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How can ck-12 (an open educational resource, oer) enhance the attitude and academic performance of class vii students in science?

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ABSTRACT

Open Educational Resources (OER) has come to the limelight with the onset of the COVID-19 pandemic and enables the learning process to be individualized and self-paced. Studying the attitude of the students towards the use of OER like CK-12 and its impact on the academic performance of the students is imperative to enhance its effectiveness. However, there is limited research done to explore the status of attitude about OER and its impact on the learning process. This study attempts to study CK-12 (an Open Educational Resource, OER) towards enhancing the attitude and academic performance of class VII students in science. It is quantitative descriptive research using a survey and quasi-experimental method (switching replication method). The pretest and post-test data on attitude were collected from 57 students of grade VII using an attitude questionnaire before and after the two-month intervention period. During the intervention period, academic performance tests of various concepts were administered. Findings from the research report that though there was no significant difference in the overall attitude of students between the pretest and posttest, there did exist a significant difference in the academic performance of students taught using CK-12 class and regular class. This indicates that though students enjoyed and performed academically well in the self-paced OER modules, it implies that they were aware that teacher-led instruction carried higher importance. Thus, teachers can never be replaced by online self-paced materials. Instead, the two should be complementary and coexist for effective learning.

Keywords: CK-12, OER, attitude, academic performance, grade seven, science

INTRODUCTION

With the onset of the COVID-19 pandemic, it is the need of the hour to equip the students with skills, and knowledge for self-regulated learning through digital means. The traditional teaching and learning method is on the verge of being replaced with the blended teaching and learning method. Furthermore, according to the BCSEA results (BCSEA, 2020), the science performance of Bhutanese students was comparatively poor compared to other subjects in the

past years. Kuzhugchen Middle Secondary School is no exception. This indicates that currently, Bhutanese students lack the abilities in science. It could be due to the impact of frequent lockdowns in the nation, with online teaching and learning enforced to students who weren't oriented extensively on the use of online platforms. In addition to it, personalized self-regulated learning seemed to be lacking. Thus, an intervention is envisioned to enhance the learning in science through the use of CK-12, an Open Educational Resource (OER).

"Learning is a very personal process and requires individualization of style and level of learning as well as customization of teaching content in a world that has increasing administrative rules and limitations on teachers and declining resources" (CK-12 Foundation, 2012). Moreover, technology use is a helpful means for students to establish concepts, understand the content and increase knowledge in learning (Chen, Wei & Li, 2016). CK-12 is an Open Educational Resource (OER) that can be used in the classroom for regular teaching and learning. It is a good means of aid for teachers as well as students to learn concepts and assess their understanding. It is curated in a sequenced manner starting from the theoretical construction by connecting with the real world, availability of main concepts with examples and videos, review questions and adaptive practice at the end. It indeed comprises everything that is required for the normal conventional classroom teaching and learning process but on an online basis. In the words of Mason (2018), cost savings, increased access, improved quality and increased teacher professionalism are some of the suggested benefits of CK-12. Thus, this action research attempts to help students to adopt the online platform of CK-12 to enhance their learning at their own pace.

RECONNAISSANCE

Situational analysis

1. Country

Bhutan is a small mountainous country sandwiched between China and India, with a population of 754,000 and a territory of 38,394 square kilometres. The system of government is Parliamentary Democratic Monarchy instituted in 2008. It holds a minimum of 60% of land under forest coverage as per the compromising act of preservation of the environment. The country commemorates the origin of Gross National Happiness (GNH) founded by the fourth King of Bhutan, Jigme Singye Wangchuk during his reign as monarch.

2. Education System in Bhutan

The system of education during the early century was tedious and comprehensive. It required the students to stay at the temple and digest whatever was being taught by their master regardless of students' understanding of the subject. It was traditional-based learning with the least participation from the students' side and teachers were hardly concerned about an individual's ability to learn. In addition, there was not much integration of Western subjects other than Dzongkha.

