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The Effect of a Teacher-Developed Curriculum on Engineering Students' Assessment Scores and 21st Century Skills

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Abstract

This study aimed to evaluate the effect of a teacher-developed curriculum on grade 11 female Emirati students' assessments scores and 21st century skills. Qualitative and quantitative methods were used to answer the research questions. A quasi-experiment was set up with two groups consisting of two female teachers and 20 female students. The quasi-experiment focused on evaluating the pre-and posttest scores for the students to ascertain whether a teacher- developed curriculum would show significant improvements in students assessment scores. Further, an observation of a top-down and teacher-developed lesson was conducted and carefully analyzed to overlook the 21st century skills deployed by the female students. The results of the quasi-experiment showed that students assessment scores improved under both treatments and there was no significant difference in the assessments scores of students who were taught through a teacher-developed curriculum. However, a teacher-developed curriculum enhanced the use of the students' 21st century skills.

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Introduction

The recent global pandemic and changes in students' needs and academic interests has demanded teachers to alter or change the top-down curriculum essentially provided to them. Throughout the past years, teachers have perceived that they strongly needed to be a part of curriculum development to suit the needs of the overall teaching and learning environment. This included, but not limited to, the resources available to the teacher, students' English proficiency, and educational technologies the teachers and the students have access to. Therefore, other methods of curriculum development need to be explored in order to solve the challenges teachers faced with a top-down curriculum.

The most basic group in the curriculum development process is teachers who have a core role that can't be ignored during curriculum development (Oliva, 2008). In a teacher-developed curriculum, the curriculum focuses solely on the student needs in each specific class. The teacher is aware of the suitable tasks and activities for the curriculum, prior knowledge the students have and to what level of content depth the students need. As implementers of the curriculum, teachers should actively be participators in curriculum development (Oliva, 2008).

In a study done by Bas and Sentürk (2019), it was found that teachers did not have the opportunity to directly participate in the curriculum development process. Taba (1962) believed that "teachers are aware of the students' needs; hence teachers should be the one to develop the curriculum and implement it in practice" (Läänemets & Kalamees-Ruubel, 2013, p.4). El-Okda (2005) stated that most Arab countries focused on the top-down model and teachers had minimal participation in curriculum development. This research aims to examine and observe the effect of a teacher-developed curriculum on the students' assessment scores as well as their use of 21st century skills.

The opportunity of teachers to work in curriculum development is itself a great significance. As teachers are a vital part of society, it is their main role to ensure the successful implementation of the curriculum. Since teachers' skills, knowledge and expertise may impact students' performance it is important that they have a part in curriculum development. Teachers are able to change, modify and enhance the curriculum to suit the characteristics of the students. Their vital role in curriculum development could reflect prosperous outcomes in teaching and learning.

Teacher-involvement in curriculum development is a crucial area of study in modern education. Klein (1991, as cited in Bas & Sentürk, 2019) stated that "increasing the participation of teachers in the curriculum development process will both enhance the status of the teaching profession and improve the curriculum to provide a better educational system" (p.6). Bas and Sentürk (2019) emphasized the importance of teachers' participation in curriculum development at both the central and local level. Alsubaie (2016) highlighted that curriculum development should be viewed as a process by which meeting student needs leads to improvement of student learning. "Teacher involvement in the process of curriculum development is important to align content of curriculum with students' needs in the classroom" (Alsubaie, 2016, p.2).

Curriculum Development: Definition and Process

Curriculum is the interaction between the people and the resources, the materials, and the contents. Curriculum has been defined as "an umbrella and continuous process in which structure and systematic planning methods figure strongly from design to evaluation" (Carl, 1995, p.5), "all the learning which is planned or guided by the school, whether it is carried in groups or individually, inside or outside the school" (Taylor, 1966, p.5) and "all the learning which is planned or guided by the school, whether it is carried in groups or individually, inside or outside the school" (Kerr, 1968, p.5).

