use of the e-resources such as videos, pre-recorded lectures and study material made it convenient as they were in control of their time of learning outside class. The use of online platforms, in this instance TSIME and WhatsApp, to have discussions and ask questions from fellow students or the lecturer provided a virtual platform where no one felt intimidated not to speak out. Respondent S45 said:

“I prefer to use the online platforms for class. I was more motivated than usual. The advantage is that it is a very convenient way of learning, using my cell phone, I could easily study at any place, any time”.

Many students also mentioned enjoying working with peers, a lively and dynamic learning atmosphere, and a sense of accomplishment. One student (S32) concluded:

“The conventional way of learning, where the lecturer will be standing in front of us and talking the whole time might seem efficient, but it usually leads to poor absorption of what we will be taught and we might barely pay attention anyway. We will not be very active in class”.

Another student (S39) felt that:

“Studying uploaded course material before class shortens the time for learning. It was more interesting and I think that it really was more efficient. I think a lecture-based class is boring to students. I enjoyed the quizzes the most”.

Of importance to note, a few students reported that they did not feel the flipped-classroom method made learning better and that it was inconvenient as they had to use their personal internet connectivity most of the time. Student S7 had this to say:

“I still prefer the conventional way of learning. Unnecessarily hard effort was needed that was not even beneficial but time consuming and in our economy it was difficult to do work at home as there was often no electricity. Group work was also a challenge at times because many of the students were not in university residence.”

Engagement.

Students commented on the quality of engagement they encountered during flipped-classroom learning. Having access to course material uploaded on the e-learning platforms prompted student engagement with course content, which was further strengthened through active-learning exercises when they attended class. In-class learning exercises also facilitated engagement with fellow students and the lecturer. Respondent S41 said:

“I was confident to answer questions in class and taking part in deeper discussions because I came to class after studying so I had good knowledge about the topic. It made me more engaged and interested in the course and I was more prepared to think critically and apply things that I had learnt.”

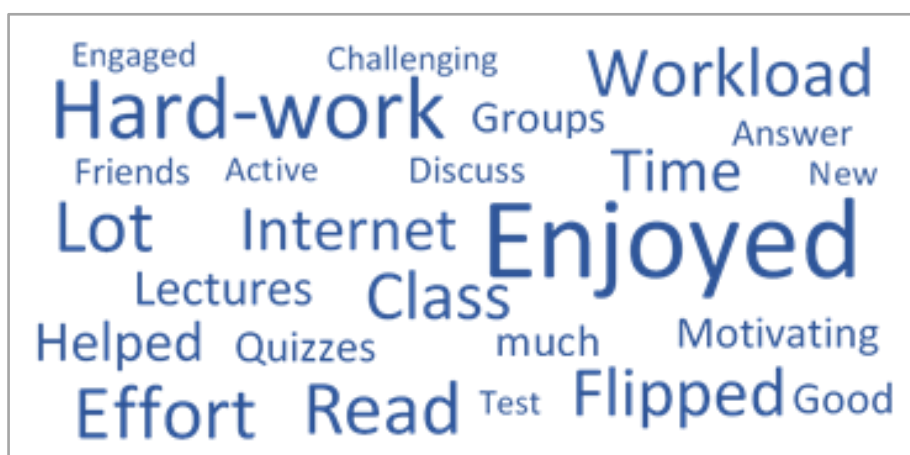


Figure 1: A word tag-cloud of the most frequently spoken words by students narrating their flipped-classroom learning experiences

Students also explained that learning prior coming to class made them engage more with the lecturer as they often would note down questions from where they had not understood. That engagement strengthened relations with their instructor. While responses mostly highlighted how flipped-classroom learning improved engagement, some students noted barriers to engagement. For example, Student S18 said:

“I did not like the exercises we were required to do in pairs. I do not think it enhanced my learning. I was often paired with people who were not enthusiastic and felt I couldn’t discuss course relevant questions because I was not confident that they would know the answer.”

Responsibility:

Students clearly accentuated that the flipped-classroom improved confidence and responsibility. The new learning method gave students independence and self-governance by allowing them to progress through lectures at their own pace, guide themselves to additional content and assess their own learning achievements. Student S02 said:

“Watching the pre-recorded lectures and going through course material kept me ahead in class. I was always well read which gave me confidence in quizzes, discussions and tests.”

In addition, students reported feeling responsible for their learning outcomes and appreciated that if they did not comply and neglected studying assigned course material they would always be behind in class and in assessments likewise. Students also explained that they had come out very good in problem solving, recall, critical thinking and studying itself. Accordingly, the flipped-classroom incited perceptions of growth in content acquisition and higher-order thinking in the students. Student 27 explained:

“Being part of the class that used the flipped-classroom method of learning was hard at first but I really grew to enjoy every moment of it. I learnt what being an independent student meant and involved and I learnt how to study on my own, a skill that is actually very difficult to have. I am now confident that even if all classes are structured like this, I will be able to ace all of them”

Based on these results, the answer to research question two is that the flipped-classroom teaching methodology was well accepted by students and majority of them perceived it to be a high impact teaching/learning method that gave good learning outcomes.

SQ3: What were the elements of the flipped classroom approach that students recognized as challenging?

The interviews asked for the students’ concerns about the flipped-classroom model in terms of its shortcomings. Some students reported that they perceived in-class student presentations negatively because they did not believe that fellow students were able to prepare a presentation with adequate content mastery and good presentation quality. Other students pointed out that adapting to a flipped classroom approach from conventional learning method was overwhelming. A time-limited setting to complete assignments and practicals can be intimidating in the early stages of commencing the flipped-classroom approach.