However, monastic/traditional education still prevails even today, especially in Lhakhangs and Dzongs. On the contrary, the change in time has noticed the importance of Western/modern education owing to its numerous advantages. Modern education was introduced to our country in 1914 by the first King of Bhutan as a door to integrate learning of different subjects besides Dzongkha. The medium of instruction used in the schools today is English. Since its inception, the education system in Bhutan has progressed dramatically from two schools in 1914 to 529 schools currently, with a total enrollment of 166,786 students (from Pre-primary to XII) and 9,279 teachers (Annual Education Statistics (AES),

2019). This indicates a great deal of importance given to the education system by the Royal Government of Bhutan. The major reform is the shift from 'chalk and talk' to digitized classrooms and experiential learning methods. Bhutan Education Blueprint (2014) points out that policymakers especially focused on providing knowledge and skills demanded by current challenges of advancement of technology.

3. School

Kuzhugchen Middle Secondary School (KzMSS) is one of the schools under Kawang Geog, Thimphu Dzongkhag which was established in the year 2001. At present, KzMSS comprises 35 qualified teachers, 9 non-teaching staff, 7 supporting staff, 1 NFF instructor, 2 contract teachers, and 530 students from diverse backgrounds. The school is 19 kilometres away from the city of Thimphu. The school is well equipped with basic infrastructure such as computers with internet facilities for both staff and students, different playgrounds, a library, washrooms, continuous water supply for both drinking and washing purposes and laboratory facilities which contributes to a positive learning environment. KzMSS is the only school in Thimphu thromde which provides breakfast and lunch for the students. Therefore, one can see that most of the students are from poor family backgrounds and providing meals from school has benefited a lot of the students as well as the community of Kuzhugchen.

4. Class VII students.

The sample is selected from grade VII students of KzMSS. Students of grade VII consist of 34 girls and 23 boys making 57 in total. They are all from diverse backgrounds and have the basic skills and knowledge about using computers and the Internet, which is a prerequisite for this research. The investigators selected these classes for the study since the selected classes are eligible due to the factors the investigators purposely looked at, such as; they are not appearing for the board examination, having two sections and the performance in science for these groups of students was low in the previous year.

Competence

Sushma Pradhan is a science teacher at Kuzhugchen Middle Secondary School, under Thimphu Dzongkhag, Bhutan. She completed her Bachelor in Education from Samtse College of Education, Samtse, Bhutan. She has a Master of Arts in Education from Lovely Professional University, Punjab, India. She is part of the research committee and contributed in enhancing the research culture in the school through school-based research work.

Sonam Zam is a mathematics teacher at Kuzhugchen Middle Secondary School, under Thimphu Dzonkhag, Bhutan. She pursued her Bachelor in Education from Samtse College of Education, Samtse, Bhutan. She completed her MSc in Applied Mathematics from Mahidol University, Thailand. She has a keen interest in carrying out research in the field of Education.

Yangchen Zangmo is a Geography teacher at Kuzhugchen Middle Secondary School, under Thimphu Dzonkhag, Bhutan. She has pursued her Bachelor of Arts from Sherabtse College, Bhutan and a P.G. Diploma from Samtse College of Education, Bhutan. She also has a keen research interest and hopes to make a difference in the education system through school-based action research.

All the investigators are familiar with carrying out action and conventional research in the field of Education and their recent manuscripts are published in Bhutan Journal of Research and Development (BJRD), Bhutan. We are keen learners and collaborate to carry out research for the improvement of the education system.

Critical friend

The idea of a 'critical friend' or 'critical colleague' is a 'partner' who can give advice and is working with the researcher in the AR. Instead of perceiving their role as an advisor or consultant, the 'critical friends' see themselves as the 'friend' of the teacher–researcher (Royal Education Council, 2018). Our critical friend during the research is our colleague, Mr Sonam Dorjit of the same school, who is an ICT teacher and has a Masters in IT. As our friend, he would help us with the research and guide us if we were heading in the wrong direction during the research. He would guide us with teaching and conducting activities in the laboratory and deal with any technological problem during CK-12 classes as he has more experience in it compared to us. Hence, he is perceived to be of immense help to the research.

LITERATURE REVIEW

CK-12 online platform as OER

"Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under the copyright that has been released under an open license, that permits no-cost access, re-use, re-purpose, adaptation and redistribution by others" (UNESCO, 2018). The materials are freely available on the Web, which can be used by both educators and learners. It may include materials like study resources, simulations, videos, games, and assessment matrices. CK-12 is an OER that helps teachers augment learning for students worldwide. It consists of web-based free educational materials in multiple modalities, catering to different learning styles of students. The resources are high quality and customizable, and they leverage digital tools to enhance learning. CK-12 Foundation aims to provide free access to content through digital tools, facilitating online engagement to enhance learning, irrespective of the educational resources available for a student or region (CK-12 Foundation, 2012).