Curriculum development includes curriculum design, curriculum implementation and curriculum evaluation (Ornstein & Hunkins, 2009). According to Jadhav & Patankar (2013) curriculum development is "the process of creating planned syllabus, teaching, training, and exhibition modes" (p.5). Jadhav and Patankar (2013) suggest that curriculum development is a dynamic process. The process consisted of several stages including planning, preparing, designing, developing, implementing, evaluating, revising, and improving. According to Alsubaie (2016), "teachers' involvement in the curriculum development process is essential in meeting the needs of society" (p.1), thus, it is essential for teachers to reflect on the society's needs in the curriculum development process.

Models of Curriculum Development

A curriculum model depends on the requirements of the people, group of people, and the society (Bibi, Bhuttah, Ullah, & Xiaoduan, 2018). "Basically, models are samples that provide guidelines to action and more or less set up for educational purpose" (Bibi et al. 2018, p.3). Two known scholars that developed models of curriculum development are Ralph Tyler and Hilda Taba. Ralph Tyler's model followed four main principles of curriculum development, which are:

(1) purpose of the school
(2) educational experience
(3) organization of the experiences and,
(4) evaluation of the experiences. (Bibi et al. 2018, p.5)

Bibi et al. (2018) discussed that Tyler's model was 'society centered', thus, it followed the needs of the society. Läänemets and Kalamees (2013) opined that Tyler's model described learning "as taking place through the mixed behaviors of the student" (p.3), also known as a learner-centered approach. Taba emphasized that in developing a curriculum, teachers should be an active part (Bibi et al., 2018). Tyler's curriculum model focused on a top-down approach whilst Taba focused on a bottom-up approach which was known as the grass-root approach. Thus, Taba developed a method that clarified what needs to be learned to the students (Costa & Loveall, 2002). While using this approach, Taba emphasized "that the role of teacher in the development of curriculum is very crucial" (Bibi et al., 2018, p.6). The grass-root approach was explained using the seven-steps introduced by Taba. These seven steps are:

(1) find the requirements of the learners
(2) identifying goals to be learned by the teachers

(3) the contents and objectives should match
(4) the content should be categorized according to the interest of the children.
(5) the methods of instruction should engage the learners
(6) the actions of learning should categorize to recall the learners what they learned
(7) in the process of evaluation both the teacher and the student involved. (Ornstein & Hunkins, 2002)

Furthermore, Tyler's approach argues from the administrator approach while Taba's approach reflects the teacher's approach (Läänemets & Kalamees, 2013). Tyler believes that curriculum should be designed by the administrator and it is the role of the teacher to implement it. On the other hand, Taba's model revolves around the fact that teachers are aware of the students' needs, thus they should both develop and implement the curriculum (Läänemets & Kalamees, 2013).

Centralized and Decentralized Curriculum Approaches

Curricula can be designed on a macro, meso, and micro level. Eunitah et al. (2013) discussed that the centralized curriculum uses a top-down approach. In a top-down approach, the implementation starts with the government and continues to school. In contrast, a decentralized curriculum is the complete opposite. Eunitah et al. (2013) added that a decentralized curriculum begins at the grassroots level, which was referred to as schools and then elevates up.

Teacher Involvement in Curriculum Development

It is essential to look at the importance of teacher involvement in curriculum development. Johnson (2001) emphasized that curriculum development can be challenging, however, the participation of people directly related and involved in student instruction is vital. Teachers can understand the psychology of the learner as well as the teaching methods and teaching strategies (Jadhav & Patankar, 2013). According to Alsubaie (2016), if the curriculum was developed by another party, then teachers would have to make an extra effort to understand and implement it. Therefore, the curriculum development team should consider the teacher as a part of the curriculum development process (Carl, 2009).

