# The Effect of Different Blending Levels of Traditional and E-Learning Delivery on Academic Achievement and Students' Attitudes towards Blended Learning at Sultan Qaboos University

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**ABSTRACT**
This research aims to design three educational programmes based on blended learning delivery to students attending the "introduction to educational technology" course. Each programme differs in its blending proportion between traditional and e-learning. The objective is to determine the most suitable blending ratio between the two delivery formats for this course, and compare the effectiveness of the three blending levels to the traditional instruction in terms of developing students' academic achievement and their attitudes towards using blended learning at the College of Education, Sultan Qaboos University. The results show a statistically significant difference at the level of <0.05 between the mean scores of all the experimental groups and the three control groups in the post academic achievement test, in favour of the experimental groups. The research recommends using a blended learning strategy with all blending ratios in teaching and developing different learning variables, such as understanding and thinking.
**Keywords**: blended learning, ratios, e-learning, achievement, attitudes, Oman

## INTRODUCTION

Higher Education Institutions (HEIs) face several demands imposed by the ever-growing scientific and technological developments. They have to face the increasing turnout on higher education and improve their level of efficiency, effectiveness, and quality in line with era demands. They also need to develop human resources to meet the market and the development plan requirements. Therefore, radical changes in the university education system have to be made so that education is not limited to traditional teaching styles, but rather relies on modern ICT patterns, while remaining flexible and efficient. This can be easily accomplished by allowing instructional materials and curricula to reach higher education (HE) students at anytime and anywhere, giving them the competences, skills, and knowledge necessary for success in their careers and social lives.

Many HEIs in different countries use a mixture of learning delivery based on combining traditional and e-learning delivery formats, which many studies have proven effective in developing students' knowledge and skills (Akkoyunlu and Soylu, 2008; Ibrahim, 2007; Vaughan, 2007; Allam, 2008; So, and Brush, 2008; Morsi, 8002; Ali, 2009; Ghanem, 2009; Al-Qabbani, 2010). Drysdale et al. (2013) reveal that more unique blended learning (BL) contributions are needed. Other studies suggest that BL can solve traditional learning and e-learning problems, especially if internet technology developments are considered (Halverson et al., 2017; Cassidy et al., 2014).

BL has been recommended by researchers at various conferences, such as the 12th Scientific Conference of the Egyptian Association of Education Technology (2009), and the 4th International Conference of the Omani Society of Education Technology (2017), emphasising the need to adopt BL as one of the HE e-learning patterns. In addition, experiencing BL in HE worldwide has proven successful. For example, the Malaysian Open University has adopted e-learning, considering it essential to raise the learning quality, and at the same time, meet different students' needs (Ali, 2008). Additionally, universities, such as Harvard in the US and Cambridge in the UK, provide various BL models in different disciplines.

## LITERATURE REVIEW

The type and nature of blending elements have resulted in numerous BL definitions. For example, Shaheen (2008) and Ammar (2010) state that BL mixes the Internet with traditional education. Other researchers perceive BL as a blend of all e-learning forms (computer or Internet-based) and traditional education, stressing that it is not limited

to only one, but both delivery types (Bonk and Graham, 2005; Draffan and Rainger, 2006). A third category of researchers define BL as a blend of the attributes and advantages of both traditional and e-learning in an integrated and structured form (Motteram, 2006; Akkoyunlu and Soylu, 2008). Al Musawi (2011) notes that BL enables teachers to use various forms to provide educational materials that enhance students' learning.

Abdel-khaleq (2010), Soman (2010), Al-Ghamdi (2011) and Faragon (2012) conducted quasi-experimental studies to measure the effect of BL on students' achievement in different subjects, and their attitudes towards it. They used educational materials, educational software, and an attitudinal scale towards BL as research tools. The studies consistently found a statistically significant difference between the mean scores of the control and experimental groups after the academic achievement test, in favour of the experimental group. The studies also show positive attitudes towards using BL as an instructional strategy. These studies are corroborated by Ahmed's (2011) study which explored the effect of using integrated learning in teaching chemistry on students' achievement and attitudes towards using it. An educational website, a student's guide, a teacher's guide, an achievement test, and an attitudinal scale were used as research tools. The study found statistically significant differences between the mean scores of the control and experimental groups after the academic achievement test at different levels (understanding, remembering, and application), in favour of the experimental. Moreover, it shows statistically significant differences between the mean scores of the experimental and control groups' attitudes towards BL, in favour of the experimental group. The study explains that BL takes into account learners' ability and pace of learning, leading to an increase in their interaction and assimilation of the subject content. Zhonggen and Yuexiu (2015) confirm existing shortcomings in both e-learning and traditional methods, and that educational institutions may devote their teaching methods towards a mixture of both approaches despite economic costs and other potential losses.

