## ORIGINAL RESEARCH ARTICLE

# The effectiveness of flipped learning strategy in the development of scientific research skills in procedural research course among higher education diploma students

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There have been efforts to investigate the effectiveness of the flipped learning strategy in the development of scientific research skills (SRS) in the procedural research course among higher education diploma students. However, studies examining the effectiveness of the flipped learning strategy in the development of SRS are, thus far, rare. This study adopted a quasi-experimental design, with two types of teaching methods. One research group was assigned to the flipped learning teaching method ($n = 30$) and the other to the conventional teaching method ($n = 30$). A multiple-choice SRS test was developed and used. The results showed that the flipped learning teaching method was more effective than the conventional teaching method, in gauging students' SRS.

**Keywords:** flipped learning strategy; Shoubak University College; scientific research skills; procedural research course

## Introduction

Since the first decade of the 21 century, the educational term 'Flipped Learning' has become a key topic in the educational and social sciences, as mentioned by many researchers in the domains (Thaichay and Sitthitikul 2016; Wei & Lin 2016; Yang 2017; Yuan and Chen 2018; Zainuddin & Halili 2016). From the theoretical literature, flipped learning emerges as a pedagogical approach, in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment, where the educator guides students as they apply concepts and engage creatively with the subject matter (Salem and ALwan 2018; Şanal 2016; Saunders 2014; Sedo & Kber 2018). Flipped learning is a strategy that makes the learner enjoy studies successfully. Zainuddin and Halili (2016) suggested flipped learning being made part of curriculum of school and universities. The current study is aimed to investige the effectiveness of the flipped learning strategy in the development of scientific research skills (SRS) in the procedural research course among higher education diploma students.

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### Theoretical background

Modern technology has helped to transform the traditional lecture style, which is limited to teaching within the classroom, and by relying on the method of lecture and teaching by the teacher. With scientific and technological progress, modern educational strategies seek to reshape the educational process and to change the traditional role of the school and home, where the learner takes a more active and responsible role in the process of learning. Flipped learning is one of the strategies envisaged in this process.

Flipped learning is one of the integrated learning strategies, which is an educational system that takes advantage of all the possibilities and technological means available by combining more than one learning method, whether electronic or conventional, to provide a new quality of learning that suits the characteristics and needs of the learners on the one hand and the nature of the course and the educational goals we try to achieve on the other hand (Yu, Chang and Wu 2015; Yu and Wu 2012).

Johnson *et al.* (2014) confirm that flipped learning is a type of integrated learning, which combines the activation of technology in learning without forgetting the role of interaction between the teacher and the learner, the recognition of technology and its tools as ideal for effective learning. To bring about fundamental changes in the educational context and educational institutions, the flipped learning strategy is working to enrich the learning process and achieve learning outcomes, positive at the cognitive level of increased achievement, skills acquisition, an emotional liking of the subject matter and positive interaction within the classroom between the teacher and the learners, or among the learners.

From a study of the theoretical literature and previous studies, Figure 1 furnishes a comparison between traditional learning and flipped learning (AdedoJa 2016; Altweigy 2017; Anderson and Krathwohl 2001; Başal 2012; Bergmann 2014; Bergmann and Sams 2012, 2014, 2015; Bill 2012; Bonk and Graham 2007; Bram 2013; Brame 2013; Bsharat 2017; Chang 2016; Mahasneh and Farajat 2015; Mahasneh and Murad 2014).