Challenges Teachers Face in Curriculum Development

Alsubaie (2016) argue that teachers may not have the necessary skills needed to develop a curriculum, therefore their involvement in the curriculum will be of minimal benefit. "There should be major advances in teacher development in order for teachers to actively reflect on society's needs in each stage of the curriculum development process" (Alsubaie, 2016, p.1). Not all teachers could participate in curriculum development. Handler (2010) emphasized the need for professional development to upskill teachers in the curriculum implementation process. Thus, teachers would need training and workshops to be able to contribute to curriculum development. Gerrard and Farrell (2014) concur that the lack of expertise for curriculum design and low teacher qualification are other factors that exclude the involvement of teachers from the curriculum implementation process.

Teachers' Perspective of their Participation in Curriculum Development

In a qualitative case study design conducted by Senturk and Bas (2019) surveying the views of 27 teachers in terms of their participation in curriculum development, it was concluded that most teachers had the opportunity to participate in the curriculum development process at the local level. However, it can be argued that the opportunity for teachers to participate in the curriculum development process is rather limited (Senturk & Bas, 2019). Messick and Reynolds (1991) discussed that teachers knew the needs of the students as they were the closest people to them. Kubitskey and Fishman (2006) claim that educational reform initiatives rely on teachers' participation in curriculum development. Teacher's involvement in curriculum development influences the teachers to implement the curriculum in the classroom effectively (Maleybe, 1999). According to Senturk and Bas (2019), teachers are dissatisfied with their insufficient participation in the curriculum development. This leads to disconnected teaching in the classroom as teachers developed feelings that their views in curriculum development were not taken into consideration.

In another study conducted by Nghihalwa (2018) to study teacher's involvement in the planning and development of the curriculum, the researcher used multiple methodologies including, a qualitative research approach, interpretivism and a case study, to understand the views of teachers in regards to their involvement in curriculum development. Nghihalwa (2018) stated that the use of interpretivism allowed the researcher to understand as well as interpret teachers' perceptions and prescribed views. Nghihalwa (2018) concluded a significant element that was related to the challenges teachers faced in curriculum development which was teachers expertise. Lau (2005) suggested that failure to implement the curriculum was due to teachers who were not acquainted with curriculum issues, therefore highlighting the fact that teachers' expertise is significant in curriculum development. Nghihalwa (2018) also concluded that is was significant to involve teachers in curriculum planning and development, moreover, the teachers were taking into consideration the learners needs, thus, this resulted in developing a curriculum that was meaningful to the students. Consequently, teachers in the study stated that the curriculum contained objectives and unnecessary content that were unlikely to be implemented. Teachers felt that the topics were boring and inapplicable for the students. This highlights the importance of teachers to be able to develop or amend the curriculum to reflect the environment, needs and conditions of the students and overall society.

The 21st Century Skills and Curriculum

Over the last decades, teaching students was based merely on reading, writing and arithmetic. Curriculum models were developed based on a teacher-centered approach. Nowadays, however, curriculum developers know the importance of developing educational goals and teaching methods in order to prepare students for college and their future careers (Alismail & McGuire, 2015). With the changing demands of the 21st century workplace, Saba et al. (2015) argue that "in addition to traditional learning students must also be able to apply concepts learned in class to solve real-world problems, to cooperate well in groups and workplace teams, and to understand of the importance of civic engagement and social responsibility" (p.24). Twenty-first century skills are vital to prepare students with the necessary knowledge and life skills that will help them in their future careers. "Therefore, curriculum in the 21st century should focus on the construction of knowledge and encourage students to produce the information that has value or meaning to them in order to develop new skills" (Alismail & McGuire, 2015, p.151).

Teachers play an important role in helping students utilize and develop 21st century skills. Alismail and McGuire (2015) emphasized that "today, teachers should give students the opportunities to engage in various activities that promote cooperative learning such as projects, problems, design and researched-based learning" (p.152). Willingham and Andrew (2009) discussed the challenges teachers face with teaching collaboration, creativity, and innovation. They emphasized that teachers know only how to teach self-direction.