The content in the printed textbooks is limited, and searching for them online is time-consuming, and costly. CK-12 Foundation provides a variety of resources in different forms for science and math that can easily be navigated by the students as well as teachers. It includes reading materials, simulations, videos, web links, activities, lesson plans, assessments, and concept maps (Owens, 2016). PLIX and simulations are two modalities that enable students to learn in an exciting and fun manner. The content is given life as students fiddle with them. Teachers can assign, monitor and assess students' learning by integrating with Learning Management Systems like Google Classroom, Canvas, etc.

Attitudes towards the use of CK-12

Owing to the limited research on attitudes towards the use of OER, a few findings from the previous research related to it are discussed below.

Open Educational Resources (OER) are revolutionizing the way that education is done. They make learning accessible, open, and multifaceted by bringing the distant past closer. OERs are frequently mistaken for online resources and have varied meanings to different people. OER are distinct from the abundance of multimedia sources that are available on the Internet, some of which may or may not be useful for education. They may be hosted on and available like sources on the Internet, but unlike other sources, they have been reviewed for educational value (Zawacki-Richter et al., 2017).

State and federal governments have long been strong supporters of OER in higher education in the United States. In 29 states, legislation encouraging and facilitating the use of open

educational resources in higher education has either been passed or is now pending in the legislature. The Affordable College Textbook Act was filed in Congress in 2019 to lower textbook costs by boosting the use of open educational resources (OER) in higher education (SPARC, 2020). Students who have immediate access to course materials may be more motivated to participate in class, make better use of available resources, and ultimately learn more (McPherson & Bacow, 2015).

Farah, et al. (2021), revealed that the CK-12 online platform as OER is believed to be easy, more concise, understandable, and user-friendly. It improved their higher-order thinking skills while studying statistics. They concluded that the level of efficiency, satisfaction and feasibility of CK-12 application in the study of the topic of Statistics was high and students were very satisfied with the use of CK-12 application because it could meet the needs in the learning process. These results proved that the CK-12 application has a high potential among students to continue to use it.

However, according to Raebel (2015), learners did not show a drastic change in their attitude towards blended learning using OER in comparison with direct instructions. There was only a subtle positivity towards a shift to technology-driven instructions. They were aware that despite the rich resources and self-paced learning they experienced, the teacher-led instruction were felt of greater importance. They didn't show the desire to replace teachers with computers but desired the coexistence of the two. Similarly, Rowell (2015) also reveals that the value of OER was perceived to be the lowest with a rating that indicated neither a positive nor negative attitude which may imply that they haven't fully made up their mind regarding OER. Perhaps, they require more experience and clarity on the use of OER before attempting any educational purpose.

In addition, Kumar & Raja (2019) revealed in their study of the status of awareness and attitude towards OER that students weren't aware of OER. There was a moderate positive attitude towards it. To utilize OER, students' attitude plays a critical role and staff development should focus on creating awareness of OER to their students for maximum learning in higher education. Therefore, wider use and production of new OER are necessary which shall cut down the education cost.

The Royal Society for STEM under His Majesty's Secretariat carried out a trial of the CK-12 EduTech platform at the Kuzhugchen Middle Secondary School (KMSS) for all class IX students in the second half of the 2021 academic year. The subjects such as Biology, Chemistry and Physics were allotted to conduct one out of three classes (periods) in a week assigned to each of these subjects on the CK-12 platform. The other subject which used the CK-12 platform was Mathematics where two classes out of four were taught using CK-12. Traditional method of teaching was used for the rest of the classes. The findings from the trial implementation in Kuzhugchen MSS state that the CK-12 is flexible, in content and features which is useful for both teachers and students; powerful learning management system with opportunities for creating virtual classrooms, adaptive practice quizzes, and automated and instinct insights on the student's performance; flexibility to create own content and quizzes; reduction of workload; and no subscription cost (RSSTEM, 2021).

CK-12 towards enhancing academic performance

In the study conducted by Raebel (2015), both control (direct instruction) and experimental groups (Blended learning using OER) showed positive gains in content understanding. Blended learning did not have a negative impact on student achievement. Blended learning and direct instructions produced positive student growth in the understanding of writing

linear equations in mathematics. However, the average post-test mean was slightly higher with the blended learners, which suggested that blended learning does have a greater impact on student achievement than direct instruction.