### Advantages of flipped learning

Many researchers (Drake, Micaela and Robin 2016; Durak 2015, 2016; Fiorella and Mayer 2013; Flipped Learning Network 2014; Gecu and Satici 2012; Gerstein 2012) have confirmed the advantages of flipped learning. Flipped learning is able to constantly adapt itself to students' needs; it is mixed with fun and vitality with a little explanation inside the classroom, and a lot of collaborative learning and discussions and educational projects; it helps underachievers by arranging help from the teacher who walks around the students, thorough watching educational videos at home, making the teacher focus on students who need more time to learn and in guiding them to improve their performance. In adhering to the requirements of the digital age, flexibility and effectiveness, flipped learning increases interaction between teacher and student and helps students of all levels to excel, especially those with special needs. Flipped learning helps in classroom management, transparency and overcoming the shortage of qualified teachers as well as teacher absenteeism. It ensures good investment of lesson time, taking into account the individual differences among students by repeating the lesson more than once through the video and strengthening the relationship between the teacher and students. Flipped learning encourages the optimal
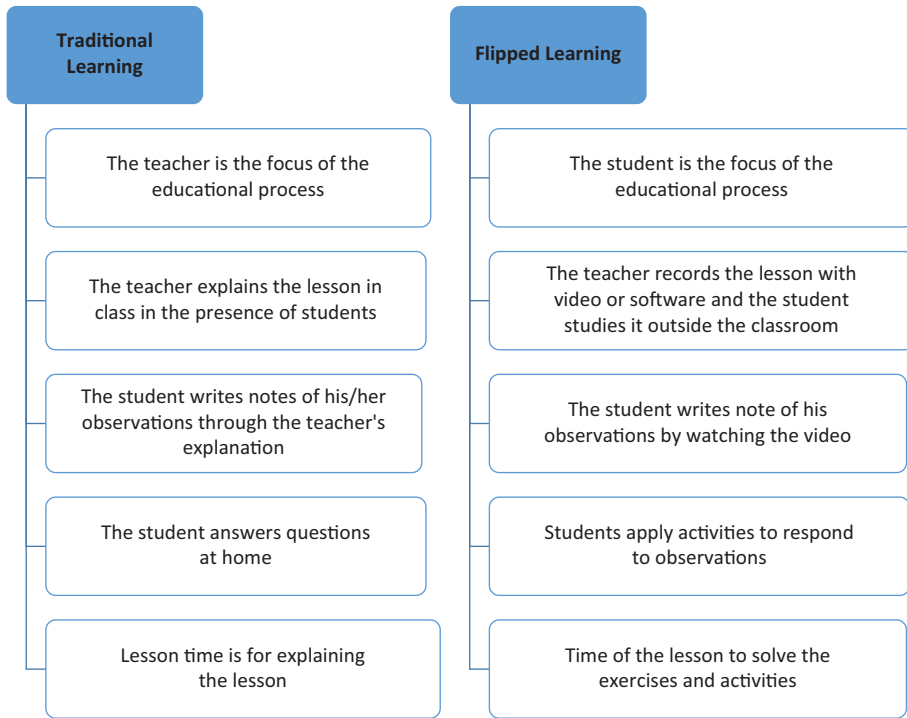
Figure 1. Comparison of traditional learning and flipped learning.

use of modern techniques in the field of education. The student becomes an information-searcher rather than a mere passive recipient. It also enhances critical thinking skills, self-learning, experience building, and communication and collaboration skills among students.

***Teaching procedures in flipped learning according to the current study***

The researcher conducted the procedures described in Figure 2.

The researcher developed a set of instructions for students in the experimental group, as shown in Figure 3.

***Researches about the effectiveness of the flipped learning strategy***

The researcher, after studying the theoretical literature and previous studies, did not find studies on the subject of determining the effectiveness of the flipped learning strategy in the development of SRS. Studies were mostly focused on the effectiveness of the flipped learning strategy in the development of group variable. Bsharat (2017) investigated the effect of using the flipped learning strategy on tenth-grade students' achievement and their mathematical self-concept at Jericho Governorate. It was applied as a quasi-experimental approach on a sample of 43 tenth graders at Al-jeftlek secondary co-education school. The researcher used two tools in the study. A post-test measures the achievement of the students after the completion of
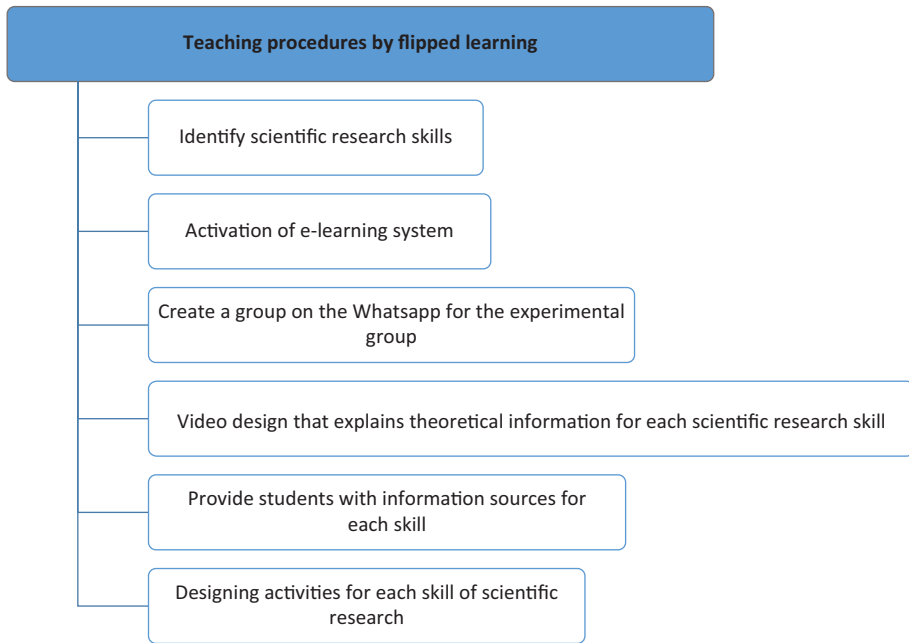
**Teaching procedures by flipped learning**