Willingham and Andrew (2009) suggest that "because of these challenges, devising a 21st century skills curriculum requires more than paying lip service to content knowledge" (p.19). Moreover, the skills need to be taught in the context of particular content knowledge while treating both equally. Evidently, teacher's involvement in curriculum development is not free from challenges, however, "involving teachers in curriculum development process has more benefits than not involving them" (Nghihalwa, 2018, p.35).

Teachers' involvement in curriculum development has been presented in literature mostly as qualitative and quantitative research, therefore it is equally important to present this study using a quasi-experiment and underline its effect on students' academic performance and 21st century skills. This study aims to investigate the effect of a teacher-developed curriculum on engineering students' assessment scores and 21st century skills in the United Arab Emirates.

Objectives of the Study

The objective of this study is to investigate the effects of teacher-developed curriculum on engineering students' assessment scores and acquisition of 21st century skills.

The study aims to answer the following research questions:

(1) Is there a statistically significant difference in the mean scores of students taught through a teacher-developed curriculum and students taught through a top-down curriculum?
(2) Is there any significant difference in the 21st century skills displayed by engineering students in the top-down and teacher-developed curricula?

Table 1. Students' Mean Scores and Standard Deviation in Pre- and Posttest of the Assessment on Circuit between Experimental and Control Groups

	Curriculum		Pretest	Posttest
Group A (Control) (N=10)	Top-down	Mean	6.5	7.2
		Standard Deviation	2.415	2.616
Group B (Experimental) (N=10)	Teacher-developed	Mean	6.6	7.6
		Standard Deviation	1.577	2.633

Method

Quasi-experiment

According to Fraenkel and Wallen (2009) “a quasi-experiment does not include the use of random assignment” (p.271). A nonrandom quasi-experiment was set up with two groups of two teachers and 20 female Emirati learners in order to investigate whether the involvement of teachers in curriculum development that is integrated into engineering instruction shows positive results in terms of the improvement of students’ performance in assessments. A pretest-posttest nonequivalent groups design was followed. The experiment includes an experimental group and a nonequivalent control group. The independent variable (teacher- developed curriculum) is administered to the experimental group. The nonequivalent control group will receive a top-down curriculum developed by the Ministry of Education. Both groups will take the same assessments to analyze the use of each type of curriculum on students’ performance.

Sample and Sampling Technique

Purposive sampling was employed to select the teachers for the study, specifically those who would contribute to the curriculum development and participate in the experimental group. According to Fraenkel and Wallen (2009), purposive sampling is based on prior knowledge of a population and the specific goals of the research, allowing investigators to use their judgment in selecting participants. In this study, teachers were chosen based on their educational background and teaching experience, with preference given to those holding an engineering background to ensure sufficient subject knowledge for effective curriculum implementation without compromising study outcomes. Selected teachers also had at least four years of teaching experience. The final sample was divided into two groups: Group A, the non-equivalent control group, which included one teacher and ten female Emirati learners who used the Ministry of Education’s top-down engineering curriculum; and Group B, the experimental group, which also consisted of one teacher and ten female Emirati learners but was treated with a teacher-developed curriculum designed to meet Ministry qualification standards, achieved through training provided by the researcher prior to implementation.
Instrumentation

Quantitative Quasi-experiment

A quantitative quasi-experiment was setup consisting of a pretest and a posttest. The pretest and posttest were used to check the effectiveness of the curriculum during both deliveries, as well as to investigate the primary research question; “what effect does a teacher-developed curriculum have on engineering students’ assessments scores?”. The pretest was administered to the students at the beginning of each classroom lesson, and the posttest was administered to the students directly after the classroom session was completed.

Pre- and Posttest Development

A test was developed using google forms to be taken by all the students at two times throughout the research process. The tests included a pretest and a posttest. The test consisted of 10 multiple choice questions directly related to the student learning outcomes of the engineering curriculum. A sample of the pre-and posttest can be found in Appendix B. The test was designed to be taken before the treatment to evaluate what the learners already know and directly after the treatment to evaluate what students have learnt after being treated.

