The Impact of using Understanding by Design (UbD) Model on 8th-Grade Student's Achievement in Science

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Abstract

The study explores the impact of using Understanding by Design (UbD) Model on 8th-grade student's achievement in science. The population of the study consisted of all the students of 8th grade at the Al Majd Model School for boys and Al Ebdaa Model School for Girls in Dubai. A sample of (60) students was drawn using random sampling technique. They were divided into two groups formed through matching based on their pre-test scores. The main objective of the study is to expose the experimental group in using Understanding by Design (UbD) Model and to compare the effectiveness of this mode of teaching in the teaching of science material. The pre-test-post-test control group experimental design is chosen for this work. The independent variable in the study is UbD model of teaching, while the dependent variable is the academic achievement of students. This study tool depended on academic achievement test in the Sciences material for the 8th grade prepared by the researcher. Also, the validity and reliability of the study tools was verified. The results shows a non-significant differences between the experimental and control groups based on the mean score in the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model (pertest scores), a Significant differences between the experimental and control groups based on the mean score in the Academic Achievement of Science Test (AAST) for 8th grade after applying UbD Model (posttest scores), and a non-significant differences between boys and girls based on the mean score in the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model.

Keywords: *Backward Design, Understanding by Design Model (UbD), Students Achievement, Achievement in Science, 8th Grade Students*.

Introduction

The world is witnessing a strong move at various educational levels. As a result, numerous platforms for designing and managing curriculum reforms has brought about Learning design, which focuses on the transmission of information in effective ways in the long run. However, in the long term, science education must aim for the active use of scientific knowledge and skill in everyday life.

The significance of Academic achievement has constantly provoked instructors to utilize diverse methodologies, techniques, systems, and models to focus and to have a significant impact on learners learning. Diverse variables can prompt better Academic achievement. Therefore, some of these variables are accepted to have a solid association with one another, while a few others have a weaker one. Some other variables are also different. However, the esteemed vital ones are really unbiased or negative (Afshar, Rahimi & Rahimi, 2014).

Teaching for the purpose of understanding is not simply another way of teaching, just as manageable as the usual lecture-exercise-test method. It involves genuinely more intricate classrooms. Basically, understanding has Six Facets (Perkins, 1992; Wiggins & McTighe, 2012; Taylora & Booth, 2015) which are:

1. Explanation: A mutual declaration of the meaning of words spoken, actions, motives, and providing thorough and justifiable accounts of phenomena, facts, and data.
2. Interpretation: An explanation of the meaning of another's artistic or creative work; an elucidation through telling meaningful stories, offer apt translations, provide a revealing historical or personal dimension to ideas and events; and making subjects personal or accessible through images, anecdotes, analogies, and models.
3. Applying: To make an application or to effectively use and adapt what they know in diverse contexts.
4. Have Perspective: The state of having a meaningful interrelationship: See and hear points of view through critical eyes and ears; see the big picture.
5. Empathizing: Find value in what others might find odd, alien, or implausible; perceive sensitively on the basis of prior indirect experience or related to someone else's emotional experience.
6. Have Self-knowledge: Perceive the personal style, prejudices, projections, and habits of the mind that both shapes and impedes our own understanding; they are aware of what they do not understand and why understanding is so hard.

When something is meaningfully understood, it is held longer. This is based on obtaining further understanding which is normally exceptionally adaptable in the circumstances and ways it can be utilized and encourage imagination. Understanding by Design (UbD) is a composition for improving understudy achievement. Emphasizing the teacher's essential part as an originator of understudy learning, UbD meets various desires inside the benchmarks driven instructive module. This will help instructors enlighten their learning goals, devise uncovering assessments of understudy cognizance, workmanship capability, and enamoring learning activities (Williams & Margot, 2009).

Consequently, instructional design is a systematic practice for developing high-quality instructional programs. Using the "Understanding by Design" model (developed by Grant Wiggins and Jay McTighe), this model is also known as a "backward" design model. Learning activities, instructional strategies, and embedded assessment methods are all derived from the outcomes so as to create a cohesive and effective learning design (Hinchliffe, 2016).