Identify scientific research skills

Activation of e-learning system

Create a group on the Whatsapp for the experimental group

Video design that explains theoretical information for each scientific research skill

Provide students with information sources for each skill

Designing activities for each skill of scientific research

Figure 2. Teaching procedures by flipped learning.

**Instructions for students**

Watch the video and see the sources of information before the lecture

Write notes after watching the video and see the sources of information

Students' willingness to perform exercises and activities during the lecture

Participation of students in activities and exercises during the lecture
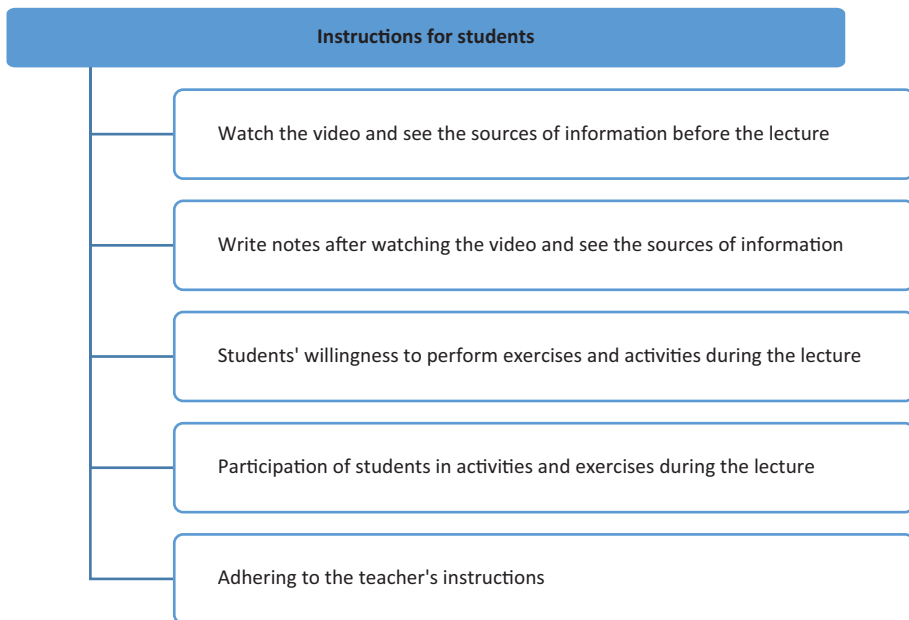
Adhering to the teacher's instructions

Figure 3. Instructions for students.

teaching of the special geometry unit (C) and (A) scale of mathematical self-concept in the pre- and post-phases of using flipped learning strategy. The results of the study were statistically significant at $\alpha = 0.05$, based on the achievement of the post-test, and the scale of the mathematical self-concept of the tenth-grade student was in favour of the treatment group who used the flipped learning strategy to learn the special geometry unit.

Qtash (2019) studied the effect of using the flipped learning strategy on the achievement and retention of second-grade students in mathematics skills. To achieve this goal, the study used a quasi-experimental design. The sample of the study consisted of 40 male and female students, selected purposively from a government school in Amman. The sample was distributed into two intact groups: an experimental group consisting of 20 male and female students was taught by the flipped learning instructional strategy and a control group consisting of 20 male and female students was taught by the traditional method. The findings of the study revealed that there were significant differences for the experimental group that was taught through the flipped learning instructional strategy in the achievement test. There were also statistical differences between the experimental group who was taught through the flipped learning instructional strategy in the achievement and cognitive retention of mathematical skills.