Teacher-developed Curriculum

To develop the curriculum, both teachers for Group A and Group B were given a training on how to create lessons whether from teacher-developed or top-down curriculum. The researcher along with the teachers went through the learning outcome to be covered and the performance criteria the students needed to achieve. The researcher explained to the teacher in Group B (experimental) that she needed to create a curriculum based on the learning outcome "demonstrate the construction and testing of the circuit" and the performance criteria "identify different types of circuits". The teacher was also asked to prepare a PowerPoint to include the content for the curriculum and a detailed lesson plan for the purposes of comparisons between the two types of curricula.

Observation

In this study, a non-participant observation was conducted since the researcher did not participate in any of the activities being observed. An observation form was created to overlook the 21st century skills deployed by engineering students in grade 11. The observation answers the research question "what effect does a teacher-developed curriculum have on engineering students 21st century skills?". While creating the observation form, the researcher attended a grade 11 engineering lesson on Tuesday, November 3rd to check the validity of the instrument used. "Observation forms should always be used on a trial basis in situations similar to those to be observed in order to work out any bugs or ambiguities" (Fraenkel & Wallen, 2009, p.120). After trial testing, the observation form, the researcher attended two engineering lessons through Microsoft Teams. The main focus of the observation was to overlook the four most important 21st century skills, communication, collaboration, creativity and critical thinking.

Data Collection Procedure

The data collection procedure included two treatment lessons. The treatments were carried out on two sequential days, however, both classes started at the same time and were treated under the same online classroom environment. Group A was observed on Day 1 at 10:30 in the morning and Group B was observed same time the next day. All learners were informed that all information, including names and the scores on tests, will be kept confidential.

The treatment procedure for both Group A and B were as follows:

(1) The learners took the pre-lesson test (5-10 minutes).

(2) Group A was given a virtual lesson from the top-down curriculum provided by the Ministry of Education (25-35 minutes).

(3) Group B was given a virtual lesson from a teacher-developed curriculum. The lesson was relatively short to align with the test developed (25-35 minutes).

(4) The learners took the post-lesson test (5-10 minutes).

The assessment scores were documented using google forms and the observations were documented through detailed notes taken by the researcher. The researcher used a color code scheme to ensure the correct 21st century skill was targeted. Each color matched a specific 21st century skill.

Results

Data Analysis for Group A and B Pretest and Post-test Results

Descriptive analysis for Group A and Group B's pretest and post-test results, as shown in Table 1.

Hypothesis Testing using t-test

A two-sample equal variance t-test was conducted, and results are as shown in Table 2.

Table 2. Two-sample t-test for the Score in Assessment on Circuit in Post-test between Experimental and Control Groups

Two-sample t-test			
t	F	Sig. (one-tailed)	Mean difference
- 0.340	10	0.368	0.4

Note: Significant level, p = 0.05

The significance value is set to 0.05 or 5%. If the P-value < significance value, then the researcher can reject the null hypothesis. If the P-value > significance value, then the researcher cannot reject the null hypothesis. In this study, the P-value one-tail = 0.368> 0.05. Furthermore, the null hypothesis cannot be rejected as the P-value is greater than the significance value.

Analysis of Students' 21st Century Skills

Observations were used to gain further insight into the effect of a teacher-developed curriculum on students' 21st century skills. An observation form was filled out for both the Group A class and the Group B class observed during the study. To conduct a detailed analysis, the observation form was divided into three main sections:

(1) collaboration, cooperation, and communication;

(2) creativity and innovation and

(3) critical thinking, problem-solving, and time-management.

The frequency table and percentage of occurrence for the Group A classroom is shown in Table 3. Overall based on the results of the classroom observation, there was moderate use of 21st century skills in the classroom. Collaboration, cooperation, and communication all together accounted for 48% of the total occurrences, the use of creativity and innovation was 19% and critical thinking, problem-solving and time- management skills were set to 33%.