Pavia et al. (2017) revealed in their study the use of a variety of OER (Sophia, Curriki, CK-12), CK-12 and Curriki platforms showed optimal use as users found it easy to identify courses and modules. For this reason, all three platforms evaluated received a maximum score. In the textual relationship between the reader and the web pages, only the Sophia platform received an average score, due to unsatisfactory perceptual quality when used in different browsers. Overall, the CK-12 platform presented positive results in the modes of symbolization, pictorial and verbal resources.

Similarly, the study conducted by Perdana, Jumadi, & Rosana (2019), to analyze the relationship between analytical thinking skills and scientific argumentation in physics learning by using CK-12 simulation about optics in Indonesia. From the pretest and posttest of the data, findings showed that the analytical thinking skills and scientific argumentation of the students are rather low. However, Problem-based learning with web-based simulation can enhance a student's scientific argumentation and analytical thinking skills, as the results indicate that there is a statistically significant relationship between analytical thinking skills and scientific argumentation.

In a nutshell, Technology is pervasive, and skills and knowledge related to technology are indispensable in the digital world. It plays a critical role in teaching and learning. It is a medium for learning. We need to prepare learners to thrive in the technological world. Fortunately, the children have become more techno-savvy and educators need to utilize this burgeoning tech-savviness by using technology to improve interaction, engagement, and understanding of the concepts. Furthermore, the rise in remote and hybrid learning, self-regulated learning, availability of web-based resources, and the modern advancement in technology call for it to succeed in the real world (Cullen, 2022).

ACTION RESEARCH QUESTION(S)

How can CK-12 (an Open Educational Resource, OER) enhance the attitude and academic performance of class VII students in science?

AIM

This action research aims to investigate the impact of the CK-12 foundation, an Open Educational Resource (OER) on the academic performance of class VII students in science and their attitude towards CK-12.

OBJECTIVES

The study attempts to achieve the following objectives:

1. To investigate the difference in students' attitude before and after using the CK-12 platform in science class.
2. To find the difference in attitude of students about the use of CK-12 based on gender.
3. To find the difference between the academic performances of students taught through CK-12 and regular teaching.
4. To provide information to determine the policy relating to the utilization of OER in the learning process.

METHODOLOGY

Research Design

This research used quantitative descriptive research using a survey and quasi-experimental method (switching replication method). The investigator adopted this method since it helps to find relationships between variables by employing mathematical models, theories, and hypotheses about phenomena (Given, 2008). Through such methods, people's understanding, practice, values, and views can be gathered for interpretation quantitatively.

Research Participants

The research participants were two sections of grade seven students of Kuzhugchen Middle Secondary School comprising 57 (34 female and 23 male) students in total. The participants were selected based on emergent sampling, as the researcher taught these two sections of class seven students.

DATA COLLECTION PROCEDURE

Research Instrument

Students' attitude data was collected using a survey questionnaire for both pretest and posttest and academic performances were gathered using science achievement tests during science classes for 2 months.

1. *Attitude Survey Questionnaire*

It consists of a list of questions that correspond to students' answers about the topic. A questionnaire is simply a 'tool' for collecting and recording information about a particular issue of interest. It is mainly made up of a list of questions but also includes clear instructions and space for answers or administrative details. Moreover, Naresh (2006) suggests that a questionnaire is a formalized set of questions for obtaining information from respondents. The overriding objective is to translate the researcher's information needs into a set of specific questions that respondents are willing and able to answer.

The investigators used this method as it is associated with the number or quantity, whereby one can gather many different views and accordingly plan the intervention strategies. A questionnaire is the main means of collecting quantitative primary data. A questionnaire enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis (Naresh, 2006). Moreover, the tool will help us get reliable information on our research problem by distributing questions to the participants without the teacher's guidance. The questions distributed were preferably simple but one that fetched more information. The attitude survey questionnaire was adapted from Raebel's (2015) Capstone Project and is appended as Appendix 1. The attitude survey questionnaire was administered to the students before the intervention and after the intervention. The reliability test using Cronbach's alpha in this study was 0.88.