Reda's (2012) study shows the effectiveness of using a blended teaching strategy to solve environmental problems. Moreover, Tawfiq and Jaafar's (2017) study investigated the effectiveness of using combined learning in teaching a "home economics teaching methods" course for improving students' achievement and attitudes towards it in the College of Education, University of Najran, KSA. The results indicate the effective use of BL in the selected course on improving the experimental group's achievement and attitudes. Additionally, there is a positive correlation between female students' scores in the academic achievement test, and their scores on the BL attitudinal scale. Al-Qahtani (2018) examined the effect of teaching mathematics using BL on middle school students' achievement and development of critical thinking skills. The results reveal statistically significant differences between the mean scores of the experimental and control groups in the post achievement and critical thinking skills tests, in favour of the experimental. Sahni (2019) reports improved student learning in the group where BL was applied, in terms of achieving learning outcomes and comprehensive participation in online and class activities. She attributes this improvement to the students' motivation to learn, because they had some control over time, place, or speed of learning.

The above studies evince that BL improves students' achievement, interaction, participation, thinking, and attitudes towards learning; and helps develop communication skills. Therefore, it provides appropriate solutions for students and teachers to control the learning process flexibly and smoothly.

**BLENDING RATIO**

Authors note the scarcity of literature related to blending ratios. However, Graham (2006) defines four levels of BL, namely; activity, course, program and institutional blending levels, suggesting that blending ratios differs at each level. Allen et al. (2007) defines BL as a course in which the electronic content percentage ranges between (30%-79%). Alajab and Hussain (2015) assessed the impact of a proposed BL strategy for teaching the English language to health sciences students, and their motivation towards learning it. The mixing rate was about 60% for traditional mode, and 40% for e-learning, provided via the electronic system (Moodle®). The results reveal a significant impact of the proposed strategy on students' achievement and motivation to learn English. Furthermore, the experimental group report a high degree of satisfaction for experiencing BL in their English learning. Banyen et al. (2016) studied BL with a rate of 60% for e-learning and 40% for the traditional mode. They found that undergraduate students positively perceive BL because it adds changes to the learning method, making it more enjoyable and stimulating, because they can use technology outside the classroom. Owston and York (2018) found that students who were exposed to 36-50% of online BL outperform their colleagues who were exposed to less than 30% of online or 100% f2f delivery format. They recommend at least one-third of the traditional f2f time to be replaced with online activities. It can be concluded that online content should cover 30 to 79% of the educational materials, depending on the targeted mixing levels, and traditional learning should cover the remaining percentage.

In this research, the researchers test blending at three levels: 75%, 50% and 25% of online content, providing classroom instruction using the remaining percentages (see the Experimental Design of the Research below). This

research design was conducted to determine the most appropriate blending ratio between three traditional and e-learning blending levels in the "introduction to educational technology" course, and compare the effectiveness of these levels to the traditional instructional format in terms of developing students' academic achievement and determining their attitudes towards using BL at the College of Education (CoE), Sultan Qaboos University (SQU). The study proposes three different content structures for the "introduction to educational technology" course, in which each structure differs in its proportion of topics addressed and presented traditionally or electronically. The suggested structures are as follows:

1. The first structure delivers 75% of the course content traditionally in a physical classroom, and the remaining 25% of the course content is delivered remotely through Moodle®.
2. The second structure delivers 50% of the course content traditionally in a physical classroom, while the other 50% is delivered online through Moodle®.
3. The third structure delivers 25% of the course content traditionally in a physical classroom, and the remaining 75% is delivered online through Moodle®.

The research derives its importance from exploring ways to help the lecturers to determine and select the most appropriate blending ratio. It also bridges the gap in the literature by contributing with more research in this area.

## METHODOLOGY

### RESEARCH QUESTIONS AND HYPOTHESES

The study addresses the following questions:

1. What is the effect of different blending levels of traditional and e-learning delivery formats on developing students' academic achievement in the "introduction to educational technology" course at the CoE, SQU?
2. What is the effect of different blending levels of traditional and e-learning delivery formats on developing students' attitudes towards using BL in the "introduction to educational technology" course at the CoE, SQU?

The following research hypotheses were postulated:

1. There is a statistically significant difference at a level of <0.05 between the mean scores of the students of the first experimental group in the pre- and post- academic achievement tests, in favour of post application.
2. There is a statistically significant difference at a level of <0.05 between the mean scores of the students of the second experimental group in the pre- and post- academic achievement tests, in favour of post application.
3. There is a statistically significant difference at a level of <0.05 between the mean scores of the students from the second experiment and the control group in the post academic achievement test, in favour of the experimental group.
4. There is a statistically significant difference at a level of <0.05 between the mean scores of the students from the experimental groups and the control group in the post academic achievement test, in favour of the experimental groups.
5. There is a statistically significant difference at a level of <0.05 between the average scores of the students from the first experimental group in the post attitudinal scale application, and the hypothetical mean of the scale, in favour of post application.
6. There is a statistically significant difference at a level of <0.05 between the mean scores of the students from the second experimental group in the post attitudinal scale application, and the hypothetical mean of the scale, in favour of post application.
7. There is a statistically significant difference at a level of <0.05 between the mean scores of the students from the third experimental group in the post attitudinal scale application, and the hypothetical mean of the scale, in favour of post application.
8. There is a statistically significant effect at a level of <0.05 between the mean scores of the three experimental groups in the post academic achievement test.
9. There is a statistically significant effect at a level of <0.05 between the mean scores of the three experimental groups in the post attitudinal scale application.
10. There is a statistically significant difference at a level of <0.05 between the mean scores of the students from the second experimental group in the pre- and post- academic achievement tests, in favour of post application.