Table 3. The percentage of the frequency of occurrence for the 21st century skills deployed by students in Group A and Group B

	Group A		Group B	
Collaboration-Cooperation-Communication	f	%	f	%
a) teacher provides students the opportunity to speak/read with their own voice	7	33	13	34
b) students are flexible and accept their classmates' ideas and plans	-	-	2	5
c) students initiate discussion with the teacher	3	14	2	5
d) students initiate a discussion with other students	-	-	1	3
e) students work together in a team	-	-	3	8
Creativity-Innovation				
a) students answer questions creatively or untraditionally	1	5	-	-
b) students generate new ideas about a specific concept	-	-	-	-
c) teacher asks higher order thinking questions	1	5%	4	11
d) teacher provides students the opportunity to be challenged and take risks	-	-	1	3
e) students relate topics to real-life experiences	2	10	2	5
Critical Thinking-Problem Solving-Time Management				
a) students generate or ask their own unique essential question	3	14	4	11
b) students find multiple solutions to task/activity problems	-	-	1	3
c) students interpret information from a task and discuss it with the teacher	-	-	1	3
d) students analyze information from a given task	4	19	1	3
e) students finish tasks on time	-	-	3	8

First, examining the students' collaboration, cooperation, and communication skills, it was noted that in only 33% of the occurrences the teacher gave the students the opportunity to speak and 14% of the occurrences the student initiated the discussion with the teacher. For example, at minute 8:49 the teacher started the warm-up activity where students were discussing the electrical component symbols. It was evident that students didn't initiate discussions with the teacher or other students, however, responded to a teacher's discussion when they were required to. Furthermore, there were no other evident observations on the student to student interaction, whether, through discussions or teamwork, this led to poor collaboration and cooperation skills in the classroom. Second, creativity and innovation were not evidently encouraged in the classroom, the percentage of the frequency occurrence was very low. Students were not given the opportunity to be challenged or generate new ideas about a given topic. However, when a student was asked a higher-order thinking question they were able to answer it creatively, placing the frequency occurrence to 5% for both instances. For example, at minute 15:02 the teacher provides the students with a schematic diagram. The teacher asks the students to analyze the schematic diagram and identify the values and symbols in the diagram. At minute 15:42 one of the students answered: "if we compare this diagram to the one we took in the previous class, then I can see different components, such as a resistor and an LED". Third, examining the critical thinking, problem-solving and time management skills, it was observed that the students struggled with finishing a task on time. When given a task by the teacher, the students could effectively analyze the task (19%) by asking the teacher unique questions (14%) to reach a conclusion. For example, at around minute 25:00, the teacher provided the students with an individual task. The students were given two images and the teacher asked them to analyze, compare, and identify the types of circuits in both images. This is where it was evident that students were able to analyze a task as one student said “in the first image one of the components is not connected” concluding it was an open circuit.

The frequency table and percentage of occurrence for the Group B classroom is shown in Table 6. The total number of frequencies was 38 (N=38). The Group B classroom was rich with 21st century skills. Collaboration, cooperation, and communication all together accounted for 55% of the total occurrences, the use of creativity and innovation was 18% and critical thinking, problem-solving and time-management skills were set to 26%.