As a theory, Understanding by Design (UbD) is focused on the accompanying key thoughts (Castek & Coiro, 2015; Williams & Margot, 2009; McTighe & Seif, 2002) which are:

1. An essential objective of training ought to be the improvement and extending of understudy comprehension.
2. Understanding uncover their achievable acts when they are furnished with mind-boggling, bona fide chances to clarify, translate, apply, move a point of view, relate, and self-evaluate. At this point when it is connected to complex assignments, these “features" gives a reasonable lens through which educators can better survey understudy understanding. Viable educational program improvement reflects a three-stage configuration procedure called "regressive plan" that postpones the arranging of classroom exercises until the objectives have been cleared up and evaluations have been outlined. This procedure serves to maintain a strategic distance from the twin issues of "course reading scope" and "action arranged" educating, in which no reasonable needs and designs are obvious.
3. Understudy and school execution additions are accomplished through normal surveys of results (accomplishment information and understudy work) which thereafter is taken by focusing on acclimations to educational module and direction. Instructors get to be at their best when they look for criticism from understudies and their companions, and utilize input to conform methodologies to outline and educating.
4. Teachers, schools, and regions profit by "meeting expectations more intelligent" through the collective plan, offering, and associate audit of units of study.
5. UbD's standards and practices reflect an agreement of instructive scholars on what instructional methods advance learning activities (Wiggins & McTighe, 2012). They include: educational module that concentrates on top to bottom learning while in the meantime making important associations with platform information; developmental and summative appraisals that give chances to further learning; and successful understudy learning happens when specialists have a decent understanding of the disciplinary center of the subjects they educate. UbD's concentrate on expert cooperation in learning groups, curricular arrangement, real instructional method, and developmental appraisal is likewise upheld by numerous universal examination studies (Young, 2005; Williams & Margot, 2009).

UbD has two premises. The first one is the backward design, while the second is teaching for understanding. In the backward design, the teacher starts with classroom outcomes and then plans the curriculum by choosing activities and materials that help to determine student's ability and foster student learning. Backward design challenges "traditional" methods of curriculum planning. In traditional curriculum planning, a list of content that will be taught is created and/or selected.

The current study will be based on UBD model in order to raise the degree of academic achievement for students of the eighth grade basic education in science. It also aims to clarify the differences between the experimental and the control group before applying and after adding to

learn about the differences between the scores of academic achievement in science for both males and females.

The Problem of the Study

Watching the reality of science education today, it was observed that it is not fulfilling its expectations. This is commonly unsatisfactory in many countries of the world, even in developed countries. Therefore, there is criticism directed to the teaching of science in our time. The most important thing to do is to focus on information as an objective basis in the teaching of science through the use of traditional methods of teaching. Subsequently, there is still the general philosophy of the school and its role in the society. In addition, the objectives of Education and the message of the teacher were based on the process. It focuses on information transfer rather than focusing on generation and use. It should, however, be noted that classroom practices for science teachers concentrated on the cognitive side and the lack of attention to confirm the ways of science and methods. This is in spite of its importance in all stages of education because that which was proposed in the books of science and scientific knowledge emphasizes the facts and concepts in its final form.

In UAE, there is a problem in the teaching of science as a result of reliance on traditional models in education without modern model. The educational mainstream failed to resolve many of the teaching of science problems. As a result, science teachers agree that the best way to improve science education and development can only be done through the use of the scientific method based on research and experimentation and the use of reasons in solving problems. Thus, this is a missing factor in the traditional education of Sciences (TIMSS, 2011).

Internationally, more countries demonstrated relative strengths in knowing science than in applying scientific knowledge and reasoning (TIMSS, 2011). Similarly, little research exists to base evidentiary claims that teaching for understanding has a direct effect on improved student performance. Also, we can activate students' thinking to build understanding in the subject areas. We can help students to think more critically and creatively at the same time using UbD model. However, this appears clearly in the results of the United Arab Emirates (UAE) educational research on student's achievement in Mathematics and Science through the Trends in International Mathematics and Science Study (TIMSS). On the other hand, the results of these studies indicate the existence of difficulties in learning scientific concepts in various scientific fields with a large number of students. Hence, various approaches used in the teaching of science did not succeed in bringing about changes in students' understanding. The National Council for Research (NCR) related report teaches physics in the United States to a large number of high school graduates who lack understanding of many of the concepts (Wiske, 2005).

This, however, calls for the development of new teaching methods through a well-planned and effective manner. Thus, this study aims to investigate the effect of using Understanding by Design (UbD) model on 8^{th}-grade student's achievement in science.

Based on the above model, the UbD is considered as a guide to creating high-quality units targeted to individuals and groups interested in improving teachers and student's skills. In designing

the units of the study based on the (UbD) framework, the curriculum will be organized around a set of modules that will move from basic ideas. Accordingly, study questions can be identified as follows:

1- Are there significant differences between the experimental and control groups in the mean score of the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model (per-test)?