2. *Academic performance Test*

This tool is an assessment tool in which students' comprehension is evaluated through the basis of conducting tests. To check their level of understanding, short tests were conducted twice for CK12 classes and twice for regular classes in a week by using a switching replication method between two sections of grade VII. When section A was taught using CK-12, the other section was taught using regular class on the same topic. Therefore, the tests varied as per the topics taught throughout the intervention period.

INTERVENTION PROCEDURE

During the science classes for class VII students, CK-12 was implemented using the quasi-experimental method (switching replication). Two periods were taught using the CK-12 online platform by switching topics in both the classes and the other remaining periods were taught using regular teaching methods. The intervention period was carried out for 2 months.

For teaching the concepts through CK-12, FlexBooks 2.0 was adopted since it has all the requirements desired by the teacher. The teacher explored the content beforehand for the selection of the best and appropriate content as per the National School Curriculum, 2022. Most of the concepts are available in CK-12, though the standards differ. Thus, making the selection of the content lies at the disposal of the teacher. The selected content, video and adaptive practices were then assigned to the students, which were completed in the computer laboratory in a period. During the lesson, the teacher briefed on the topic, and objectives of the lesson and asked students to complete it at their own pace in the laboratory. Teachers simply monitored their learning process and assisted as and when demanded by the students.

The content and the assessment parts in the CK-12 platform are well organized and put in. The videos consist of lessons as well as real-world connections. Every lesson consists of some review questions, which students wrote in their notebooks to check their understanding. Adaptive practices are a good way of assessing students' understanding since they consist of various levels of questions. During the practice, students were provided with hints to reattempt the wrong questions, and if he /she doesn't get it right, different questions would be replace, which would allow them to continue with the practice. The adaptive practice was a good way to motivate students to continue learning as it shows their performance meter like beginner, intermediate, or mastery level. The worksheets of adaptive practices and assessment grading can also be downloaded for further practice. After the assessment, teachers were provided with insights regarding the students lagging through emails.

For the regular class, teachings were done using various strategies like inductive method, deductive method, 5E, lecture, discussion, presentation, and use of ICT like PowerPoints, videos, worksheets etc. There was a lot of teacher input in the regular class, unlike CK-12 class where students learned the concepts on their levels and paces. For the assessment in CK-12 classes, the teacher extracted the students' performance for the first 10 questions in the first attempt from the adaptive practice. The same ten questions were given to assess the understanding of the same concept in other classes taught using regular methods.

ETHICAL CONSIDERATION

Researchers sought written approval from the school administration to carry out the research in the school. Written consent forms were also obtained from the participants for their participation in the study. The data from the survey was kept confidential and respondents were assured of their right to withdraw from the study at any time. The names of the respondents were not recorded on the questionnaire, which renders the data anonymous.

DATA ANALYSIS

After seeking approval from the school management, the data was collected for the pretest, intervention period and posttest. The data collected were tabulated and statistically treated by employing descriptive statistics like frequency, mean, standard deviation and t-test in SPSS-version 23. The mean and standard deviation were used to determine the level of attitude and academic performance of the sample whereas an independent sample t-test was used to find

the significant differences between groups like test period(pretest and posttest), classes(CK-12 class and regular class) and gender.

RESULTS AND DISCUSSIONS

Demographic characteristics of students

Table 1 shows the detailed profiles of the sampled students. The survey comprised a total of 57 (23 Male and 34 Female) students, 40.4% male and 59.6% female. The ages of the students range from 11 to 19 years, with the mean age being 13.5 years and a standard deviation of 1.34. The majority (52.6%) of the respondents were 13 years old.

Table 1

Demographic characteristics of students (n=57)

Variable	Min	Max	*M*	*SD*
Age	11.00	19.00	13.59	1.34
Pre-test scores	67.00	117.00	93.80	10.78
Post-test scores	45.00	124.00	93.45	15.70

Test of Normality

The pretest score was tested for normality and it was found to be normally distributed, as assessed by Kolmogorov-Smirnov and Shapiro-Wilk test ($p>0.05$) and shown in Table 2.

