TRƯỜNG ĐẠI HỌC SƯ PHẠM TP HỒ CHÍ MINH
TẠP CHÍ KHOA HỌC
KHOA HỌC GIÁO DỤC
ISSN: 1859-3100 Tập 15, Số 7 (2018): 22-31

HO CHI MINH CITY UNIVERSITY OF EDUCATION
JOURNAL OF SCIENCE
EDUCATION SCIENCE
Vol. 15, No. 7 (2018): 22-31

Email: tapchikhoahoc@hcmue.edu.vn; Website: http://tckh.hcmue.edu.vn

FLIPPED CLASROOM LEARNING AND INITIAL APPLICATION IN TEACHING "REFRACTION OF LIGHT" IN PHYSICS 11, HIGH SCHOOL EDUCATION

Le Hai My Ngan [1*]***, Le Luong Vu*** [2]

[1]*Physics Department – Ho Chi Minh City University of Education*

[2]*Physics Department, Graduate*

Received: 31/5/2018; Revised: 19/7/2018; Accepted: 25/7/2018

ABSTRACT

Flipped classroom is a blended learning strategy in which the conventional notion of classroom-based learning is inverted, so that students can acquire knowledge through given materials before class, with classroom time then being used to practice and apply concepts and ideas through interaction with peers and teachers as well as to solve some difficult problems. The article presented a general look about Flipped Classroom learning with some videos as well as learning materials at home to teach the chapter "Refraction of light" grade 11, high school education.

Keywords: flipped classroom, refraction of light.

TÓM TẮT

Lớp học đảo ngược và bước đầu áp dụng vào giảng dạy "Khúc xạ ánh sáng" Vật lí 11 THPT

Phương pháp Flipped Classroom bắt đầu bằng việc học sinh tự làm việc với bài giảng trước tại nhà thông qua đọc tài liệu, tóm tắt tài liệu, nghe giảng thông qua các phương tiện hỗ trợ và khai thác tài liệu trên mạng. Bài giảng trở thành bài tập ở nhà mà học sinh phải chuẩn bị trước khi lên lớp. Toàn bộ thời gian trên lớp sẽ dành cho các hoạt động ứng dụng lí thuyết vào giải quyết vấn đề, thảo luận nhóm để xây dựng hiểu biết dưới sự định hướng của giáo viên. Bài báo giới thiệu về phương pháp dạy học Lớp học đảo ngược kèm theo đó xây dựng nguồn tài liệu học tập ở nhà và vận dụng phương pháp Lớp học đảo ngược để dạy các kiến thức chương "Khúc xạ ánh sáng" *– Vật lí 11.*

Từ khóa: Lớp học đảo ngược, khúc xạ ánh sáng.

1. Introduction

In recent years, Flipped Classroom learning is more and more effective in some high schools and universities in US. In Vietnam, teacher may know this kind of learning through some sources on Internet or some Vietnamese articles such as "Flipped classroom

[*] Email: *nganlhm@hcmup.edu.vn*

– Combination between offline and online learning" of Nguyen Van Loi, Can Tho University in Scientific magazine of Can Tho University (Nguyen Van Loi, 2014). According to a survey conducted by the Sophia Learning and Flipped Learning Network in May 2014, the number of Flipped Classroom teachers in US increased to 78% in 2014, compared with only 48% year 2012. In particular, the teachers in the survey agreed that this approach helped them to improve classroom attitudes and student scores by 67% compared to traditional way (Sophia and the Flipped Learning Network, 2014). With these advantages, Flipped Classroom is implemented in teaching at many US institutions, mainly in the high school and tertiary levels. Currently there are a number of institutions in Vietnam that apply the Flipped Classroom in teaching such as FPT University, Vietnamese-American University, American International School (Apollo) and some other educational institutions. However, due to the fact that the conditions have not been supported, the application of this method is still limited in Vietnam, especially in public high schools. This article presents the basic of Flipped classroom learning and the real condition apply in Vietnam, along with supporting materials to teach the chapter "Refraction of light" grade 11, Vietnamese high school physics.