### RESEARCH DESIGN

#### A) Model

This research follows an experimental approach, conducting a field study comprised of three experimental groups and one control group. The research variables are as follows:

- Independent variable: a study programme based on using BL with three levels: 75%, 50% and 25% of online content.
- Dependent variables:
  1. Students' academic achievement in the "introduction to educational technology" course.
  2. Attitudes towards using BL among students at the CoE, SQU.

The research adopts an experimental design; i.e. the "Two Randomised Groups Pre-test and Post-test Design" as shown in Fig. 1.

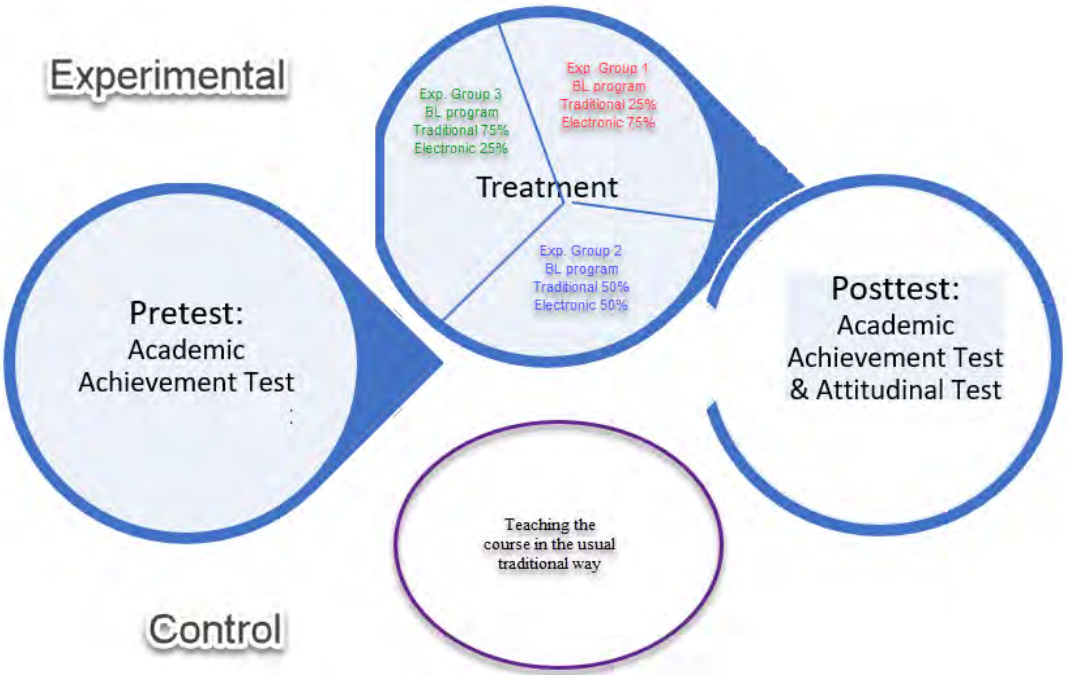


**Fig. 1.** Experimental design

**B) Participants**

The research project and its tools were piloted on a random sample of third-year students at the College of Education attending the "introduction to educational technology" course (TECH 3007) in the academic year 2017/2018. Then, it was applied experimentally on third-year students in the same college, attending the same course in the academic year 2018/2019.

The main research sample was selected from students of the CoE, SQU. These students were enrolled to study the TECH 3007 course in the fall semester of the academic year 2018/2019. Three groups of students in sections 11, 21 and 31 were randomly selected. The total number of students selected was 92. The students of section 11 were assigned as the first experimental group with (31) students, students of section 21 were assigned as the second experimental group with (30) students, and section 31 students were the third experimental group with (31) students.

**C) Instrumentation**

The research project used the following two data collection tools prepared by researchers:

1. Academic achievement test for third-year students attending the "introduction to educational technology" course (TECH 3007) in the CoE.
2. Attitudinal scale to measure students' attitudes towards using BL in the CoE, SQU.

