The Impact of Using Understanding by Design (UbD) Model on Class 10 Student's Achievement in Chemistry

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ABSTRACT: The purpose of this action research was to examine the impacts of Understanding by Design (UbD) Model on class ten student's achievement in chemistry. The study population comprises students of class 10 of Mendrelgang Central School. A sample of 62 students: 22 boys and 40 girls, was drawn using the purposive sampling technique. The participants were divided into two groups, the control and the experimental group. The pretest-posttest control group experimental design is used for this study. This study focuses on investigating the effectiveness of the Understanding by Design model in improving class ten students' achievement in chemistry. The result shows a non-significant difference between the control and experimental group's mean score on the Academic Achievement of Chemistry Test (AACT) for class ten before applying UbD Model (pre-test), a significant difference between the control and experimental group's mean score of the Academic Achievement of Chemistry Test (AACT) for class ten after applying UbD Model (post-test) and significant difference between boys and girls mean score of the Academic Achievement of Chemistry Test (AACT) for class ten before applying UbD Model.

INTRODUCTION

According to the BCSE (2018), the science result has been consistently low, with a mean value of 51.85 compared to other subjects. Watching the reality of science education today in our country, it was observed that it is not achieving its expectations. This has been common in many countries, even in developed countries. Therefore, there is criticism directed at science teaching in our time.

Understanding by Design (UbD) is a model proposed by Wiggins and McTighe [1] as a planning method in education. As mentioned by Brown [2], Understanding by Design (UbD) supplies a regular speech for teachers interested in promoting student understanding rather than formulaic knowledge or recall learning. It also provides a framework and a toolkit on research-based best practices that have been proven effective in helping educators to promote understanding-based results for learning, expand the range of assessment tools and the processes they use to monitor student achievement, and enhance their design of instructional activities to promote high levels of student's achievement.

In alliance with the multitudinous benefits of Understanding by Design (UbD) revealed by numerous researches, this study was planned to examine the impacts of Using Understanding by Design (UbD) Model on Class 10 Student's Achievement in Chemistry.

Reconnaissance Situational Analysis

The chemistry means a result of the class ten students in Mendrelgang Central School has been relatively low compared to other subjects. We tried various teaching strategies, approaches, and skills, but that did not have significant improvement in the learners who seem to have a predisposition to chemistry being the most complicated and dull subject. This, however, calls for the development of new teaching methods in a well-planned and effective manner. Thus, this study aims to investigate the effect of using the Understanding by Design (UbD) model on class 10 students' achievement in chemistry.

Literature Review

Understanding by Design (UbD) is a model proposed by Wiggins and McTighe (1998) as a method of planning in education. At its core, UbD has three main stages: (a) Identify the desired results, (b) determine the desired evidence, and (c) plan instruction and experiences to meet the results [3].

Wiggins and McTighe (2005) stated that it aims to provide students with the ability to effectively use the material of the subject, and not just learn the material. One effective way to ensure classroom-based instruction includes lessons and units developed using the Understanding by Design (UbD) process. Planning begins by looking at the goals (standards) that need to be addressed. Educators begin with these goals and work backward, looking at the essential questions that will be considered to be the desired understandings, the knowledge and skills that students will acquire, and the ways that learning will be assessed. Evidence of learning can be assessed through authentic performance tasks, quizzes, tests, academic prompts, homework, journals, etc., along with the student's self-assessment. The learning plan is sometimes called the heart of a lesson plan [4].

Wiggins and McTighe [1] refer to Understanding by Design as a theory of Understanding. Therefore, the backward design process is compatible with several major educational initiatives, including problem-based learning [5], Dimensions of Learning [6], and The Skillful Teacher [7].

Using the principles of UbD, teachers focus first on learning goals (understanding goals). These are the enduring understandings that they want their students to have developed after the learning sequence. There is also a focus on several essential, or guiding, questions. Enduring understandings go beyond facts and skills to focusing on more significant concepts, principles, or processes [8]. Finally, Hinchliffe [8] summarizes UbD Model in a few words, "When we truly understand, we can explain, can interpret, can apply, have perspective, can empathize, and have self-knowledge."