Salem and Alwan (2018) investigated the effectiveness of the flipped learning strategy in pattern-making and grading of women's clothing, using Gemini CAD System. The sample consisted of 30 female students. The findings of the study revealed that there were significant differences for the experimental group who was taught through the flipped learning instructional strategy in the achievement test.

Qstah (2016) studied the impact of using the flipped learning strategy on concept development and reflective thinking in biology, among female tenth graders, adopting the descriptive analytical approach and the experimental approach. Study tool, content analysis tool, a scientific concepts test and a reflective thinking test were employed. The sample consisted of 80 female students in the tenth grade. As shown in the results, there are statistically significant differences at the significance level $(0.05 \geq \alpha)$ between the mean scores of the control group and the experimental group in the science concepts test, in favour of the experimental group. There are statistically significant differences at the significance level $(0.05 \geq \alpha)$ between the mean scores of the control group and the experimental group in the reflective thinking test, in favour of the experimental group.

Sedo and Kber (2018) aimed at identifying the influence of using flipped strategy on the achievement of Faculty of Education in Gadarif University. The researchers adopted both descriptive study and experimental methods; these two methods were most appropriate for this study. The tools used in the study were achievement test and attitude test. The results of these analyses were used to discuss the hypotheses of the study. The main findings were (1) there are statistical differences in educational achievement, showing the experimental group benefiting, (2) students taught through the flipped strategy were more effective and positive than those taught by traditional method and (3) there are strong and positive attitudes among fifth class students towards use of flipped strategy in teaching lessons.

Overmyer (2014) studied the effect of the flipped classroom model on college algebra students' achievement. His findings show that though there was no statistically significant difference in the scores of students in the two groups, students in the flipped sections did score slightly better than those in the traditional sections.

Yuan and Chen (2018) investigated the effects of flipped learning, student question generation and instant response technologies on students' learning motivation, attitudes and engagement. By a structural equation modelling, the results showed that the constructs of flipped learning and student question generation have a positive impact on the students' learning motivation, attitudes and engagement.

All the earlier studies focused on the effect of flipped learning on some variables (achievement). The present study differs from previous studies in that it is the only study that investigates the effectiveness of the flipped learning strategy in the development of SRS.

**The present study**

The aim of this study is to contribute to the knowledge of the effectiveness of using the flipped learning strategy in the development of SRS (procedural research) among higher education diploma students. The research was conducted on 60 students comprising experimental and control groups. This study is one of the rare studies in this domain, as it distinguished the structure of the instrument for SRS test, to measure the effectiveness of using the flipped learning strategy in the development of SRS among higher education diploma students.

In line with this research intent, only main hypotheses were identified:

**H0**: there are no statistically significant differences in $\alpha = 0.05$ between the average achievement in the testing of SRS of the students between the experimental and the control groups.

The study attempted to answer the following questions:

*First question*: What are the SRS to be developed by students in the course of procedural research?

*Second question*: Is there a statistically significant ($\alpha = 0.05$) difference between the average scores of the students of the experimental group and those of the control group in the test of SRS?

**Method**

*Research design*

The study adopted a quasi-experimental design.

*Measures*

In this study, the effectiveness of using the flipped learning strategy in the development of SRS on the course (procedural research) among higher education diploma students was investigated.

*Study sample*

The individuals for this study consisted of 60 students. Table 1 shows their characteristics.

Table 1. Demographic characteristics of the individuals.

| Group | Frequency |
|---|---|
| Experimental | 30 |
| Control | 30 |
| Total | 60 |

Table 2. Correlation coefficients (Pearson) between the score of each paragraph and the total score of the test.

| N | r | Sig. | N | r | Sig. | N | r | Sig. |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.000 | 0.810 | 11 | 0.825 | 0.000 | 21 | 0.854 | 0.000 |
| 2 | 0.000 | 0.820 | 12 | 0.912 | 0.000 | 22 | 0.812 | 0.001 |
| 3 | 0.001 | 0.821 | 13 | 0.841 | 0.001 | 23 | 0.847 | 0.000 |
| 4 | 0.000 | 0.831 | 14 | 0.832 | 0.000 | 24 | 0.865 | 0.001 |
| 5 | 0.001 | 0.910 | 15 | 0.871 | 0.000 | 25 | 0.897 | 0.003 |
| 6 | 0.003 | 0.920 | 16 | 0.932 | 0.001 | 26 | 0.874 | 0.001 |
| 7 | 0.000 | 0.901 | 17 | 0.874 | 0.000 | 27 | 0.921 | 0.002 |
| 8 | 0.001 | 0.952 | 18 | 0.841 | 0.001 | 28 | 0.854 | 0.000 |
| 9 | 0.000 | 0.932 | 19 | 0.865 | 0.000 | 29 | 0.811 | 0.001 |
| 10 | 0.000 | 0.892 | 20 | 0.854 | 0.000 | 30 | 0.852 | 0.000 |

### *Research ethics*

The researcher first made an arrangement to work with the Dean of Shoubak University College, structured the instruments and verified their validity and reliability.

