The Effect of the Interaction between the two Infographic Types and the Cognitive Style and their Impact on Developing the Cognitive and Performance Aspects of Digital Graphics Design Skills and Motivation towards them among Students of Educational Technology at the University of Jeddah

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Abstract

The current research aims to investigate the effect of the interaction between the two types of infographics in terms of presentation and cognitive style in developing digital graphics design skills and motivation towards it among undergraduate students in the Department of Educational Technology, College of Education, University of Jeddah, Saudi Arabia. To achieve this, the experimental method was used and the study sample consisted of (109) students, who were divided into four experimental groups according to the cognitive style and the infographic technique used in education. The research reached a number of results. The most important of which are: the absence of statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in the development of cognitive aspects of digital graphic design skills and motivation towards it among students of Educational Technology in experimental groups at the University of Jeddah. In the light of the foregoing, the research presented a set of recommendations, most notably: the necessity of employing infographic technology in its static and motion patterns in teaching the digital graphics design course and other courses.

Keywords: Infographics, Cognitive Styles, Tolerance\ Intolerance of Ambiguity, Cognitive Skills, Performance, Digital Graphic Design Skills, Motivation.

1.1 Introduction

Today, the world is witnessing rapid technological progress and development in line with modern changes in personal, societal, technological and scientific requirements. This requires from society members to deal and adapt to these technical and cognitive changes, to take advantage and make optimal use of them in various sectors of life in general, and in the field of education in particular. The educational field by keeping pace with all these developments and innovations helps in devising the best educational methods aimed at developing the capabilities of learners and qualifying them to deal with the changes of the times.

There are many patterns of educational content delivery between verbal, sensory, formal, and visual through which knowledge is represented, as the visual educational content delivery systems have proven their effectiveness at various educational levels, because the image is one of the most effective means in communicating the educational message and the organizing the knowledge relations, which in turn, as mentioned by Ghufran Afana and Suad Al-Waeli (2016, p. 748), increased interest in optical technologies in our time and their exploitation in education and the dissemination of knowledge. Attar (2011, p. 8) reported that some studies have confirmed that the educational process and teaching methods become more effective in achieving its goals by increasing the impact on the learner's senses, which represents the essence of the education process based on visual imaging, including the use of infographics.

Shaltout (2016, p. 1) stated that, in the light of the successive technical developments, which provide the learner with a huge amount of data and information that may be difficult for him to deal with and understand, infographic designs have emerged, as an effective educational method in simplifying information, and facilitating reading this huge amount of knowledge data, and being able to analyze and simplify it in an effective and attractive manner.

The main function of the infographic technology is to embody the data by converting it into visual forms that enable the recipient to derive meanings and messages in a smooth and easy way, especially as it has an aesthetic appeal that attracts attention and provides an enjoyable visual experience (Purchase & Moere, 2011, p. 2).

The infographic technology works to give an attractive visual form to the educational content, and to collect and display information in a concise manner, which helps the learner to understand complex data and information easily. It also helps those in charge of the educational process to transfer information and provide educational content in an interesting way, which prompted many educational institutions and universities to adopt this technology and invest it in serving the educational process and integrating it into academic curricula (Ashman & Patterson, 2015, p. 619).

Crooks, Lankow, & Ritchie (2011, p. 42) mentions that infographic technology was not only used in the educational process, but was also employed in marketing and commercial advertising, and many brands are looking to capture the

interest of customers by using this technology in defining and describing a product or service, which contributes to improving sales.

Infographic technology is a tool for converting complex data into graphics that are easier for the learner to deal with and absorb more effectively, which made it an important and essential tool for teachers, lecturers and learners, because it provides them with the intellectual skills necessary to move them to the stage of analysis and criticism, and enhance the skills of instructional design on both sides of the educational process. This made this technology and its patterns (static, motion, and interactive) one of the present and future requirements in the world of education (Morsi, 2017, p. 45).

Several conferences and meetings were held that recommended employing infographic technology in the educational process, such as a Symposium at Al-Quds Open University, which was on "Means of Employing Infographics in the Educational Process", as they pointed out the importance of using visual techniques (infographics) in education (Judeh and Al-Abadla, 2013). Ashman & Patterson (2015, p. 613-621), Rosenberg (2015, p. 38) have also referred to the importance of using infographics in education and training in various fields of knowledge.

Several studies and research have confirmed the role of using infographic technology and its impact on the cognitive and performance aspects of some of the different skills of learners, such as the study of: Smiciklas (2012); Akkoyunlu & Kibar (2014); Abu Asbeh (2015); Ott, Robins & Shephard (2012); Abu Osba (2015); Abu Zeid (2016); Morsi (2017); Al Shaya and Al Zahrani (2018), and other studies.