According to Castillo [10], Understanding by design framework has helped to enhance the delivery of instruction in the High School Department of DLSZ through the following: new curricular developments such as curriculum mapping, construction of the unit assessment matrices (UAM), and revision of the learning module components; more meaningful integration of values in lessons; more effective management of instructional time; and enriched student learning.

Florian and Zimmerman [11] discussed Understanding by Design, Moodle, and Blended Learning as a case study about Secondary School. The results indicated that using the Understanding by design (UbD) Moodle and blended learning (BL) models has provided opportunities for students to develop the skills in knowledge intensity that they will need to compete globally. The study emphasized that schools which introduce new pedagogy such as UbD and BL often increase the academic achievement of the students. Consequently, the study also recommended a discussion of the experiences of secondary school students in (UbD) classrooms and the use of Moodle.

In addition, Almasaeid [12] pointed out UbD model in teaching shows higher degrees of academic achievement for students in science material depending on this model when compared to the traditional way. And also, Svoboda [13] described the Understanding by Design model helped advancement in the academic level of the learners and was helpful because it led to identifying ways in which we could improve upon the lessons in the future.

Research Setting

This study was conducted in Mendrelgang Central School. The school is situated North-West of Tsirang Dzongkhag. It is about 21 kilometers away from Damphu town towards Sarpang. Under the School Reform System initiated by the Ministry of Education in 2014, Mendrelgang Middle Secondary School became one of the twenty-four pilot Central Schools in the country. It is the largest Central School and was granted the status of the autonomous school in 2015.

Research Objectives

This study focuses on investigating the effectiveness of the Understanding by Design model in improving class ten students' achievement in chemistry.

Research Objectives

How can the Understanding by Design model improve class ten students' achievement in chemistry?

Study questions can be identified as follows:

1. Are there significant differences between the experimental and control groups in the Academic Achievement of Chemistry Test (AACT) for class ten before applying the UbD Model (pre test)?
2. Are there significant differences between the experimental and control groups in the Academic Achievement of Chemistry Test (AACT) for class ten after applying the UbD Model (post-test)?
3. Are there significant differences between boys and girls in the Academic Achievement of Chemistry Test (AACT) for class ten before and after applying the UbD Model?

METHODOLOGY

This study uses a pre-test, post-test control group experimental design. A pre-test for experimental and control groups was done in order to ensure the congruence between the two groups before applying the UbD model to the academic achievement of the chemistry test for class ten. Also, the control group was taught by teachers using the "traditional approach," while the experimental group was taught by teachers using the UbD model. Post-test was done in identifying the differences between the two groups after the application of the UbD model at the academic achievement of the chemistry test for class ten.

Fifty questions based on the BCSE prescribed syllabus were prepared by a team of chemistry teachers in the school and were used to collect baseline and post-line data before and after the intervention to test the academic achievement of the students in chemistry. The school science department examined the validity of an academic achievement test during a professional learning community meeting.

Intervention

1. Incorporate the Understanding by Design model (Backward model) for planning the chemistry lessons. Researchers will come together and plan the classroom lesson plans based on the Understanding by Design model by Wiggins and McTighe.
2. Students learning activities will be specially designed using the WHERETO model.
3. Students' learning will be assessed with various quizzes, tests, academic prompts, observations, homework, journal, and presentation.

Data analysis

The collected data analyzed by using SPSS Version 22, which depends on some of the statistical analyses, such as the t-test.

Result Study

The data were analyzed by conducting an independent sample t-test where the independent variable in the study is the Understanding by Design (UbD) model of teaching. In contrast, the dependent variable is the Academic Achievement of Chemistry Test (AACT) of students shown below in Table 1, 2, 3, and 4.

First Question

Are there significant differences between the experimental and control groups in the Academic Achievement of Chemistry Test (AACT) for class ten before applying UbD Model (pre-test)?