First, examining the collaboration, cooperation, and communication skills it was evident that the students enjoyed participating in the class and were highly engaged. At minutes 11:43, 19:21 and 35:10 the teacher provided the students with a task to complete. The tasks were to be completed in teams. The teacher had already set up the students in groups so that no time would be wasted during the class period. This gave the students the opportunity to work together in a team and accounted for 8% of the total frequency occurrences. The teacher used a stopwatch to time the activities, therefore the students completed all the activities on time (8%). Moreover, after every topic covered, the teacher asked the students concept checking questions (CCQs) for example “is there is a schematic diagram for each electronic circuit used in industry?” and “when there is a break in the circuit does this imply that the two terminals points are externally disconnected?”. These questions led students to initiate discussions with the teacher (5%) as well as giving the students the opportunity to speak with their own voice (34%). At minute 13:42, a student raised her hand to ask her colleague why she thought schematic diagrams were easier than breadboard circuits. This was the first instance of a student initiating a discussion with another student (3%). The student continued her explanation, thereafter other students joined to accept their colleague's ideas (5% of the total frequency occurrence). Second, the use of creativity and innovation was 18% of the total frequency occurrences. At minute 14:02 the teacher played a video for the students, during the video the teacher stopped to ask the students higher-order thinking questions (11%), “Identify the importance of the positive and negative polarities in a battery? Compare the types of circuits? If there is zero-resistance, identify the correct type of circuit.”. Moreover, the students were granted the opportunity to participate as well as to check on their understanding. A one-minute discussion was initiated by the students to discuss the importance of the video. At minute 26:32 the teacher picked a random student to share her screen and finish the circuit that she was building on the circuit construction application. This was the first case where a student was challenged (3%). The students were not very familiar with relating topics to real-life experiences and this was evident in the classroom as it was noted to be only 10% of the total frequency of occurrences. At minute 23:22 one of the students mentioned that while working on her engineering project it was not functioning properly due to a few open circuits. The student used the lesson terminology to relate what was being taught to a real-life experience. Third, critical thinking, problem-solving, and time-management skills were noted to be 26% of the total frequency of occurrences. At minute 35:10 the teacher gave the last class activity. In this activity, students were required to work in a group to create the different types of circuits taught in the lesson. In this activity, students were asking their own essential questions such as "if I remove this component from this circuit, will it become an open circuit?". The students also found multiple ways to solve the task. This was evident as one of the students presented the answer to the task in two different ways.

Discussion

Summary of Quasi-experiment

The descriptive analysis of the pre-and posttest assessment results for both Group A and Group B shows that there was an improvement in the mean assessment scores of both groups regardless of the type of curriculum used. The mean score of Group A improved by 0.7 points and the mean score of Group B improved by 1 point. With such a low number of students, the mean test results of each group involved in the experiment were highly influenced by the results of each individual student within them. This might have led to minimal improvement in assessment scores. Furthermore, comparing the mean values of the posttest results of Group A and Group B, it was shown that there was only a difference of 0.4 points between the two groups. Group B, the experimental group that was treated with a top- down curriculum, had a higher mean score than Group A in the posttest taken after completing the treatment procedure. This was the expected outcome, as a teacher-developed curriculum was due to improve the assessment scores of the students.

However, based on the results of the t-test conducted, it was evident that the null hypothesis was true and there was little evidence to prove that the assessment scores of the students improved after being treated by a teacher-developed curriculum. There was actually no significant difference in the assessments scores between students who were taught through a teacher- developed curriculum and students who were taught through a top-down curriculum.

A teacher-developed curriculum was supposed to enhance the performance of the students' assessment scores as it played a vital role in adapting the curriculum to the students' individual needs. However, according to the data analysis, this was not statistically verified. First, this could be due to the level of expertise and qualification of the control and experimental group teachers. Second, the students were not focused on completing the assessment to a high standard as they were made aware that no marks were to be rewarded and this caused a lack of interest in completing the assessments. It was evident in some occurrences that the students' assessment score was relatively higher in the pretest than the posttest. This may have impacted the reliability of the overall assessment scores.