Students also voiced that having access to all pre-class course materials at the beginning of the course could be more helpful for their learning and preparation for classes. They also stated that viewing long static

videos could be boring hence teaching materials given to students should be tailored-made to their level of understanding. According to the SDT, the success of pre-class study materials can be explained by satisfying students' need for independence as well as competence.

IV. Discussion

The most notable findings of the current study were that (1) students had positive perceptions towards the flipped classroom learning methodology (2) there was a significant increase in the view that studying foundational course content prior to attending class greatly enhances in-class learning and appreciation of the course and (3) the qualitative findings triangulate these findings, clarifying that learning key material prior to class enabled students to engage in in-class active learning exercises with more motivation, confidence, responsibility and enthusiasm.

The findings from the current study agrees with other studies in nutrition sciences field that reported positive student perceptions associated with the flipped classroom learning method⁽¹²⁻¹⁴⁾. As much as active learning has very high perspectives among students, the way the flipped classroom method is implemented cannot be overemphasized. The quality and efficiency of implementation is very important and if ignored the flipped classroom can yield results completely opposite what would be desired⁽²⁾. Student comments clearly expressed a yearning for high-quality engagement with peers and the lecturer regardless of having all the course content at their disposal. Students also voiced concerns about the burden that flipped classroom learning could potentially create if lecturers do not careful take into account overall student workloads.

Table no. 2: Summary of Strategies that can be used to successfully implement the flipped classroom teaching method

Period	Recommended	Not Recommended
Before class	<ul style="list-style-type: none"> • Explain advantages of the flipped approach at the beginning of the course • State clear learning objectives, provide defined and logical guidance during the first lesson • Upload course materials and tasks/assignments • Provide enough time for students to study uploaded material and complete tasks Pre-class material <ul style="list-style-type: none"> - Pre-recorded screencasts or lectures (with lecturer's presence) - Relevant educational videos (not longer than 15 minutes) - Annotated hand-outs - Animated e-books - Online quizzes 	<ul style="list-style-type: none"> • Study materials uploaded at last minute • Long and difficult to understand videos • Assuming all students will have the same level of understanding of study material
In-class	<ul style="list-style-type: none"> • Brief recap of pre-class materials at the beginning of class • Encourage students to apply knowledge gained from pre-class study In-class activities and discussions relevant to pre-class materials <ul style="list-style-type: none"> - Open questions - Individual or group quizzes - Group debates - Pair and share activities - Student presentations 	<ul style="list-style-type: none"> • Repeating pre-issued course study materials
After class	<ul style="list-style-type: none"> • Continuously monitor and evaluate students' adherence to pre-class studying and engagement in class activities • Obtain feedback from students on what worked well and what did not • Discuss and share ideas with colleagues and attend relevant seminars and trainings • Regularly revise and modify lessons and plans to suit students' needs 	

In addition to considering student workload, lecturers must also consider their own time and resources. Designing and implementing course content and in-class activities require thoughtful planning and enough preparatory work. A lot of time and attention is needed for recording and editing lectures, finding appropriate video content and designing in-class activities. Coming up with the right level assignments and practicals is also intensive. Furthermore, the underlying principle of the flipped classroom model is that lecturers and students have seamless access to the appropriate technology and technological support. As some students in the current study highlighted, lack of access to internet connectivity mainly renders the flipped learning method ineffective and poses its rejection by students.

Despite the noted limitations, the flexibility of the flipped classroom teaching model makes it highly adaptable. A large number of research studies across a wide range of disciplines has reported markedly improved learning outcomes using various approaches of the flipped classroom method⁽¹⁵⁻¹⁷⁾. As other institutes, disciplines and individual lecturers consider implementing the flipped classroom model of teaching, authors of the current study believe the flipped classroom will work better when not the whole course teaching plan is flipped. It is still important to have some short lectures conducted the traditional way as this will enhance student-instructor contact that students in the current study highlighted was still needed.

For consideration, a wide selection of offloading course content to students have been shown to effectively improve learning outcomes. Animated e-books, pre-recorded videos and annotated handouts, for example, can all be used to effectively offload course content⁽¹⁸⁻²⁰⁾. Similarly, several in-class active learning strategies are available for engaging students including case-based discussions, panel discussions, team-based learning, quizzes and student debates⁽⁸⁾. Lecturers can choose from this selection and tailor make it for their class. Table 2 presents a summary of recommended strategies to ensure effectiveness of the flipped classroom teaching methodology.

While a comparison of examination scores can provide sight into the impact of the flipped classroom on examination performance, that measure alone does not adequately capture the experiences of students during classes. As the current study was conducted for the duration of a single semester, the authors could not utilize examination grades as there were no grades from the year, for the same class, to compare with. However, results of current study are still very conclusive as they provide insight into the overall impact of the flipped classroom, not just on grades but also on engagement, preferences, and perceptions.

Further research should focus on the longitudinal impact of the flipped classroom teaching method on knowledge and skill retention along with the ability of students to develop sustainable self-regulated learning skills. It is also important to further determine how flipping the conventional teaching method impacts learning outcomes of students in other disciplines, study levels, courses and institutions at large.

V. Conclusion

While passive in-class lecture-based course content delivery remains a sturdy tradition in tertiary education, the need for more dynamic and vibrant methods that enable students to take an active role in the learning process is important. Most of the Nutrition students at the University of Zimbabwe preferred the flipped classroom learning method, reporting that learning key material prior to class significantly enhanced their learning. Furthermore, it encouraged their engagement in in-class active learning activities with more confidence, motivation and responsibility. Ultimately, the quality of the flipped classroom teaching plan, availability and access of resources determine the efficiency of the flipped classroom teaching methodology in improving students' learning outcomes.

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