2. Flipped classroom approach

2.1. What is flipped classroom

Flipped classroom learning stems from the premise of inquiry-based and egalitarian philosophy: with the growing access to vast information through the internet, the traditional model of teacher as the sole steward of knowledge has become obsolete (Jenkins et al., 2017).

As the Higher Education Academy (HEA) states, "*there is a huge range of different blended approaches; the balance between online and face-to-face components, and the integration of other methods, depends on the needs of learners and the context within which the learning is implemented*" (2017). The key purpose of the flipped classroom is to provide a greater focus on students' application of conceptual knowledge rather than factual recall or straight transfer of information.

2.2. How flipped classroom learning works

Flipped classroom includes two important stages which are preparation phase at home and learning phase in classroom. In each stage, both teacher and students have to work hardly to make the lesson the most effective. Flipped classroom just works well when students pay attention to finish the pre-class assignment. Therefore, teachers have to find out the best way to motivate their students to access the given materials at home and do the assignment prior to class.

In the preparation phase, teachers created some videos and learning materials for a new topic which are uploaded on the website or a Internet communication channel.

Students have to watch the videos at home, or in school if they didn't have Internet access at home. Through these videos ans materials, students study and get the main points of the lesson prior to class. Besides, students must finish pre-class exercises or quizes to after the video. In case they have problem, they can leave message or questions for their teacher before the classtime. The teacher may answer them directly or prepare the suitatble activity in class if it is the common problem of the most of students in class.

In class time, teacher just summarize the main content in the lesson. The remain time is used for discussing or solving the problems which students still get stuck. Teacher can apply some modern method such as Peer Instruction of Mazur to enhance the knowledge for students on class.

2.3. The Pros and Cons of Flipped classroom learning

2.3.1. The Pros

In Flipped classroom, students study theory at home under teacher's intruction and supervision. In the class teacher helps students to handle difficult questions and problems as well as to develop more and more skills such as teamwork or do experiment.

- Flipped classroom increase the interaction time between teacher and students. Students have more time and more chances to talk to the teacher about what they didn't understand in deed. Flipped classrooms allows class time be used to master skills through collaborative projects and discussions. By this way, students are able to own the knowledge they achieve, which in turn builds confidence.
- In Flipped classroom, it is flexible for students to arrange the most suitale learning time for themselves instead of just sitting in class during one period in school as well as to learn at the own pace. All lectures and materials are available on the Internet so students can stop, pause or replay the video as they want to take note or discuss with friends more about the problem they didn't understand. Furthermore, it also gives them opportunity to practise self – study at home.
- Students have a good preparation before the class by the way finishing all the pre-class assignment. Not only that, students also let teacher know what makes them get stuck in the lesson by the way do the quiz or test after the lecture as well as raise questions before the class. In class teacher may focus on these problems instead of go around what they have already known. Besides, other skills such as teamwork, critical thinking may be developed thoroughly as well as possible in the class.
- With flipped classroom, students are supported as much as possible, especially in case they must be off in the class. By making video lectures available at all times online, students who are forced to miss class due to illness, sports, vacations or emergencies, can catch up quickly.

2.3.2. The Cons

- One of the most prominent issues is the necessity for students to have access to a computer and Internet in order to follow the pre-class assignments. In some areas, there is lack facility of Internet as well as other digital devices, so that students have limited access to the learning resources.
- One more concern is that teacher may find difficult to control and motivate students to participate and prepare for class in flipped classroom approach.
- As indicated by a report of OECD (2015), the average class size in Asian countries is significantly higher than those of Western countries. Due to the tight school schedule, it is extremely difficult for Asian teachers to frequently assess students during class, not to mention to make use of the assessment results. Moreover, students are also very familiar to traditonal teaching and learning, so that initially they feel so difficult to get acquainted to the new way of learning.
- There is a concern that implementing a flipped classroom adds an extra workload on teachers. It takes a considerable time of the teacher to compile the lesson portfolio from the lecture video to the plan on class. It alse requires responsibility and much effort from teachers.