Table 2

Test of normality for pretest scores

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test score	0.086	57	0.200*	0.987	57	0.819*

Similarly, the post-test scores were also tested for normality and it showed that the data was normally distributed, as assessed by Kolmogorov-Smirnov ($p > 0.05$) as shown in Table 3, even though the Shapiro-Wilk test failed to meet the value ($p < 0.05$). Nevertheless, Khalili (2019) supports that skewness and kurtosis values between -2 and +2 are accepted in social science. The skewness and kurtosis values of post-test scores in this study are -0.986 and 1.748 respectively. Further, Hughes (2019) and Abdollahi (2018) reveal that the Kolmogorov-Smirnov test would be most appropriate for samples greater than 30 and the Shapiro-Wilk test is appropriate for sample sizes less than 30. In this study, the sample size is greater than 30. Thus, the post-test scores were considered normally distributed.

Table 3

Test of normality for posttest scores

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Posttest scores	0.089	57	0.200*	0.943	57	0.010

Likewise, the science achievement test scores were also tested for normality; it was found to be normally distributed, as assessed by Kolmogorov-Smirnov and Shapiro-Wilk test ($p>0.05$) and shown in Table 4.

Table 4

Test of normality for academic performance scores

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CK-12	0.093	57	0.200*	0.962	57	0.069*
Regular	0.091	57	0.200*	0.979	57	0.406*

Following are the results presented according to the objectives of the research:

1. ***Difference in the attitude of students before and after the use of the CK-12 platform in science class***

The first objective of this study was to compare the attitude of students before and after the use of the CK-12 platform in science class. Independent-sample t-test was applied to determine the difference in the pretest and post-test scores of the students. Table 5 represents means, standard deviations, and t-test results. The mean of the pretest score was higher by 0.35 compared to the posttest score. However, there was no significant difference in scores between the pretest ($M = 93.80$, $SD= 10.78$) and posttest ($M= 93.45$, $SD= 15.70$), where $t(112) = 0.139$, $p= 0.890$ at 5% significance level. Therefore, we fail to reject the null hypothesis (H01) and conclude that there is no difference in students' attitudes before and after using the CK-12 platform in science class.

Similar results were found by Raebel (2015) that post-survey had relatively similar results on attitude and concluded that differences in instructional strategy will not make a difference in the attitude of the students. Though students enjoyed the self-paced OER modules, it does imply that students were aware that teacher-led instruction carried higher importance. Thus, teachers can never be replaced by computers online self-paced materials or OER. Instead, the two should be complementary and coexist for effective learning (Evans, 2012). Nevertheless, there are possibilities for students to develop a definitive perception of the value of OER in the courses they take as they gain more experience interacting with the variety of OER available (Rowell, 2015).

Table 5

Attitude difference between pretest and post-test score

	M	***SD***	***df***	***t***	***P***

Test Period	Pre-test	93.80	10.78	112	0.139	0.890
	Post-test	93.45	15.70			

2. Difference in the attitude of students about the use of CK-12 based on gender

To find the difference in attitude between the male and female students about the use of CK-12, an independent sample t-test was computed and the result is presented in Table 6. The mean score of female students in the pretest is slightly higher than male students, while male students' posttest score is slightly higher than female students. However, there is a decline in the overall mean score of both the genders from pretest to the post-test score. The result showed that there was statistically no significant difference between male and female students for both pretests (t (55) = -.014, p= 0.989) and posttest score (t (55) = .094, p=.926) at 5% significance level of attitude. Thus, the null hypothesis (H01) is accepted and it can be concluded that there is no significant difference in the attitude of male and female students before and after the use of the CK-12 platform in science class.

Table 6

The difference in attitude of students about the use of CK-12 based on gender

	Gender	***N***	***M***	***SD***	***t***	***df***	***P***
Pretest	Male	23	93.78	10.68	-.014	55	.989
	Female	34	93.82	11.01			
Posttest	Male	23	93.69	16.39	.094	55	.926
	Female	34	93.29	15.47			