Table 1. Pre-test mean score of control and experiment group

Pre-test	Group	N	Mean	Std. Deviation	t	P
AACT	Experimental group	31	20.9516	6.79075	-0.550593	0.583957
	Control group	31	21.8952	6.70262		

Corresponding to Table 1, the experimental and control group's mean values are relatively close. At the end of the t-test analysis for independent groups, the calculated t value was ascertained t = -0.550593, and the meaningful P-value was more than 0.05 (P >0.05). This indicates no significant difference between the pre-test mean scores of the experimental and control groups.

Second Question

Are there significant differences between the experimental and control groups in the Academic Achievement of Chemistry Test (AACT) for class ten after applying UbD Model (post-test)?

Table 2. Post-test mean score of control and experiment group

Post-test	Group	N	Mean	Std. Deviation	t	P
AACT	Experimental group	31	27.6452	7.98665	2.069897	0.042775
	Control group	31	23.7910	6.61017		

Examining Table 2, the experimental and control group's mean values are different. At the end of the t-test, the calculated t value and meaningfulness level was ascertained; t = 2.069897 and P-value of 0.042775. As the P-value is less than 0.05, it indicates a significant difference between the result of the Academic Achievement of Chemistry Test (AACT) between the control and the experimental group.

Question Three

Are there significant differences between boys and girls in the mean score of the Academic Achievement of Chemistry Test (AACT) for class ten before and after applying the UbD Model?

Table 3. Pre-test means a score of boys and girls

Pre-test	Gender	N	Mean	Std. Deviation	t	P
AACT	Female	40	20.5656	6.61589	-1.367256	0.176646
	Male	22	22.9830	6.74364		

Table 3 shows that boys' and girls' mean score values are reasonably close to each other. The t-test analysis for gender according to calculated t value and meaningfulness level (t = -1.367256 and P-value greater than 0.05). This infers no significant difference between the boys and girls in their mean score values during the pre-test.

Table 4. Post-test mean score of boys and girls

Post-test	Gender	N	Mean	Std. Deviation	t	P
AACT	Female	40	24.1818	6.71356	-2.237533	0.028977
	Male	22	28.5114	8.25432		

The t-test analysis for gender according to the calculated t value and meaningfulness level for the post-test in table 4 shows that there is a significant difference in the mean score values in the academic achievement of boys and girls as the P-value is 0.0287, which is less than 0.05.

Reflection

This study shows that there is an increase in the mean score values of student's achievement in chemistry tests (increased by 3.9) between the control and the experimental group after the intervention, with the P-value of 0.42775 asserting a meaningful difference between the two groups further adding to the body of earlier literature by suggesting Understanding by design helps in improving student's achievement in chemistry. This finding concurs with previous studies. For example, Almasaeid [12] found that UbD teaching has high degrees of academic achievement for students in science material, depending on this model compared to the traditional way. The study also infers a significant difference between the

gender in the academic achievement of class ten chemistry, which is a new finding. This finding contradicts the earlier study done by Almasaeid [12], stating there was no significant difference in the gender in the academic achievement of science in grade eight students.

Limitations and future directions

This study is carried out with a relatively small sample size which would be inadequate for generalizability. Understanding by Design model is a new model of effective teaching that requires thorough Understanding and good practice before using it in the classroom. Therefore, training for teachers is recommended. Similar studies should be carried out in various subjects for evaluating students' achievements.

CONCLUSION

In the end, this action research examines the impact of using Understanding by Design (UbD) Model on Class 10 Student's Achievement in Chemistry. The results show that using the Understanding by Design (UbD) Model on Class 10 Students showed significant differences between the control and experimental groups' academic achievement. There is an increase in the Academic Achievement of Chemistry Test score means of the experimental group compared to the control group who were taught using the UbD model. This illustrates that using the Understanding by Design (UbD) Model in teaching improves students' academic achievement.

Acknowledgments

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