- *Academic achievement test*

1. Preparation: This test is prepared to determine the effect of the different blending levels of traditional and e-learning delivery on students' academic achievement in the "introduction to educational technology" course at the CoE, SQU. Multiple-choice questions constitute the main format of the test items. Every question refers to a phrase related to the studied subject, followed by four alternative answers, one of which is correct. Students should answer it by ticking the correct option. The initial test form included twenty-two items. Students' responses are assessed by allocating one mark for each correct answer, and

a zero mark when selecting the incorrect option. Therefore, the minimum test score is zero, and the maximum score is twenty-two.

2. Validation: To measure the test validity, ten reviewers specialised in instructional technology from different colleges of education in various universities were asked to provide feedback about the suitability of the test's objectives and accuracy as well as the clarity and appropriateness of the test instructions. The agreement percentages between the reviewers' responses were calculated as shown in Table 2, and the test was modified accordingly.

**Table 2.** Reviewers' feedback agreement percentages about the academic achievement test items

| Review element | Agreement percentage | Modifications made |
|---|---|---|
| Suitability of objectives | 90% | - |
| Statement accuracy | 80% | Some words were modified |
| Clarity | 70% | Two paragraphs were deleted to avoid repetition |

3. Reliability: A sample of Instructional Technology students at the CoE, SQU was piloted, and their response scores were calculated on the test. The test reliability was calculated using the "Kuder and Richardson Formula 21 test" to check its internal consistency. The value of the test reliability coefficient was 0.852, which can be trusted to ensure reliability of the results which will be obtained from the actual experimental sample.
4. Difficulty and discrimination coefficients: These are also calculated for each test item whereby the "Correction for Guessing Formula" was applied to calculate the item easiness coefficients. It is found that the values of the formula's coefficients effect range between (0.46) and (0.74).The "Johnson Equation" is also used to calculate the test items' discrimination coefficient. The values range between (0.38) and (0.71).
5. Final test form: Having achieved the previous steps, the final test form is prepared, consisting of twenty items with a 35 minutes response time, and a total of 80 marks. Table 3 shows the test specifications.

**Table 3.** Academic achievement test specifications for the "introduction to educational technology" course

| N | Topic | Knowledge | Comprehension | Application | Analysis | Synthesis | Evaluation | Total | Relative weight% |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Educational technology concepts | 1 | ------ | ------ | 1 | 1 | 1 | 4 | 80 |
| 8 | Educational communication | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 00 |
| 0 | Educational media design | 1 | 1 | 1 | 1 | ------ | 1 | 5 | 85 |
| 4 | New media | 1 | 1 | 1 | ------ | 1 | 1 | 5 | 85 |
| Total | | 4 | 0 | 0 | 0 | 0 | 4 | 80 | 100 |
| Relative weight% | | 80 | 15 | 15 | 15 | 15 | 80 | 100 | |

- *Attitudinal scale towards using BL*

1. Preparation: This scale is prepared to investigate the effect of the different blending levels of traditional and e-learning delivery on students' attitudes towards using BL. The scale content is comprised of 38 statements related to BL applications, and were collected and distributed randomly; half of which reflect positive attitudes, while the other half reflect negative attitudes towards using BL. The scale is constructed according to a five-point Likert scale, in which strongly agree is given the highest score (5), and strongly disagree is given the lowest score (1). Students respond to each statement by ticking one of the five alternatives that express their degree of approval to a particular statement. The lowest score on the scale is (38) and the maximum score is (190). The scale was drafted with instructions explaining its objectives, the need to

respond to each statement and how to respond to them, in addition to demographic data (name, college, specialisation, gender).

2. Validation: The scale was validated in two different ways; content validity and logical validity. Content validity is represented by the statement phrasing so that each statement expresses one opinion of the students' attitudes. The logical validity is conducted by asking a group of faculty members from the Psychology and Instructional and Learning Technology Departments to review the appropriateness of the scale statements in terms of the objective, statement wording, and integrity and clarity of instructions. The agreement coefficient percentages between their responses are calculated as shown in Table 4. The test was modified accordingly, and the number of scale statements is reduced to (34).

**Table 4.** Agreement percentages between reviewers' responses about the attitudinal scale statements

| Review element | Agreement percentage | Modifications made |
|---|---|---|
| Suitability for objectives | 90% | - |
| Statement accuracy | 85% | Some words were amended |
| Clarity | 80% | Four statements (2 positive/2 negative) were deleted to avoid repetition |

3. Reliability: The scale was applied in its preliminary form to an exploratory research sample to determine the extent of its reliability and validity, as well as to modify the statements that are deemed vague or incomprehensible and ensure their usability for the experiment. The scale reliability was calculated through the re-application method in which the scale was reapplied to the exploratory sample a few weeks later to avoid the first application effect. The sample responses were then scored for both applications and Pearson's equation was calculated to find the correlation coefficient between the two applications. The coefficient value is statistically significant (0.822) at the level of (0.01). This result shows the scale's reliability, and ensures the erytfotytl ba ler results to be obtained from the sample in the field experiment.
4. Final scale form: Based on the above results and modifications, the final scale consists of the cover letter, demographic data, and instructions followed directly by the (34) statements measuring attitudes towards using BL, with a lowest possible score of (34) and a maximum score of (170).