It should be noted that our noble Islamic religion, and its original educational approach, was a forerunner to the use of various educational means such as drawings and images, to achieve the efficiency of the educational process in communicating information and embodying ideas and concepts, since the time of the Prophet Muhammad, may God's prayers and peace be upon him. Evidence for the Prophet's use of this formal method in teaching is numerous, the most prominent of which is what Imam Ahmad narrated in his Musnad (Athar, 1993) on the authority of Jaber bin Abdullah, may God be pleased with him. He said: "We were sitting with the Prophet, may God bless him and grant him peace, and he drew a line like this in front of him, He said: This is the path of God Almighty, and he drew two lines on his right and two on his left. He said: This is the path of Satan. Then he put his hand in the middle line, and then recited the verse: This is my path, straight, so follow it. And do not follow the other paths, lest they divert you from His path. All this He has enjoined upon you, that you may refrain from wrongdoing" (Al-Ana'm, 153), (Hussien, 2018, p. 378-379).

It is clear from the foregoing that similar means and techniques are used; Clarification of meanings and the delivery of information, but in a more advanced and modern way that suits our current era, such as graphics, digital images and infographics.

1.2 Research problem

The rapid technological developments led to a radical change in the ways of human communication, which affected the educational process. That required the use of these new methods and technologies in education, including the infographic technology. It is at the forefront of visual communication technologies that convey and communicate information quickly, easily and efficiently. In this regard, the results of many previous research and studies, which revealed the impact of the use of infographics in developing some of the cognitive and performance aspects of learners' skills in e-learning environments, are the main motives for conducting this study, including: Kos & sims (2014); Noh et al. (2015); Darwish and Al-Dakhni (2015); Darwish (2016); and Abeer Abu Oriban (2017).

In the light of the different results of some research and previous studies that dealt with the use of infographics and their impact on developing some cognitive and performance aspects; It was necessary to conduct this study to reveal the effect of using the two infographics patterns (static and motion) in improving learning outcomes and developing learners' performance skills. For example, the results of the studies of: Sears (2012); Al-Jeriwi (2014); Kos & Sims (2014); Noh et al. (2015); Ott, Robins & Shephard (2015) found that static infographics are more effective than motion infographics. While the results of the studies of Crooks, Lankow & Ritchie (2012; Abu Asba (2015) and Gebre & Polman (2015), differed with it, which concluded that the motion infographic style was more effective compared to the educational static infographic style. Despite this -as what the researcher knows- previous research and studies did not address the detection of the impact of the interaction between infographics and cognitive style in developing the cognitive and performance aspects of digital graphics design skills and motivation towards them. In light of the aforementioned justifications, the need to conduct this study came to reveal the impact of the interaction between the two infographics styles in terms of presentation (static and motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the cognitive and performance aspects of digital graphics design skills and motivation towards it among students of Educational Technology in the College of Education at the University of Jeddah. The research problem can be represented by the following main question:

- What is the impact of the interaction between the two types of infographics (static and motion) and the cognitive style in developing digital graphics design skills and motivation towards them among students of Educational Technology?

1.3 Objectives and importance of Research

The current research seeks to investigate the most appropriate empirical treatment of the interaction between the two infographics and the cognitive style and their impact on the development of cognitive aspects and performance aspects of digital graphics design skills and motivation towards them among students of Educational Technology at the University of Jeddah. Therefore, conducting such a

research regarding this topic is expected to have a high positive reflections and significance that can be summarized as in the following

- The importance of the study is in its attempt to reveal the impact of the interaction between the two types of infographics (static and motion) and the cognitive style (Tolerance\ Intolerance of Ambiguity) in developing the cognitive aspects and performance aspects of digital graphics design skills and motivation towards them, and this is evident in the following:
- The study may contribute to clarifying the importance of using infographics in teaching the digital graphics course in particular and other courses in general, and spreading knowledge in higher education institutions and universities, which helps officials and decision makers in the Ministry of Education to adopt this technical innovation in education.
- This study may contribute to the development of learners' cognitive styles, their skills in designing digital graphics and their motivation towards it.
- Some conclusions may contribute to guiding faculty members to use digital graphics in education for students in the current visual communication era according to their cognitive styles.
- The results of the study may benefit the designers of electronic courses in using the infographic style that is most attractive to learners, which gives them the greatest pleasure and suspense in the learning process.

1.4 Research Limits:

The current research is limited to the following limits:

- **Human limits**: a random sample of (109) students from the Department of Educational Technology at the College of Education at the University of Jeddah.
- **Objective limits**: The interaction between the two infographics and the cognitive style and their impact on the development of cognitive aspects and performance aspects of digital graphics design skills and motivation towards them among students of Educational Technology at the University of Jeddah.
- **Spatial limits**: Department of Educational Technology, College of Education, University of Jeddah, and Kingdom of Saudi Arabia.
- **Time limits**: The study was implemented in the first semester of the academic year (1440-1441 AH).