### *Analytical strategy*

In this study, the researcher's main focus was to investigate the effectiveness of using the flipped learning strategy in the development of SRS on the course (procedural research) among higher education diploma students. Theoretical literature and previous studies related to the subject of research were studied to structure the study instrument SRS. Appendix 1 shows the sample instruments used finally in the study.

### *Instruments*

#### List of scientific research skills

The skills of scientific research in the course of procedural research were determined through theoretical literature, previous studies and course content. The list of SRS consists of 30 skills divided into five domains, as shown in Table 2.

#### Test of scientific research skills

To determine the effectiveness of using the flipped learning strategy in the development of SRS on the course (procedural research) among higher education diploma

students, they were measured through the SRS test, consisting of 30 multiple-choice questions, yielding a total score of 30.

### *Instrument validity*

### List of scientific research skills

The skills of scientific research in the course of procedural research were determined through theoretical literature, previous studies and course content, and then checked with experts for language, clarity, relevance and comprehensiveness of the content. The items were rated as follows: 4 – Very relevant, 3 – Quite relevant, 2 – Somewhat relevant and 1 – Irrelevant. The researcher then puts the items into two groups: categories 1 and 2 in one group and 3 and 4 in the other. The researcher then calculated the Content Validity Index (CVI) using the following formula:

CVI = items rated as very relevant and relevant (3 and 4)/total number of items

For the instrument to be valid, the CVI had to be within the accepted statistical range of 0.7–1. Computed CVI for the instrument was found to be 0.98.

### Test of scientific research skills

After the final preparation of the test, the researcher applied the test to a sample of 10 students, with the aim of finding the difficulty and discrimination coefficients for test paragraph, the calculation of the validity and reliability of the test and the time required for the test to be applied. The validity of internal consistency was verified, by finding the correlation coefficients (Pearson) between the score of each paragraph and the total score of the test, using the statistical program (SPSS), as shown in Table 2.

Table 2 shows that all the test paragraphs achieved significant correlation with all score of the test at 0.05, demonstrating the test's internal consistency.

To verify the constructional validity, the researcher found the correlation of the domains of the test of the skills of scientific research with the total score of the test, as shown in Table 3. Table 3 shows that the domains of SRS that constitute the test achieved correlation with the total score of the test. Correlation range was 0.887–0.923, all of which are statistically significant at a level of significance 0.05.

Verification of the difficulty and discrimination coefficients for test paragraph are shown in Table 4. Table 4 shows that the degree of difficulty of the test was between 0.42 and 0.59, and that the degree of discrimination between the tests was between 0.71 and 0.53, indicating that all test intervals fall within the acceptable level of difficulty and discrimination.

### *Instrument reliability*

The researcher used the Cronbach's alpha method to measure the reliability of the test as a first method reliability; the coefficient of test reliability was found using the Cronbach's alpha, as shown in Table 5. Table 5 shows that the value of the total reliability coefficients is 0.898, which is its high value; this indicates that the test has a high degree of reliability.

Table 3. Correlation of the domains of the test of the skills of scientific research with the total score of the test.

| N | Domain skills | r | Sig. |
|---|---|---|---|
| 1 | The study problem and its theoretical background | 0.910 | 0.000 |
| 2 | Theoretical literature and previous studies | 0.923 | 0.000 |
| 3 | Method and procedures | 0.895 | 0.000 |
| 4 | Results and discussion | 0.887 | 0.000 |
| 5 | Other research skills | 0.889 | 0.000 |

Table 4. Difficulty and discrimination coefficients for paragraphs.