**D) Process**

- *Designing and producing the BL program*

I. ***Analysis/Design stage:*** This stage involves the following steps:

1. Defining the BL program general objectives: Setting goals is an initial step to building the remaining elements of the program, as goals define the program content, educational strategy, educational media, and appropriate evaluation tools.
2. Determining the target group characteristics: The target group is third-year students at the CoE, SQU. Their backgrounds, interests and intellectual levels were analysed and identified.
3. Determining the BL program content: The program content includes the course knowledge structure. The course covers concepts of instructional media and educational technology, and their role in the teaching and learning processes. In addition, it demonstrates the historical developments of this field, the communication models, and the design principles. It also introduces new instructional technologies.
4. Defining the learning environment: a theoretical session is conducted in a traditional learning environment to introduce the course cognitive structure. Computer labs are used to display how the experimental groups can access and use the e-platform and its interactive tools.
5. Determining the BL program behavioural objectives: Identifying the program content, units and lessons helps to formulate the behavioural objectives for each unit and lesson in a procedural manner that can be observed and measured to explore the degree to which they have been achieved (e.g. the students are required to apply visual design principles, design and produce a set of new media, use different instructional media, and evaluate some instructional media).
6. Determining the content presentation methods: The content presentation methods are determined after setting the BL programme behavioural objectives. Thus, different online content percentages are delivered to each group.
7. Designing educational activities: A set of educational activities is designed in accordance with theoretical and practical lessons, considering the electronic nature of e-learning delivery.
8. Designing the educational platform: Designing the e-learning part of the BL programme includes the following sub-steps:
   I. Setting up an online study plan flowchart.
   II. Preparing a complete blueprint to illustrate the program pages and hyperlinks.
   III. Designing the programme page content for students' navigation.

IV. Designing the main page including ten icons easing movement between the programme pages.

9. Designing the interaction modes: The BL programme includes several interaction modes, namely:
   I. Student-content interaction through internal links within the content, and continuous assessment of the lessons.
   II. Student-online platform interface interaction.
   III. Traditional face-to-face interaction through in-class theoretical lessons, during the course hours, according to the prescheduled sessions.
10. Identifying the feedback strategy: The feedback is designed through self-assessment, where students receive their results to every question after answering it, or the grading of students' activities and assignments through the platform email. Additionally, teachers can assess students' performance during the classroom meetings.
11. Designing the assessment tools: The assessment tools are designed to include a set of objective questions following the completion of each course topic. These tools are: an achievement test for the cognitive part of the course, and a scale measuring attitudes towards using BL.

II. ***Production stage***: This stage involves:
1. Production of the educational platform.
2. Connecting the platform with the interactive tools.
3. Initial production of the platform.

III. ***The evaluation stage:*** This stage involves:
1. Evaluation of the platform structure.
2. Experimentation of the platform on the pilot sample.
3. Modifications and final production of the platform.

*IV.* ***The field application stage:*** This stage involves:
1. Approval and accessibility of the educational platform.
2. Implementation of the instructional strategies: The proposed BL instructional strategies are implemented on the three experimental groups and the control group.

- *Fieldwork procedures*

The research experiment was conducted in three steps:

A. Pilot research:

The pilot experiment was conducted to:
a) calculate the validity and reliability of the two research tools,
b) modify the proposed designs for BL environments in light of: students' responses, their suggestions, and their observations thereon,
c) identify the difficulties that the researchers may face during the implementation stage,
d) determine the necessary time plan for implementing the field experiment
e) gain experience in the field application of the research.

The pilot experiment was conducted on a sample of 29 students from the CoE, SQU, who were enrolled in the Techno 3007 course section in the spring semester of the academic year 2017/2018. The following procedures were followed to implement the pilot experiment:
1. The pilot experiment began in the spring semester of the academic year 2017/2018, between Sunday 11/3/2018 to Thursday 29/3/2018.
2. The BL environment and the two research tools were applied to the students.
3. Reliability, validity, response time, discriminatory factors, ease and difficulty coefficients were applied for the achievement test. Validity and response time were calculated for the attitudinal scale.
4. A teaching time plan was set using the BL environment in light of the pilot experiment. It was found that the average time taken to learn basic knowledge is three weeks. Therefore, implementation of the basic research experiment would require five weeks; three of which for the learning process, and two weeks for the pre- and post- application of the research tools.
5. The main research sample was accordingly selected (see the 'Participants' section above)

B. Field research:

The field research experiment was conducted in the following steps:

1) Pre-application of the academic achievement test: The test was applied to the research sample directly before starting learning in the BL environment from Sunday 7/10/2018 until Wednesday 10/10/2018. The researchers clarified the purpose of the test to the students, asked them to adhere to its instructions and emphasised the need to respond to all test items. The test was then corrected, and the students' grades were checked in preparation for statistical treatment.
2) Implementation of the research experiment:
   - Duration of the experiment: The research experiment lasted five weeks during the fall semester of the academic year 2018/2019. It started on Sunday 7/10/2018 until Wednesday 7/11/2018. The academic achievement test was applied in the first week to all students of the research sample. Both research tools were applied in the last week for all students. The time period for learning the course topics for the three groups was therefore three weeks.
   - Implementation procedures of the experiment: The students of the three experimental groups studied the course topics and implemented the predetermined educational strategy within the computer labs of the college. The learning session was four hours divided into two days per week. Each group was assigned to a Moodle® educational site specifically designed to its blending requirements.
   - Post application of the two research tools: After completing the research experiment, both the academic achievement test and attitudinal scale were applied to the students of the three groups from Sunday 4/11/2018 until Wednesday 7/11/2018, followed by the correction of the students' responses. The grades were checked with the name of each student and his/her grade in both instruments in preparation for statistical treatment. The appropriate statistical methods were then used to answer the research questions.

C. Data analysis

The research uses the following data analysis and statistical methods:

- To determine the effectiveness of each proposed BL program on the two research variables, a t-test was used to calculate the statistical difference between the mean scores of the experimental groups' pre- and post- applications for each tool separately.
- Eta squared (η2) and the corresponding value of (d) were used to determine the extent to which each BL program affects the two research variables separately.
- To determine the effectiveness of the BL program in comparison with the traditional method on the two research variables, the mean of the adjusted gain scores ratio between the experimental and control groups are calculated for the two research tools separately. Then, the t-test was used to calculate the statistical difference between the mean of the adjusted gain scores ratio in the experimental groups and the control group for the two research tools separately.
- To determine the effect of different blending levels of traditional and e-learning delivery formats on the two research variables separately, one-way analysis of variance (ANOVA) was used to calculate the statistical difference between the mean scores of the experimental group students in the post-application of each tool separately.

## RESULTS

**RQ1: What is the effect of different blending levels of traditional and e-learning delivery formats on developing students' academic achievement in the "introduction to educational technology" course at the College of Education, SQU?**

- ***Ensure group equivalence:***

The mean scores of the three experimental groups were calculated in the pre- achievement test, and the one-way analysis of variance (ANOVA) test was applied. Table 5 summarises the findings.

**Table 5.** ANOVA results in the pre- achievement test

| Source of Variance | Sum of squares | DoF | Average squares | p | Sig. |
|---|---|---|---|---|---|
| Between groups | 0.042 | 8 | 0.1. 4 | 0.850 | 0.. . . |
| Within groups | 60.0. . | 22 | 0.626 | | |
| Total | 60.. 85 | 00 | | | |

Table 5 shows that the "p" value is not significant at the level of ≥0.05 confirming no significant differences between the mean scores of the three research groups in the pre-test; indicating equivalence of these groups in the academic achievement component.

- ***Student academic achievement in post-test application:***

The mean scores of the three experimental groups were calculated in the post- achievement test, and the one-way analysis of variance (ANOVA) test was applied. Table 6 summarises the findings.

**Table 6.** ANOVA results in the post- achievement test

| Source of Variance | Sum of squares | DoF | Average squares | p | Sig. |
|---|---|---|---|---|---|
| Between groups | 4.8. | 8 | 8.105 | 0.0 | 0.41 |
| Within groups | 802.. 60 | 22 | 8.0. 8 | | |
| Total | 810.000 | 00 | | | |

Table 6 shows that the "p" value is not significant at the level of ≥0.05 confirming no statistically significant differences between the mean scores of the three experimental groups in the post- achievement test. This indicates no statistically significant effect at the level of ≥0.05 for different blending levels on students' academic achievement. Accordingly, the first hypothesis was verified and rejected, whereas the alternative hypothesis is accepted.

In order to understand the three BL environments' effectiveness, and the extent of their impact on developing the three experimental groups' academic achievement, a t-test for two interrelated groups was applied, followed by calculating the Eta ($\eta^2$) value and its corresponding (d). Table 7 summarises the findings.