2. Research Methodology

2.1 Research Approach:

The research approach constitutes a path to reach the desired goal, as it is a set of tools that will be used to access the evidence, proofs and proofs by answering questions and testing the validity of the study's hypotheses. In order to achieve the objectives of the current study, the experimental method was used, where the researcher found that the experimental method is the most appropriate method to study it in the light of the nature and objectives of the current research. Through this approach, the researcher explored the extent of the change in the independent variable and observed the effects and results of this change on the dependent variable, through using the experimental groups.

2.2 Research Population and Sample

The research community means: "All individuals, people or things who are the subject of the research problem" (Obaidat and others, 1996, p. 219). The current study population consists of all students of the Department of Educational Technology at the College of Education at the University of Jeddah in the Kingdom of Saudi Arabia. A random sample of (109) students was selected from the research community, Department of Educational Technology, College of Education, University of Jeddah in the Kingdom of Saudi Arabia. Where they were divided into two experimental groups using the cognitive style scale (tolerance\ intolerance of ambiguity), and then the first experimental group was divided with the cognitive style (ambiguity tolerance) into two experimental groups, one of which applies the static infographic and the other applies the motion infographic. The same applies to the second experimental group with a cognitive method (ambiguity intolerance), which was divided into two experimental groups, one of which applies the static infographic and the other applies the motion infographic, and accordingly we have four experimental groups as follows:

- (G1) Cognitive style (ambiguity tolerance), static infographic style.
- (G2) Cognitive style (ambiguity intolerance), static infographic style.
- (G3) Cognitive style (ambiguity tolerance), motion infographic style.
- (G4) Cognitive style (ambiguity intolerance), motion infographic style.

2.3 Research Hypotheses

1- There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the cognitive aspects of digital graphics design skills for students of Educational Technology in the groups Experimental at the University of Jeddah.

2- There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in

developing the performance aspects of digital graphics design skills for students of Educational Technology in the groups Experimental at the University of Jeddah.

3- There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing motivation towards digital graphics among students of Educational Technology in experimental groups at the University of Jeddah.

2.4 Research tools

There are several tools, which are used to collect the data necessary to answer the questions of the study and achieve its objectives. We explain these tools as follows:

2.4.1 Achievement test

The researcher developed an achievement test to use it in identifying the level of student acquisition of the cognitive aspects of digital graphic design skills, which are related to the text editing tools Type Tool and Mask Tool and the ways to employ them in Adobe Photoshop. It includes multiple-choice questions type, true or false questions, questions of connecting between tools or paragraphs and their appropriate description. The number of test items was (40).

2.4.1.1 The validity of the achievement test

In order to verify the validity of the apparent test, the researcher presented the test in its initial form to a group of arbitrators and experts in the field of educational technology. This is to ensure the consistency of the questions with the prepared and monitored objectives, the clarity, simplicity and accuracy of the linguistic and scientific formulation of the questions, the clarity of instructions and the method of answering, and the suitability of the questions to the level of students. The acceptance rate for the test items was determined by 85% of the judges' opinions regarding the appropriateness of the paragraphs. After getting to know the opinions of the arbitrators, the necessary modifications were made by deletion or modification. To verify the Internal Consistency Validity of the test, Pearson correlation coefficients were used by calculating the correlation coefficients between the score of each question of the test and its total score. After conducting the statistical treatment of the answers of the exploratory sample through the SPSS program, it was found that the correlation coefficients for each of the cognitive test questions are positive, and statistically significant at the significance level (0.01) or less. All values of the correlation coefficients were statistically acceptable and ranged between (0.526-0.791), and all of them are statistically significant. Which indicates the sincerity of the internal consistency between the scores of each question and the total score of the test, and the suitability of the test to measure what it was prepared to measure.

2.1.4.2 The stability of the test

The calculation was carried out through the half-split method, where the researcher divided the test into two parts; the first for odd numbers, the second; For even numbers, the correlation coefficient between the two test halves was calculated using the Guttman Split Half reliability Coefficient. The researcher found, by applying the split-half in the SPSS program, that the reliability coefficient of the test was (0.8), a coefficient that indicates that the test has a high degree of stability.