2- Are there significant differences between the experimental and control groups in the mean score of the Academic Achievement of Science Test (AAST) for 8th grade after applying UbD Model (post-test)?

3- Are there significant differences between boys and girls in the mean score pf the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model?

The Significance of the Study

The theoretical importance of the study emanates from the focus of the learner on the educational process of learning. They have a well-developed ability to withstand increasing responsibility for learning, provided with knowledge about his accession, and they have patterns of analytical difference. Learning skills, self-directed development of himself, and his abilities was such that they are able to continue learning during their lifetime. It also focuses on the system or the composite layout and dynamic relationship on how teachers teach and how they learn from their students. Also, teacher's training in detail and applied programs are often not addressed.

Practically, this study is an evidence of a research to achieve the aspirations of the scientific theories. However, it encourages educators and other researchers to conduct similar studies.

The present study is a translation of realistic overall objectives for Education, which aims to refine the individual personality of all mental, spiritual and emotional aspects, and rehabilitation to be able to interact and coexist with modern techniques. This can be achieved through the development of different thinking pattern which has an independent and personal leadership responsibility.

An embodied practical importance of the extent by which teachers take advantage of the Ministry of Education of this study was based on the expected results. However, its offer is real and reliable, and the educated confirms new calibration summed up in its emphasis on the actual use to become an expert teacher in learning and achieving the integration of the curriculum, education, and Calendar to support the understanding which is real and reliable.

As they might provide plans for a new model of teaching, teachers have prepared a new scientific way to be able to provide the style of the basic concept. Also, it has been offering feedback on how to oversee the recruitment and deal with curriculum that was prepared.

4. Theoretical Framework and Literature Review

Understanding by Design is the brainchild of Grant Wiggins and Jay McTighe, two internationally recognized experts in the field of curriculum, assessment, and teaching for understanding. Wiggins and McTighe underscore that Understanding by Design is a framework, and not an educational program. They have attempted to synthesize the best practices and the

research-driven design principles associated with teaching and assessing for understanding. Although complex and challenging, their work speaks to educators who know, either from experience or from intuition, that discrete, atomistic instruction focused on traditional drill-and-kill approaches is guaranteed to produce little, if any, genuine learning or deep conceptual understanding among their students (McTighe, Emberger & Carber, 2008).

Educators who have worked extensively with the Wiggins and McTighe framework almost universally acknowledge its commonsense recommendations for (1) unpacking curriculum standards; (2) emphasizing students' understanding, not just formulaic recall; (3) expanding assessment tools and repertoires to create a photo album of student's achievement instead of a snapshot; and (4) incorporating the best of what current research tells us about teaching for understanding to meet the needs of all learners (Wiggins & McTighe, 1998).

UbD is a model of planning that was championed by Wiggins and McTighe (1998) as a method of intentional 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 (Florian & Zimmerman, 2015).

Based on the goal of teaching according to UbD Moodle, Wiggins and McTighe (2005) stated that it aims to provide students (you) with the ability to effectively use the stuff of the subject, and not just learning the stuff. Thus, UbD contains three stages which are:

Stage 1: Identifying the desired results, unpacking the learning, prioritizing learning, goals, determining expectations, and clarifying learning outcomes.

Stage 2: Determining acceptable evidence.

Stage 3: Planning learning experiences and instruction.

One effective way to ensure that classroom-based instruction includes inquiry is to develop lessons and units 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 (McTighe & Sief, 2003).

Understanding by Design (UbD) provides a common language for educators who are 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 (Brown, 2016).

Wiggins and McTighe (2011) refers to Understanding by Design as a theory of understanding. Therefore, the backward design process are compatible with several prominent educational initiatives, including problem-based learning (Stepien & Gallagher, 1997), Socratic seminar, 4-

MAT (McCarthy, 1981), Dimensions of Learning (Marzano & Pickering, 1997), and The Skillful Teacher (Saphier & Gower, 1997).

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 at the completion of the learning sequence. There is also a focus on a number of essential, or guiding, questions. Enduring understandings go beyond facts and skills to focusing on larger concepts, principles, or processes (McTighe, 2016).

Teachers then decide on how their students will demonstrate their understanding. The researcher about UbD determines 'six facets of understanding'. They believe that students truly understand when they: Can explain, can interpret, can apply, have perspective, can empathize, and Have self-knowledge.