| N | Difficulty factor | Discrimination factor | N | Difficulty factor | Discrimination factor | N | Difficulty factor | Discrimination factor |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.50 | 0.61 | 11 | 0.52 | 0.64 | 21 | 0.51 | 0.53 |
| 2 | 0.51 | 0.64 | 12 | 0.50 | 0.59 | 22 | 0.53 | 0.59 |
| 3 | 0.52 | 0.65 | 13 | 0.58 | 0.58 | 23 | 0.50 | 0.62 |
| 4 | 0.59 | 0.68 | 14 | 0.50 | 0.58 | 24 | 0.50 | 0.64 |
| 5 | 0.49 | 0.64 | 15 | 0.51 | 0.67 | 25 | 0.50 | 0.63 |
| 6 | 0.56 | 0.65 | 16 | 0.50 | 0.69 | 26 | 0.49 | 0.60 |
| 7 | 0.48 | 0.67 | 17 | 0.47 | 0.68 | 27 | 0.43 | 0.61 |
| 8 | 0.45 | 0.69 | 18 | 0.48 | 0.69 | 28 | 0.42 | 0.68 |
| 9 | 0.54 | 0.70 | 19 | 0.49 | 0.59 | 29 | 0.47 | 0.63 |
| 10 | 0.53 | 0.71 | 20 | 0.51 | 0.60 | 30 | 0.46 | 0.67 |

Table 5. Coefficient of test reliability using the Cronbach's alpha.

| N | Domain skills | Q. no. | Cronbach's alpha |
|---|---|---|---|
| 1 | The study problem and its theoretical background | 6 | 0.891 |
| 2 | Theoretical literature and previous studies | 6 | 0.912 |
| 3 | Method and procedures | 6 | 0.895 |
| 4 | Results and discussion | 6 | 0.888 |
| 5 | Other research skills | 6 | 0.902 |
| Total score of the test | | 30 | 0.898 |

## Data analyses

With the aid of SPSS version 16.0, the researcher used mean, standard deviation and analysis of the variance (ANCOVA) to compare the average scores of the students of the experimental group and the students of the control group in the SRS test.

## Result

### First question

**What are the SRS to be developed by students in the course of procedural research?**

To answer this question, the skills of scientific research in the course of procedural research were determined through theoretical literature, previous studies and course content. Table 6 shows this.

Table 6. List of scientific research skills.

| n | Domains/statement |
|---|---|
| 1 | The study problem and its theoretical background |
| 1.1 | Writing the title of the study |
| 1.2 | Writing the introduction of the study |
| 1.3 | Writing the problem of the study and its questions and hypotheses |
| 1.4 | Writing the objectives and importance of the study |
| 1.5 | Writing procedural definitions |
| 1.6 | Writing the limits and determinants of the study |
| 2 | Theoretical literature and previous studies |
| 2.1 | Information search methods |
| 2.2 | How to cite in APA style |
| 2.3 | Writing theoretical literature |
| 2.4 | Search for previous studies |
| 2.5 | Writing previous studies |
| 2.6 | Writing the differences between the current study and the previous studies |
| 3 | Method and procedures |
| 3.1 | Writing the study methodology |
| 3.2 | Writing a population and sample study |
| 3.3 | Design of search tools |
| 3.4 | Writing validity instruments |
| 3.5 | Writing reliability tools |
| 3.6 | Writing statistical analysis |
| 4 | Results and discussion |
| 4.1 | Writing and discussion results |
| 4.2 | Find frequencies and percentages using the SPSS program |
| 4.3 | Find mean and standard deviations using the SPSS program |
| 4.4 | Find correlation coefficients between variables using the SPSS program |
| 4.5 | Find the analysis of variance using the SPSS program |
| 4.6 | Link the results of the current study with previous studies |
| 5 | Other research skills |
| 5.1 | Writing recommendations and conclusions |
| 5.2 | Writing references and sources |
| 5.3 | Design of interview and interview statement |
| 5.4 | Design of observation statement |
| 5.5 | Design of document analysis statement |
| 5.6 | How to insert Appendix |

In summary, according to Table 6, the list of SRS consists of 30 items divided into five domains. The researcher confirms that all the SRS were included in the course of procedural research.

### Second question

*Is there a statistically significant ($\alpha = 0.05$) in differences between the average scores of the students of the experimental group and those of the control group in the test of SRS?*

To answer this question, the following zero hypothesis was formulated:

**H0**: there is no statistically significant difference in $\alpha = 0.05$ between the average achievement in the testing of SRS of the students between the experimental group and the control group.