3. Flipped classroom learning for chapter "Refraction of light" grade 11, high school education

3.1. Online learning channels

Currently there are many websites that support the opening of an online class such as Edmodo, Flipitphysics, etc. Most of them are partial free, but not enough tools to open an effective class. Therefore, in this study, the author proposed an alternative relevant to the current conditions of high schools in Vietnam which is some common tools available on Facebook, Google and YouTube. In fact, most students in Vietnam have a Facebook account, so using Facebook to create an online class is straightforward and easy. Teachers can use Facebook's "Group" tool to create a class and ask students to join the group where we can post information and make small discussion between teachers and students in need.

In terms of video lectures, we chose the way of self-made videos and uploaded to YouTube, then post the links on Facebook group. Thanks to that, all students can access and watch this lecture video easily. After watching the video, students must do a quiz to test what they have got through the video. We use Google tool - Google Form - to create a test in many forms. Here, the author mainly used the multiple-choice form. Google Form has the function of creating a quiz, then make statistics for the answer as well. Thanks to these information, teachers can grasp how many percent of students answer correctly so that they can identify what content students got trouble and then adjust the appropriate activity on the class.

3.2. Online learning materials

The author made two videos of lecture for two lessons "Refraction of light" and "Total internal reflection" in the chapter. The outline of each video is presented below.

- The experiments in the video is recorded by the author. The video then is created using the software Office Mix to record the lecture on Power Point. The sound is done by software Audacity. This is a simple way but is very effective, because teachers can compile the lesson as what they want. It give more flexibility for teachers like they make a presentation and lecture on class, but they can give more and more intriguing videos or pictures to make it more interesting.
- The video includes two main parts which are basic knowledge and daily life applications.

Table 3.1. *Outline of video of lecture "Refraction of light"*

Knowledge	- Light refraction phenomenon - Snell's law - Index of refraction - Relationship between index of refraction and the speed of light in various media - Reversibility of light transmission
Daily life phenomena	- Explanation of image of coin beneath water - The phenomenon of image of fish beneath water - The shift of the Sun position as observing - The phenomenon of twinkle stars at night
Link of video	https://www.youtube.com/watch?v=XDEMK8N9t-w

Table 3.2. *Outline of video of lecture "Total internal reflection"*

Knowledge	- Total internal reflection - Conditions for total internal reflection
Daily life phenomena	- The shining diamond - Periscope - Optical cable - Miracle in desert - Disappear of coin beneath water
Link of video	https://www.youtube.com/watch?v=LWF6IEE2IdY

3.3. Assessment tools before the class

One of the important things is how to motivate students to watch the whole video at home. As presented above, preparation stage at home is the key step in the flipped classroom learning in which students almost learn the main points of the lesson and classtime is just for knowledge and skills enhancement. It depends so much on students' responsibility. Therefore, in this study, we suggested that students after the recorded lecture do a quiz or short test. The scores taken from the test will be used for formative assessment in every semester. Bedsides, at the end of each quiz, students can leave the comment or raise some problems that they still got stuck after the video. From these problems, teacher may know more about students' troubles and then compile the appropriate activites for class time. In this case, students with the interesting questions may get bonus mark and students not finishing the quiz get minus mark. The mechanism as suggested may encourage students to enjoy the learning time as well as practice self-study. When students attend the class, the teacher may make formative assessment through observation of learning attitude of students. In class, students have to work in group and apply what they have already studied at home. Therefore, students thoroughly watching the video will perform better than who didn't watch the video at all.

We use the Google Form to make the test after the video. Thanks to the statistics function, teacher may have a general look about the background of students after watching the video. So that the classroom activites will be compiled more relevant for most of students in a class.