In UbD model process, teachers design the sequence of learning experiences that students will undertake to develop understanding. Beyond learning about a subject, students will need lessons that enable them to directly experience the inquiries, arguments, applications, and points of view underneath the facts and opinions they learn if they are to understand them (Wiggins & McTighe, 2005).

McTighe (2013) refers to the benefits of using UbD model in the educational process, which are:

- Provide structured, yet flexible frameworks for guiding curriculum planning, instruction, and assessment aligned to Standards.
- Examination of student work by teams of teachers, and the sharing of successful instructional strategies and resources.
- Encourage "backward" mapping of instruction from desired performances on difficult tasks.
- Offer practical design tools (e.g., Unit and Task Templates, GRASPS) to guide teachers and teams in the instructional design.
- Helping teachers to establish a "mental template" for effective planning and teaching.
- Provide educators with multiple examples (UbD units, Template Tasks, and Modules) that can be adapted and used to create additional resources.
- Engage students in the authentic application of knowledge and skills through rich tasks based on educational Standards.

Teachers whose work is guided by the principles of backward design do the following:

1. Identify desired learning results for the subject and topics they teach.
2. Determine acceptable evidence of student learning.
3. Plan learning experiences and instruction based on the first principles.
4. Regard learner differences as inevitable, important, and valuable in teaching and learning.

Referring to the curriculum mapping across the grades by using UbD, Wiggins and McTighe (2012) Illustrates that the book will be taught by Designing outlines through systemic approach for using the UbD framework to map the curriculum across the grades. Curriculum coherence is achieved through "spiraling" essential questions and "cornerstone" tasks directed toward long-term transfer goals. UbD offers a set of Design Standards with corresponding rubrics to serve as the criteria for quality control.

Finally, Hinchliffe (2016) summarize UbD Moodle in a few words; "When we truly understand, we can explain, can interpret, can apply, have perspective, can empathize, Have self-knowledge".

In order to achieve high rates of academic achievement for students of the 8th grade in science referring to UbD model, the researcher took some steps as follows:

1. The teacher gives quizzes orally to students who need to have the questions on science material read aloud.
2. The teacher continues to ensure that students who have weak achievement level in science material have access to new information related to science material. Thus, such a strategy might include student's group work.
3. The teacher provides resources for students at a range of scientific topics at varying degrees of content complexity so that all students can have access to materials that are appropriately challenging for their needs.
4. The teacher invites students to propose alternate ways of accomplishing assessment goals.
5. The teacher directs the work of one or more small groups for students who need adult guidance periodically throughout their results.
6. The teacher offers students the option of working alone or with a partner when appropriate so that students may work in a way that is most comfortable and effective for them.
7. The teacher uses rubrics with elements and criteria focused on key content goals (science material), as well as personalized elements designed to appropriately challenge various learners.
8- The teacher provides optional planning templates or organizers to guide students' product or assessment work.
9. The teacher continues to use regular groups as a means of helping him/her have a sense on how students' work is progressing.

Literature Review

Few literature review mentioned the usage of Understanding by Design UbD Model with Students Achievement and other variables. Subsequently, the researcher found three literature reviews related to the current topic which refers to the importance of UbD model in raising the academic achievement of students as follows:

Castillo (2015) study aimed to discuss the extent of the effectiveness of the use of the Understanding by Design (UbD) framework in writing learning modules. Primary research data were obtained by conducting a survey among pre-selected high school teachers across 11 subject areas. The researcher prepares his questionnaire. Also, data analysis was conducted thereafter. The UbD 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 (2015) 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.

Svoboda (2011) described the efforts to reform curricula using the Understanding by Design model and to see if this style of curriculum design will help in becoming a more effective teacher. Thus, if it leads to an increase in student learning, the hypothesis shows that this new approach to teaching will lead to an increased understanding of science concepts among students because it is based on purposeful thinking. The researcher introduced lessons from several outstanding programs, including Epicenter (Purdue University), Incorporated Research Institutions for Seismology (IRIS), the Master of Science Program in Applied Science Education at Michigan Technological University, and the Michigan Association for Computer Users in Learning (MACUL).

The results of the study indicated that although the lesson (pilot-tested) was not as successful in increasing student learning outcome, the advancement in the academic level of the learners is of significant importance. The result shows that the use of UbD was helpful because it led to identifying ways in which we could improve upon the lessons in the future.

- Participant: All participants were (60) student selected from two schools in Dubai. The first school was *Al Majd* Model School for boys (30), while the second school was *Al Ebdaa* Model School for Girls (30). All the participant (60) were divided into two groups: experimental and control after mixing them. Also, each group contains 30 participants: 15 boys and 15 girls.