**Table 7.** Descriptive statistics and values of t, $\eta^2$ and d for the experimental groups' scores in the pre- and post-achievement tests.

| Group | M | | SD | | t | DoF | Sig. | $\eta^2$ | d |
|---|---|---|---|---|---|---|---|---|---|
| | Pretest | Posttest | Pretest | Posttest | | | | | |
| First | 1.066. | 1. | 1.05146 | 1.06452 | 52.. 5 | 80 | 0.0 | 0.0016 | 81.. 80 |
| Second | 1.. . 48 | 16.5161 | 1.1. 501 | 1.5464 | 02.004 | 00 | 0.0 | 0.0. 06 | 10.250 |
| Third | 1.1000 | 16.6000 | 0.. . 602 | 1.6. 001 | 40.80. | 80 | 0.0 | 0.024. | 16.044 |

Table 7 shows that:

- The difference between the mean scores of the first experimental group of students in the pre- and post-academic achievement tests is statistically significant at the level of (0.00), in favour of post-application. In addition, the total variance of this group's academic achievement reached the value of (0.9916), due to the effect of using the first BL environment. This indicates that using the first BL environment affects CoE students' academic achievement with a percentage of (99.16%). The extent of this effect exceeds the value of (0.8) as it reached (21.729), indicating a major impact from using the first BL environment on developing students' academic achievement.
- The difference between the mean scores of the second experimental group of students in the pre- and post-academic achievement test is statistically significant at the level of (0.00), in favour of post-application. In addition, the total variance of this group's academic achievement reached the value of (0.9796), due to the effect of using the second BL environment. This shows that using the second BL environment affects CoE students' academic achievement with a percentage of (97.96%). The extent of this effect exceeds the value of (0.8), as it reached (13.859), indicating a major impact from using the second BL environment on developing students' academic achievement.
- The difference between the mean scores of the third experimental group of students in the pre- and post-academic achievement test is statistically significant at the level of (0.00), in favour of post-application. In addition, the total variance of this group's academic achievement reached the value of (0.9847), due to the effect of using the second BL environment. This means that using the second BL environment affects CoE students' academic achievement with a percentage of (98.47%). The extent of this effect exceeds the value of (0.8), as it reached (16.044), indicating a major impact from using the third BL environment on developing students' academic achievement.

**RQ2: What is the effect of different blending levels of traditional and e-learning delivery formats on developing students' attitudes towards using BL in the "introduction to educational technology" course at the CoE, SQU?**

The mean scores of the the three experimental groups were calculated in the post-application of the attitudinal scale, and the one-way analysis of variance (ANOVA) test was applied. Table 8 summarises the findings.

**Table 8.** ANOVA results for the post- attitudinal scale application

| Source of Variance | Sum of squares | DoF | Average squares | p | Sig. |
|---|---|---|---|---|---|
| Between groups | 000.2804 | 8 | 105.41. | 8.282 | 0.065 |
| Within groups | 6021.8. 6 | 22 | 60.105 | | |
| Total | 64. 8.11 | 00 | | | |

Table 8 illustrates that the "p" value is not significant at the level of ≥0.05 confirming no statistically significant differences between students' mean scores in the three experimental groups. This indicates no statistically significant effect at the level of ≥0.05 for different blending levels on students' attitudes towards using BL. This clarifies that the first hypothesis was verified and rejected, whereas the alternative hypothesis is accepted.
In order to understand the three BL environments' effectiveness, and the extent of their impact on developing students' attitudes towards using BL in the three experimental groups, a t-test for two interrelated groups was applied, followed by calculating the value of the Eta ($\eta^2$) and its corresponding value of (d). Table 9 summarises the findings.

**Table 9.** Descriptive statistics, values of t, $\eta^2$ and d for the experimental groups' scores in the pre- and post-attitudinal scale applications

| Group | M | | SD | | t | DoF | Sig. | $\eta^2$ | d |
|---|---|---|---|---|---|---|---|---|---|
| | Pretest | Posttest | Pretest | Posttest | | | | | |
| First | 144.5 | 156.6 | 0.00 | 2.6. 656 | . .602 | 80 | 0.00 | 0.66. 0 | 8.206 |
| Second | 144.5 | 151.0008 | 0.00 | 0.42202 | 4.044 | 00 | 0.00 | 0.0261 | 1.526 |
| Third | 144.5 | 151.466. | 0.00 | 6.02606 | 5.468 | 80 | 0.00 | 0.50. 1 | 8.082 |

Table 9 shows that:

- The difference between the mean scores of the first experimental group of students in post-application, along with the hypothetical mean value of the attitudinal scale are statistically significant at the level of (0.00), in favour of post-application. Moreover, the total variance of the first experimental groups' academic achievement reached the value of (0.6679), due to the effect of using the first BL environment. This means that using the first BL environment affects CoE students' attitudes towards BL with a percentage of (66.79%). The extent of this effect exceeds the value of (0.8) as it reached (2.836), indicating a major impact from using the first BL environment on developing students' attitudes towards BL.
- The difference between the mean scores of the second experimental group of students in post-application, along with the hypothetical mean value of the attitudinal scale are statistically significant at the level of (0.00), in favour of post-application. Additionally, the total variance of the first experimental groups' academic achievement reached the value of (0.3861), due to the effect of using the first BL environment. This shows that using the second BL environment affects CoE students' attitudes towards BL with a percentage of (38.61%) The extent of this effect exceeds the value of (0.8) as it reached (1.586), indicating a major impact from using the second BL environment on developing students' attitudes towards BL.
- The difference between the mean scores of the third experimental group of students in post-application, along with the hypothetical mean value of the attitudinal scale are statistically significant at the level of (0.00), in favour of post-application. Further, the total variance of the first experimental groups' academic achievement reached the value of (0.5071), due to the effect of using the first BL environment. This means that using the third BL environment affects CoE students' attitudes towards BL with a percentage of (50.71%). The extent of this effect exceeds the value of (0.8) as it reached (2.028), indicating a major impact from using the third BL environment on developing students' attitudes towards BL.