Summary of Observation

Two observations were conducted using a detailed observation form to discover the effect of a teacher-developed curriculum on students 21st century skills. The observation form focused on (1) collaboration, cooperation, and communication skills (2) creativity and innovation skills (3) critical thinking, problem-solving, and time-management skills. After conducting a thorough analysis, it was evident that a teacher-developed curriculum enhanced the use of students' 21st century skills. Looking closely at the classroom observations of both groups, it was noted that the frequency of 21st century skills occurrence in the Group A classroom was 21 (N=21) and the frequency of the 21st century skills occurrence in the Group B classroom was 38 (N=38). The use of 21st century skills rose by 55% percent with the use of a teacher-developed curriculum. Examining the communication, cooperation, and communication skills for both classes, the Group A class only utilized these skills 10 times, while Group B utilized the various skills 21 times. The Group B teacher that taught by the means of a teacher-developed curriculum seemed more comfortable proposing her own questions and activities throughout the lesson. She was more confident when asking students questions or initiating any discussions. She was able to add videos and tasks to the lesson that met the needs of her students. Moreover, the Group A teacher only had one task to be given to the student throughout the lesson. The content was very teacher- directed and the students did not have many opportunities to lead the classroom. Furthermore, the frequency occurrences for creativity and innovation skills were relatively low for both groups, 4 and 7, for Group A and B respectively. This might have been due to the online classroom environment. In a subject such as engineering, it is difficult to bring out the students' creativity without physical interaction with the resources needed for the course. Moreover, critical thinking, problem-solving, and time-management skills were effectively utilized in the Group B classroom, again concluding the benefits of a teacher-developed curriculum on students 21st century skills, however, there wasn't a big gap between a teacher-developed curriculum and a top-down curriculum. The frequency of occurrence for the teacher-developed curriculum was 10 and the frequency of occurrence for the top-down curriculum was 7. The tasks given to both groups adopted the needs of the 21st century skills leading the students to easily analyze the information in the task. It was evident that the Group A teacher did not have any flexibility to adjust the curriculum to meet her students' needs. Therefore, the occurrences in the classroom were much lower than Group B. The Group B teacher knew exactly how to interact with the students and what skills they needed to strengthen. The teaching methods, strategies and activities were all adapted to suit the unique needs of the student and classroom environment. Overall, it was noted that students utilized their 21st century skills more effectively when taught through a teacher-developed curriculum.

Conclusion

This study focused on the effects of a teacher-developed curriculum on engineering students' assessment scores and 21st century skills. The sample of this study consisted of two female teachers and 20 female Emirati students. A quasi-experiment was conducted to compare the pre- and posttest scores between students taught through a teacher-developed curriculum and students taught through a top-down curriculum. It was concluded that a teacher-developed curriculum did not have a significant effect on students' assessments scores.

Furthermore, two engineering classrooms were observed to discover how students deployed 21st century skills in both a top- down and teacher-developed curricula. After thorough analysis, it was found that even though a teacher-developed curriculum did not improve students' assessment scores it enhanced the use of the students' 21st century skills. "Future skills for the 21st century are necessary in order to prepare active citizens who are able to face the challenges of a global society; able to be innovative in order to solve complex problems; and use the power of technology to change the world for the better" (Trilling & Fadel, 2009, as cited in Alismail & McGuire, 2015, p.154). Moreover, further recommendations were made to undergo extensive studies over a prolonged period to fully understand the impact of a teacher-developed curriculum.

Recommendations

Education authorities should provide greater opportunities for teachers to contribute to curriculum development, especially in specialized subjects such as engineering. Empowering teachers to adapt content to learners' needs can foster more effective use of 21st century skills. In addition, ongoing training and workshops should be implemented to equip teachers with the necessary skills in curriculum design, instructional strategies, and assessment practices. Strengthening teachers' expertise will enable them to design curricula that both meet standards and promote innovation.

Curricula should explicitly embed collaboration, critical thinking, creativity, and communication into lesson objectives and classroom activities. Teacher-developed curricula should be encouraged as they provide flexibility to integrate these essential skills in context. Furthermore, future research should involve larger samples and extended implementation periods to better assess the long-term impact of teacher-developed curricula on student achievement and skill development. Comparative studies across subjects and educational levels are also recommended.

It is also recommended that policymakers should consider adopting a hybrid approach that balances top-down curriculum frameworks with teacher input at the local level. This balance can ensure consistency across systems while addressing the diverse needs of students.

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