6. Methodology

This study depended on an experimental approach. Pretest for experimental and control groups were done in order to ensure the congruence between the two groups before applying UbD model at the academic achievement of science test for 8th grade. Also, the control group learned by traditional approach, while the experimental group learned by UbD model. Posttest was done in identifying the differences between the two groups after the application of UbD model at the academic achievement of science test for 8th grade.

Tool of the Study

In this study, an academic achievement test was used to collect the data of the study before and after the experiment. It had 33 questions. All the questions were created based on the 8th science curriculum and its objectives. Upon the researcher's request, an experienced science teacher prepared the test and was given feedback by a jury of experts. The validity of the achievement test was examined by three science teachers and one curriculum specialists. The reliability coefficient of the test was .82, indicating a strong internal consistency.

Data Analyses

The collected data was analyzed using SPSS Version 21, which depends on some of the statistical analyses such as T. Test.

Study Results

In this part, the data were analyzed. However, the pre-test and post-test t-test results of the students in the experimental and control groups for Academic Achievement of Science Test (AAST) for 8th grade are shown Table 1 and 2 according to the first and second questions as follows:

- First Question: Are there significant differences between the experimental and control groups in the mean score of the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model (per-test)?

Table 1. Pre-test mean scores of the Experimental and Control Group

Test	Group	N	X	S	SD	T	P
AAST	**Control**	**30**	**7.7**	**0.87**	**58**	**-0.12**	**0.89**
	Experimental	**30**	**7.1**	**0.98**			

Examining Table 1, experimental and control group's average point values are quite close to each other. At the end of the t-test analysis for independent groups, the calculated t value and meaningfulness level was ascertained (t(58)=-0,12; p>.05). That is to say, there is no significant difference between the pre-test average point values of the experimental and control groups.

- Second Question: Are there significant differences between the experimental and control groups in the mean score of the Academic Achievement of Science Test (AAST) for 8th grade after applying UbD Model (post-test)?

Table 2. Post-test mean scores of the experimental and control group

Test	Group	N	X	S	SD	T	P
AAST	**Control**	**30**	**9.6**	**1.07**	**56**	**5.05**	**0.00**
	Experimental	**30**	**11.2**	**1.13**			

Examining Table 2, experimental and control group's average point values are quite different. At the end of the t-test analysis for independent groups, a meaningful difference between the groups in favor of the experimental group was detected according to the calculated t value and meaningfulness level (t(56)=5,05; p<.05). According to Academic Achievement of Science Test (AAST) for 8th grade Test post-test average point values, the experimental group was more successful than traditional methods.

- Third Question: Are there significant differences between boys and girls in the mean score of the Academic Achievement of Science Test (AAST) for 8th grade before applying UbD Model?

Table 3. Pre-test mean scores of the Boys and Girls

Test	Group	N	X	S	SD	T	P
AAST	**Boys**	**30**	**6,7**	**0,83**	**54**	**-0,13**	**0,96**
	Girls	**30**	**6,8**	**0,93**			

Table 3 shows that boys and girls average point values are quite close to each other. This occurs at the end of the t-test analysis for gender according to calculated t value and meaningfulness level ($t(54)=-0,13$; $p>.05$). That is to say, there is no significant difference between the boys and girls average point values.

7. Conclusion

In conclusion, the current study examines the impact of using Understanding by Design (UbD) Model on 8th grade student's achievement in science depending on the experimental approach. A sample of the participants was chosen and were divided into experimental and control group. The two groups was chosen as the first unit of decision science for the first semester. The researcher prepared academic achievement test in the Sciences material for the 8th grade, and teaching of the experimental group through the UbD model. However, when he was teaching the experimental group, the same was scheduled in the traditional method after the application of the study. The result shows the raising of the academic achievement rates for the experimental group compared to the control group, which pointed to the effectiveness of UbD model in teaching. It also shows high degrees of academic achievement for students in science material, depending on this model when compared to the traditional way.

8. Recommendations

At the end of the study, the researcher recommended the following:

- The teachers should be trained to use UbD model because it is found to be an effective for teaching science material.
- UbD model is a new model of effective teaching that requires thorough understanding and sufficient practice before usage for instruction.
- Similar studies should be also replicated on students at both secondary as well as elementary levels for teaching.
- Experimental studies should be conducted for the evaluation of the effectiveness of other teaching models on other materials.

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