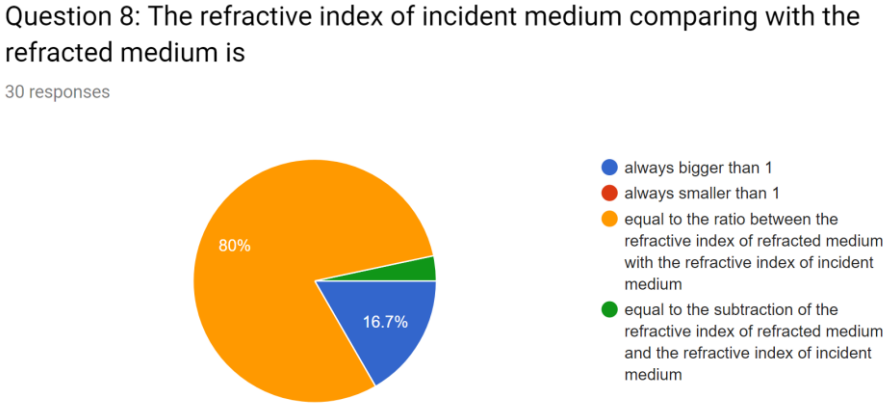
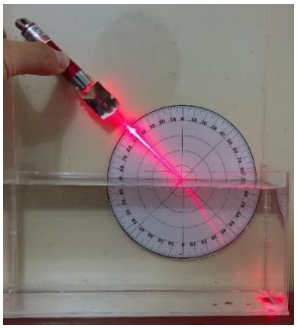


Figure 3.1. *Statistics function of Google form*

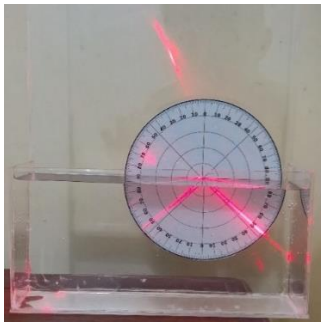
3.4. Experiment tools for classroom activity

We design some experiments for students to conduct in class. In these experiments, students based on the knowledge of refraction and total internal reflection to identify the index of refraction of some liquids, such as distilled water, salt water or sugar water. They work in group and then compare the results of the same liquid. Thanks to these

experiments, students may review what they have learned through the video as well as enhance their understanding. Additionally, students also develop skills of doing experiment and data analysis at which students seem to be weak.



Refraction of light



Total internal reflection of light

Figure 3.2. *Experiment using laser pointer*

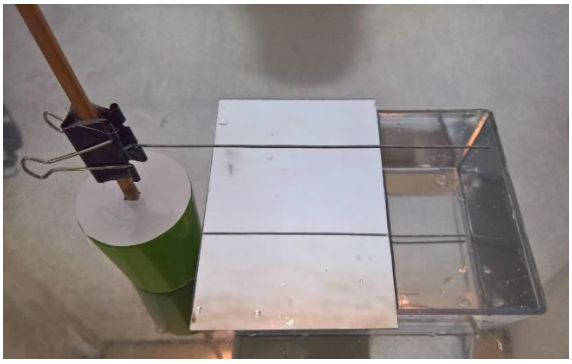


Figure 3.3. *Experiment of measuring index of refraction of a liquid using mirror*

4. Pedagogical practice for Flipped classroom

We conducted the Flipped Classroom method with procedure already compiled on 11 grade students in class 11A3 in Gia Dinh High school. This is a big size class of 49 students. All of them have account on Facebook and be available to access Internet at home. This is good condition to apply Flipped classroom. Students in 11A3 have a good background of physics so that they can adapt to the new method quickly and easily. Furthermore, the infrastructure of Gia Dinh high school is quite good with digital devices such as computer, projector.

4.1. Procedure

In preparation phase, we informed and discussed with students about the new way of teaching and learning. Most of students here are familiar to the traditional method, so it took some time and effort of them to get acquainted to a new approach in learning. Teacher discussed and announed them about how Flipped Classroom works.

Before the lesson 2 weeks, teacher create a group on FB and add all students in class to contact and give them learning materials. Teacher posted the link of video on FB and students can access these links to finish their pre-class assignment. Two days before the teaching time on class, we check the quiz students have finished and found out most of them may understand the refraction of light as well as the Snell's law in theory because it is not so difficult for all of them, however they need more the experiment to understand indeed.