## DISCUSSION AND CONCLUSIONS

This study was conducted to determine the most appropriate blending ratio between three traditional and e-learning blending levels in the "introduction to educational technology" course, and compare the effectiveness of these levels to the traditional instructional format in terms of developing students' academic achievement and attitudes towards using BL at the CoE, SQU.

- ***The academic achievement research findings can be summarised as follows:***
  1. There is a statistically significant difference at a level of <0.05 between the mean scores of the first experimental group of students in the pre- and post-academic achievement tests in the "introduction to educational technology" course, in favour of the post-test.
  2. There is a statistically significant difference at a level of <0.05 between the mean scores of the second experimental group of students in the pre- and post-academic achievement tests in the "introduction to educational technology" course, in favour of the post-test.

3. There is a statistically significant difference at a level of <0.05 between the mean scores of the third experimental group of students in the pre- and post-academic achievement tests in the "introduction to educational technology" course, in favour of the post-test.
4. There is a statistically significant difference at a level of <0.05 between the mean scores of the first experimental group and the control group in the post academic achievement test, in favour of the experimental group.
5. There is a statistically significant difference at a level of <0.05 between the mean scores of the experimental group and the control group in the post-academic achievement test, in favour of the experimental group.
6. There is a statistically significant difference at a level of <0.05 between the mean scores of the third experimental group and the control group in the post-academic achievement test, in favour of the experimental group.
7. There is no statistically significant effect at a level of <0.05 between the mean scores of the three experimental groups in the post academic achievement test in the "introduction to educational technology course".

The above results are consistent with the studies of Abdel-khaleq (2010), Reda (2012), Alajab and Hussain (2015), Tawfiq and Jaafar (2017) and Al-Qahtani (2018), who have found statistically significant differences between the mean scores of the control and experimental groups' post-academic achievement tests in favour of the experimental groups. These results also reveal the effectiveness of using a BL strategy with all blending ratios in teaching, which is consistent with results by Allen et al. (2007), who defined BL as a course in which the electronic content percentage ranges between (30%-79%). The researchers attribute this result to the ability of different blending levels to meet students' needs in the three groups, by controlling self-learning pace and allowing them to absorb the subject content. Furthermore, although blending proportions vary, more interaction and connection opportunities replace the traditional method through platforms and online means. This helps students find more information to integrate into learning: independently and thoroughly as indicated by Ahmad (2011) and Zhonggen and Yuexiu (2015).

- ***The findings which report attitudes towards BL can be summarised as follows:***
  1. There is a statistically significant difference at a level of <0.05 between the average scores of the first experimental group of students in the post-attitudinal scale and the hypothetical mean of the scale, in favour of post-application.
  2. There is a statistically significant difference at a level of <0.05 between the average scores of the second experimental group of students in the post-attitudinal scale and the hypothetical mean of the scale, in favour of post-application.
  3. There is a statistically significant difference at a level of <0.05 between the mean scores of the third experimental group of students in the post-attitudinal scale and the hypothetical mean of the scale, in favour of post-application.
  4. There is no statistically significant difference at a level of <0.05 between the mean scores of the three experimental groups in the attitudinal scale post-application.

The above results are consistent with the results of Abdel-khaleq )8010(, Ahmed )8011(, Alajab and Hussain (2015), Banyen et al. (2016), and Tawfiq and Jaafar (2017); confirming positive student attitudes towards using BL. Notably, the study sample prefers using BL as it changes the traditional teaching method and makes learning more flexible.

In light of the above findings, the study recommends:

1. More attention to using BL strategies in all blending ratios/proportions to teach different courses, and develop understanding/thinking.
2. Directing educational technology research to study the relationship between BL and teaching different technology courses.

The study also recommends:

1. Conducting more research concerned with the use of BL strategies in all blending ratios/proportions on other research variables and different study courses.
2. Researching the relationship between the use of BL in all blending ratio/proportions and students' learning, investigating different research variables and cognitive abilities.
3. Evaluating the use of other BL strategies in all blending ratios/proportions in teaching different subjects.

Some limitations exist in this study, including the use of BL strategies in all blending proportions with only two research variables. Further attention needs to be paid to other variables including cognitive abilities and different

subjects of study. Additionally, the use of BL was investigated within the higher education context and the need exists to evaluate the effectiveness of using BL in teaching different curricula on pre-university students.

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