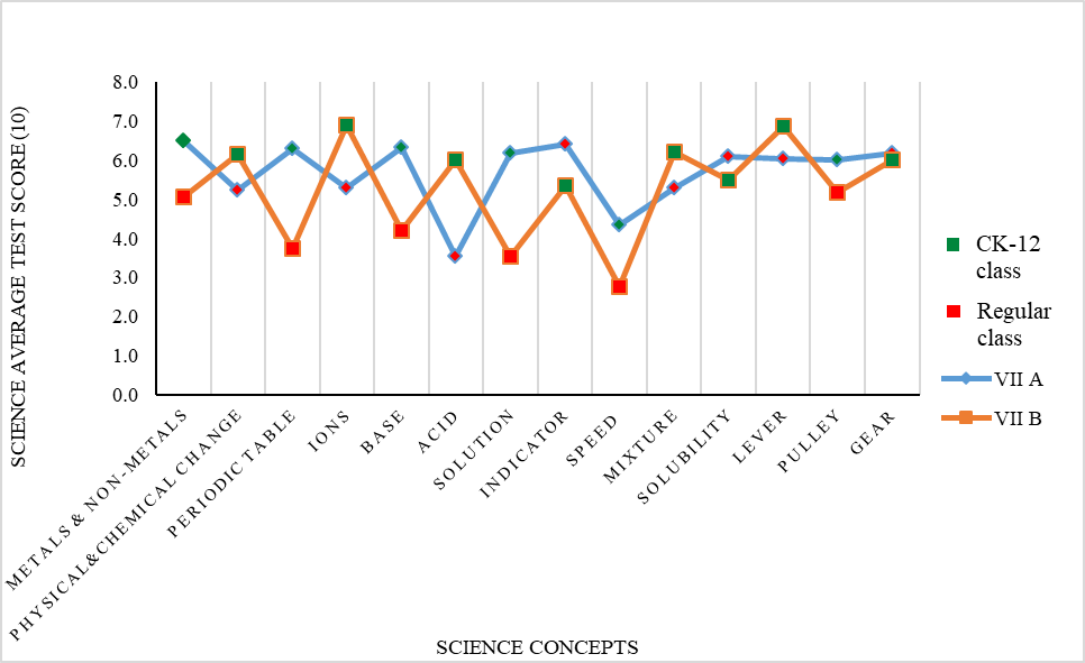
The result was consistent with the findings of Kumar & Raja (2019) that there was no difference in attitude in the use of OER among higher school students based on gender and also suggested the importance of the utilization of OER by addressing the need to create awareness about OER among staff and students, and production of a wider range of OER in the developed countries.

3. Difference in academic performance of students taught using CK-12 and regular teaching

The difference in academic performance of students taught between CK-12 and regular teaching according to the various concepts taught is presented in Figure 1 with grades VII A and VII B alternating the CK-12 platform and regular teaching using switching replication method. It shows the average score obtained by each class on different concepts. It can be observed that the average test scores obtained during CK-12 classes were higher for many concepts than the average test scores obtained during regular classes.

Figure 1

Average science test scores of CK-12 and regular classes



Furthermore, to find the statistical difference in academic performance of students taught by CK-12 and regular teaching in science class, an independent sample t-test was employed and Table 7 presents the results that the mean of academic performance during CK-12 classes was higher than regular teaching. In addition, there is a statistically significant difference between academic performance for CK-12 classes (M = 60.57, SD= 10.97) and regular classes (M= 48.35, SD= 15.19), where t (101.92) = 4.92, p= 0.000 at 5% significance level. Therefore, the null hypothesis (H01) is rejected and it can be concluded that there is a statistically significant difference between the academic performances of students taught using CK-12 and regular classes.

This very finding was supported by Raebel (2015) that experimental groups (Blended learning using OER) showed positive gains in content understanding. It did not harm student achievement and produced positive student growth in the understanding of concepts. Thus, blended learning using OER does have a greater impact on student achievement than direct instruction.

Table 7

The difference in academic performance of students taught using CK-12 and regular class

	Classes	***N***	***M***	***SD***	***t***	***df***	***P***
Academic Performance	CK-12	57	60.57	10.97	4.92	101.92	.000
	Regular	57	48.35	15.19			

FINDINGS

The following are the findings of this action research:

1. There is no significant difference in students' attitudes before and after using the CK-12 platform in science class.
2. There is no significant difference in the attitude of male and female students before and after the use of the CK-12 platform in science class.
3. There is a statistically significant difference between the academic performances of students taught using CK-12 and regular classes.
4. The academic performance of students during CK-12 classes was higher than the academic performance of students during regular classes.