On class, teachers have done the teaching time follow these steps (1) summarize the main points of the lesson; (2) let students explore and do experiment; (3) observer and help in necessary; (4) make conclusion about the whole lesson.

4.2. Results

We conducted the lesson "Refraction of light" in Flipped classroom approach on 21st of March in 2017. For the phase of learning at home, teacher supplied the link of video, online quiz and experiment handout for students on 17th of March in 2017. Four days later on 20th of March, teacher checked the number of students finished the quiz is 35/49. This shows that students got used to that way of learning but some didn't. Therefore, when implementing Flipped classroom learning in reality, teacher must set some rules for students to force them to prepare pre-class assignment well.

On class, when teacher asked some question related to the refraction of light or the law, most of students could give the correct answer, which shows that the video is clear and easy for them to watch and get the information. In detail, most of students can present correctly the definition of refraction of light. Besides, when teacher asked randomly about the Snell's law about refraction, students gave the correct answer not only in content but also in the unit of each quantity in the equation.

In the experiment of identifying refraction index of liquid using laser pointer, students worked in group and then explain the science behind the experiment. The answer was not completely correct but it also showed their good preparation on the handout that teacher gave them before. In the second experiment with flat mirror, students could explain the form of image base on what they have watched in video. This phenomenon is a little bit difficult but students may understand well thanks to watching the pre-lecture at home.

With activity of doing experiment, students were excited to do. However, due to the large number of students and the limited number of experiment kits, only about 5 - 6 students in the group are actually doing experiments, the rest is quite neglected and not paying attention. The teacher observed and commented on the results of each group. Because the experimental skills of students are not high, the experiment results are not small error, but still acceptable. Some students seem to be quite interested in new ways of learning and are interested in doing experiments, but because they are first exposed to new learning methods, they feel a little strange and difficult.

Figure 4.1. *Students conduct experiments in classtime*

4.3. Analysis

We interviewed directly with the teacher and five students after the class and recorded their ideas about the online learning materials as well as the classtime. Teacher as well as students have positive comments about the videos of two lecture in terms of performance and content. The video content is straightforward and clear with a logic structure for students to follow. The phenomena in real life are described virtually with the smooth explanation. It would be better to have a summarize of knowledge at the end of the video lecture. Some students are very excited with some phenomena that they did not know before, but if the speed is slower then it will be easier to understand. Due to the fast speed, they need to rewind to hear many times.

On a generall look on Flipped classroom method, some teachers after the demo class found out the the implementation of this method of teaching in Vietnam is quite difficult to implement due to many reasons. In the current General Physics curriculum there are many different units of knowledge, there are many theoretical units or exercises that are difficult to implement in this way. If you want to let students learn in the lab and improve your hands-on skills and capacity development, then you need to change the way you think about the current score. In addition, teaching is prerequisite for developing skills and competencies that need to be implemented in a sufficiently long time for students to become familiar with the new way of learning.

We presented here some feedbacks from students who attended the Flipped classroom learning.

- It is easier to revise when video lectures are available, so I can turn on and review the lecture.
- The experiments and other activities of learning theory is quite interesting and I feel very interested.
- I am still interested in doing experiments but I suggested that reducing the time spent doing experiments instead of solving exercises may help me have better test results.

- Due to unfamiliarity with new learning styles, I find it difficult to re-learn their knowledge.

The result just from only one class didn't give us enough information in application this approach, however it initially shows us that it is effective to apply step by step Flipped classroom for these classes with enough facilities and active students. In these kinds of classes, they can get used to the new approach and are able to understand the knowledge through the video easier. With the class with lower background, teacher base on the level of class to prepare relevant learning materials.

5. Conclusion

Flipped classroom currently is a little bit new and strange for the teachers in Vietnam, especially in public high schools. Moreover, due to the lack of condition in some schools, the implementation of Flipped classroom is also difficult. However, the article has suggested a way of applying the Flipped classroom with some online learning materials. Besides, the demo class also showed that Flipped classroom is still effective in som cases.

❖ ***Conflict of Interest:*** *Authors have no conflict of interest to declare.*

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