To test this hypothesis, mean, standard deviation and ANCOVA were used to compare the average scores of the students of the experimental group and the students of the control group in the test of SRS, as shown in Tables 7–10. The pretest was applied to the study subjects to ensure the equivalence of the study groups, as shown in Table 7.

Table 7 shows that there is an equivalence between the study groups, with the mean of the experimental group ($M = 3.57$) and control group ($M = 0.92$).

The mean and standard deviations of the students' marks were calculated on the testing of post-SRS according to the variable of the teaching method.

Table 7. Mean and standard deviations to ensure the equivalence of the study groups.

| Group | Teaching method | $N$ | Mark | Pretest | |
|---|---|---|---|---|---|
| | | | | Mean | S.D. |
| Experimental | Flipped learning | 30 | 30 | 3.57 | 1.25 |
| Control | Traditional | 30 | 30 | 4.37 | 0.92 |

Table 8. Mean and standard deviations of the marks of students on the test of post-scientific research skills.

| Group | Teaching method | $N$ | Mark | Post-test | |
|---|---|---|---|---|---|
| | | | | Mean | S.D. |
| Experimental | Flipped learning | 30 | 30 | 25.13 | 1.88 |
| Control | Traditional | 30 | 30 | 12.63 | 2.04 |

Table 9. Results of variance analysis (ANCOVA).

**Tests of between-subject effects**

**Dependent variable: post-test**

| Source | Type III sum of squares | df | Mean square | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|
| Corrected model | 2346.850[a] | 2 | 1173.425 | 302.193 | 0.000 | |
| Intercept | 1355.448 | 1 | 1355.448 | 349.069 | 0.000 | |
| Pretest | 3.100 | **1**[b] | 3.100 | 0.798 | 0.375 | 0.12 |
| Method teaching | 2118.059 | 1 | 2118.059 | 545.465 | 0.000 | 0.913 |
| Error | 221.333 | 57 | 3.883 | | | |
| Total | 23963.000 | 60 | | | | |
| Corrected total | 2568.183 | 59 | | | | |

[a]$R$ squared = 0.914 (adjusted $R$ squared = 0.911)

[b]Bold value to show the value of the statistical significance

Table 10. Effect size determination for values ($\eta^2$, $d$).

| Tools | Small | Moderate | High | Very high |
|---|---|---|---|---|
| $d$ | 0.2 | 0.5 | 0.8 | 1.10 |
| $\eta^2$ | 0.01 | 0.06 | 0.14 | 0.20 |

Table 8 shows an apparent difference in the mean of student performance (course of procedural research) to test the skills of post-scientific research between the experimental and control groups. The experimental group appears to have benefited with the mean of 25.13 and that of the control group 12.63. To illustrate the significance of the differences in the statistical averages of student scores at the level of $\alpha = 0.05$, the ANCOVA of the individual marks was used to test the skills of post-SRS according to the group variable and the results of Table 9.

Table 9 shows statistically significant differences at the level of $\alpha = 0.05$ for the effect of teaching method. Considering the value of $f$ calculated (545.465) and the level of significance (0.000), this value is less than the level of significance (0.05), and there is a difference of statistical significance between the control and experimental groups. The ETA squared of the teaching method is 0.931. It is clear that the effect of the use of the flipped learning strategy on the acquisition of SRS is very high, indicating the importance of this strategy in acquiring SRS teaching, compared with the traditional method of teaching.

$$d = \frac{\sqrt[2]{\eta^2}}{\sqrt{1-\eta^2}} \text{ (Abdelhamid 2011).}$$

Table 10 shows that the values of the $\eta^2$ field coefficient and the magnitude of the effect are significant, indicating that the magnitude of the effect of using the flipped learning strategy in the development of SRS in the course of procedural research is very high.

In summary, for research question 2, the results showed that the mean in the traditional method scores was lower than the mean using flipped learning method in acquiring SRS. The effect size of the treatment was calculated using Cohen's $d$ and found to be $d = 1.951$. This indicated that the flipped classroom treatment had a 'very high' effect, using Cohen's terminology, on the common final exam scores of the treatment group (Cohen 1988).