CONCLUSION

This study aimed to find the attitude towards the use of the CK-12 online platform as OER and its impact on the academic performance of the students in science class. Data from 57 students (34 female and 23 male) were analyzed to find (1) difference in attitude of students before and after the use of CK-12 platform in science class, (2) difference in attitude of male and female students before and after the use of CK-12 platform in science class, (3) difference between the academic performances of students taught using CK-12 and regular classes. The results showed no significant difference in the overall attitude of students before and after the use of the CK-12 platform in science class, and also based on gender. However, on a positive note, there was a significant difference between the academic performances of students taught using CK-12 and regular classes. The academic performances of students during CK-12 classes were higher than the academic performance of students during regular classes.

Probable reasons for no significant difference in the attitude of students before and after the use of the CK-12 platform in science class could be due to the short intervention period, and the frequent use of technology as a teaching aid in the class that the students are used to and did not find it as something new and enticing. It could also be because both the teachers and students have very limited exposure to EduTech and EduTech platforms. The exposure has been very recent since teachers and students were forced to use EduTech platforms only in the wake of COVID-19. Likewise, some of the reasons for no significant difference in the attitude of male and female students before and after the use of the CK-12 platform in science class could be because of no overt gender discrimination in the class. In Bhutan, both males and females have equal rights to study what they like and even electoral law guarantees equal rights. The mindset of presuming that science is one of the difficult subjects by the students can be a huge barrier towards having the same attitude by both genders. There is a statistically significant difference between the academic performances of students taught using CK-12 and regular classes because CK-12 consists of various levels of questions and during the practice, students are provided with hints to reattempt wrong questions, and if he/she doesn’t get it right, different questions would replace it which would allow them to continue with the practice.

The current findings have important implications for teachers, parents and students in enhancing learning and exploring the contents beyond what is taught in the classroom. It can be used as a tool to gear teachers and students towards gaining exposure to EduTech platforms. CK-12 is a free platform backed by a reputable foundation. Most of the features of MoE’s Learning Management System (LMS) already exist in CK-12. Schools can

immediately benefit from the rich content and powerful features in CK-12 if they decide to adopt and use it in their daily teaching and learning process. The features in CK-12 such as Flexbook 2.0, adaptive practices, Quizzes, Insights, Reports, Simulations, and PLIX are user-friendly and can reduce teachers' workload.

However, the findings are limited to data reported by one of the middle secondary schools from Thimphu, the capital city of Bhutan. As such, a similar study in other schools from different provinces might give very different results. Furthermore, studying the impact of CK-12 in various subjects would enhance and authenticate the results.

RECOMMENDATIONS

Based on the above findings and conclusions, the following recommendations are suggested:

1. The CK-12 online platform can be adopted by educators through blended teaching and learning methods instead of considering it as a completely isolated CK-12 classroom. Teacher-led instruction must be blended with technology-driven activities, to take care of individual differences of the learners.
2. The CK-12 online platform should not replace the regular teacher-led instruction as students' desire to communicate, collaborate and learn is felt more from the latter. Hence, the two should be complementary and co-existing for an effective teaching and learning process.
3. Teachers and students need to be provided with training on the utilization of OER during the regular teaching and learning process. With more awareness, experiences and knowledge on the use and navigation of OER like CK-12, a positive attitude towards future use is expected and felt.
4. After being familiar with the use of the CK-12 platform and other OERs, teachers have the liberty to adopt the existing online flexbooks available in CK-12 or can create their contextualized flexbooks as per the National School Curriculum, 2022.
5. Future research of a similar kind can be carried out by incorporating a mixed method wherein quantitative methods of questionnaires and qualitative interviews from focus groups are recommended to fetch true findings about the attitudes and perceptions of students.

LIMITATIONS

1. The small sample size (57 students) in this study may not be enough to generalize the results.
2. The data collected for this study is limited to only one middle secondary school student from Thimphu, results cannot be generalized to other schools. Including more schools for such study would produce authentic results.
3. The intervention period of only two months may not be long enough to see a change in the attitude of students towards OER platforms.
4. Since CK-12 classes were independent of teachers' teaching or input from the teachers and peers, the lack of collaboration from peers and teachers would have affected the learning.
5. Using quasi-experiment (switching replication) may not have been the perfect method to know the difference in the attitude of the students towards CK-12 as there was not an experimental and control group, both the sections were equally provided exposure to CK-12.

6. Frequent use of technology as a teaching tool in a regular classroom might have hindered the true result of the study.

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CONFLICT OF INTEREST

The authors declared no conflict of interest.

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