**Discussion, limitations and implications**

The aim of this study was to investigate the effectiveness of the flipped learning strategy in the development of SRS in the procedural research course among higher education diploma students. The results indicated that the flipped classroom treatment had a 'high' effect, implying that there are differences of statistical significance between the average scores of students in the experimental group and control group in the test skills of scientific research, to the benefit of the experimental group. The researcher emphasises that the skills of scientific research are prerequisites for students of the course of procedural research, and that the reverse learning strategy contributed to a great extent in the development of SRS (like identifying the study problem and its theoretical background, theoretical literature and previous studies, method and procedures, results and discussion, other research skills). The researcher justified this with the following:

(1) Informing students of the sources of information in the experimental group that use flipped learning, which helped to develop their awareness more. This finding is consistent with the advantages of flipped learning in theoretical

literature for the current research and with the results of many earlier researchers (Clyde & Nancy 2013; Crouch & Mazur 2001; De los 2014; Gecu and Satici 2012; Gerstein 2012; Jeremy 2007; Juhary 2015; Kurt 2017; Lim *et al*. 2014).

(2) Technological innovations were used in the study, and the students received feedback quickly at all times to know the extent of their progress and where they had reached. This increased the motivation of students to deal with the material through reflexive learning and breaking the barrier of fear of the topics of procedural research. This finding is consistent with the advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Al Tawarah, Mahasneh, & Al-Hawartheh 2017; Charles 2013; Fiorella & Mayer 2013).

(3) Flipped learning is a pattern of integrated learning, in which the use of technology in learning is activated in such a way as to enable learners to receive SRS in educational methods and from different educational sources, such as repeating a video several times, with the possibility of taking notes. This finding is consistent with the advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Edwards & Evans 2014; Maloy, Fiorella and Mayer 2013; Mazur 1997; Mazur, Brown and Jacobsen 2015; McCallum *et al*. 2015; McLaughlin *et al*. 2013; Robertson 2000).

(4) Flipped learning is characterised by its ability to constantly adapt to the needs of students. Students learn with pleasure and vitality, with little formal explanation in classes, through many teaching methods (cooperative learning, discussions and educational projects). This finding is consistent with the advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Flipped Learning Network 2014; Salem & ALwan 2018).

(5) The use of flipped education strategy helps students with low achievement, who receive assistance from a faculty member and participate in discussions among students, which helps them acquire and absorb SRS, which increases the interaction between the faculty member and his/her student. On the other hand, watching educational videos at home contributes enabling the teacher focus in the classroom on students who need more time to learn, and in guiding them to improve their performance. This finding is consistent with the advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Durak 2015; Shi-Chun, Ze-Tian and Wang 2014).

(6) The best advantage of the flipped learning strategy is to invest the best time of the lecture. Through this strategy, the core of the education is to give theoretical content to the students through the educational videos they see in advance, and classroom activities that are carried out through groups, through which students cooperate to achieve what is required of them. This allows for greater interaction among the students themselves to obtain information, followed by the teacher's interactions with his/her students in their completion of tasks and answering their queries. Teaching and requested, and also help him to help requested especially those with low achievement, it has strengthened the skills of scientific research among students. This finding is consistent with the

advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Drake, Micaela and Robin 2016; Yu, Tsai and Wu 2013).

(7) Students viewing the content in advance raised many questions among them, prompting them to record their questions and observations about what they saw, making them active in learning the next day during the lecture. They were eager to get answers to their questions, transforming from passive recipients of information to positive actors in their learning. This finding is consistent with the advantages of flipped learning in theoretical literature for the current research and with the results of many earlier researchers (Bill 2012; Bonk and Graham 2007; Bram 2013; Durak 2016).

### *Limitations of the study*

In this study, I strove to explore the effectiveness of the flipped learning strategy in the development of SRS in the procedural research course among higher education diploma students. I conducted the study under normal conditions in order to produce accurate results.

### *Next steps*

This study has brought important, but in some ways limited, knowledge. One advantage is that it is part of a wider project, in which we have additional sources of data to analyse. Not all the data that we collected from this sample of students have been utilised in this study. In addition, the present quantitative study will be followed by a study on the construction of implementing training programs to train the faculty members on how to use the flipped education strategy.

### Funding

**Appendix 1**. An example of one of the question from skills of scientific research test.

| Which of the following statements is the right to quotation in APA style? | {ID 5} |
| --- | --- |
| ◯ | Abu-Ali, O. (2017) conducted a study…. |
| ◯ | Abu-Ali (2017) conducted a study…. |
| ◯ | Abu-Ali, O. (2017) conducted a study…. |
| ◯ | Abu-Ali (2017) conducted a study…. |

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