2.4.1.3 Calculation of difficulty and discrimination coefficients for test items

The coefficient of ease and difficulty was calculated for each of the test items through the following equation:

- Ease coefficient = (number of students who answered correctly to the paragraph / number of students who tried to answer) * 100%
- Coefficient of difficulty = 1- Ease coefficient,

Based on applying of this equation, the item whose ease coefficient is greater than (0.85) has been deleted because it will be very easy, as well as the item whose difficulty coefficient is less than (0.2) because it will be very difficult? Therefore, we note that all the test items (40) were Suitable in terms of ease and difficulty, as all the coefficients of ease were less than (0.85) and all the coefficients of difficulty were greater than (0.2), and therefore these questions are able to achieve the desired goals.

The ease coefficient of the achievement test as a whole was then calculated for the exploratory sample according to the following equation:

The coefficient of ease testing = total scores of the exploratory sample students / (total test score * number of students)

Where: the sum of the scores of the exploratory sample students = 585, the total scores of the total test questions = 40, the total of the exploratory sample = 30. Therefore the test ease coefficient as a whole = 585 / (40 * 30) = 0.4875. That is, the ease coefficient of the test reached (0.4875), which is an acceptable ease coefficient and indicates that the level of the test is average.

Moreover, the researcher calculated the discrimination coefficient, which shows the ability of the question to distinguish between the students who are able to answer the question correctly from the students who are less able than them. Where the scores of the students in the exploratory sample were arranged in descending order, and then the sample was divided into two halves, i.e. (15) students in the upper group (with higher marks), and (15) students in the lower group (with lower marks), and then the discrimination coefficient was calculated According to the following equation:

Discrimination coefficient = (number of correct answers in the upper group - number of correct answers in the lower group) / number of students in one of the two groups

The discrimination coefficients for the achievement test items after their application to the exploratory sample ranged between (0.55-0.8), which indicates that the items are distinct and applicable. Whereas, the question is acceptable and

has discriminatory power if its discrimination coefficient is higher than 0.25, and the item whose discrimination coefficient is more than 0.6 is considered good and highly discriminating.

2.4.2 Performance note card

The researcher designed a performance note card to collect data about the learner in the usual behavior situation. The card aimed to assess the level of performance aspects of learners' digital graphic design skills. The note card was prepared by reviewing the educational literature and previous studies related to the study problem, and surveying the opinions of a sample of specialists through interviews and the skills we wish to acquire. Consequently, a list of the skill objectives for designing digital graphics to be developed for students was prepared, which consisted of (38) skills related to how to use the text and mask editing tools, and then work was done to prepare the card in light of the specific skill objectives.

1.2.4.2 The validity of the card

To verify the apparent validity of the card, the card was presented in its initial form to a group of arbitrators in the field of educational technology as well as digital graphic design, to evaluate the appropriateness of arbitration of the card's paragraphs, and the clarity of its linguistic formulation. Based on their opinions, some paragraphs were excluded and others were modified.

In order to verify the Internal Consistency Validity of the observation card, the correlation coefficients were calculated between the degrees of each of the observation card phrases with the total degree of skill you measure, using the Person Correlation Coefficient. Statistical processing using SPSS clarified that the correlation coefficients for each of the observation card phrases and the total score of the observation card are positive, and statistically significant at the significance level (0.01) or less. Also, the correlation coefficients are statistically acceptable and ranged between (0.525-0.770), all of which are statistically significant, which It indicates the sincerity of the internal consistency between the scores of each phrase and the total score of the observation card, and the suitability of the note card to measure what it was prepared to measure. It reached (0.834), and this indicates that the note card has a large degree of stability. Moreover, the method of multi-observer on students' performance was used to calculate the stability of the observation, where the performance of (10) students of the exploratory sample of (30) was observed with one of the observers from the department, and the percentage of agreement for this double observation was calculated by Cooper's equation:

Agreement percentage = number of times of agreement / (number of times of agreement + number of times of disagreement) * 100

After calculating the ratio, it was found that the percentage of agreement between the observers reached (89%), which is a statistically acceptable percentage to indicate the stability and reliability of the observation card.

3.4.2 Quality Assessment Card for Learners' Products for Digital Graphics Design

The researcher prepared a card to evaluate learners' products for digital graphics design. The card aims to assess the quality of the digital graphics designed, and thus learn the level of performance aspects of their digital graphic design skills.

2.2.4.2 The stability of the card

To verify the stability of the card, the stability coefficient of the card was calculated using Cronbach's Alpha. After performing the statistical treatment, it was found that the stability coefficient of the observation card and its dimensions are statistically acceptable. In formulating the card elements, the researcher relied on a list of skill objectives for designing digital graphics to be developed for students and related to how to use the text and mask editing tools. The number of card phrases was (25) in its final form. The statements belong to three categories of standards: Educational Standards for Digital Graphics Design, Visual Standards for Digital Graphics Design, and Technical Standards for Digital Graphics Design.

1.3.4.2 The validity of the card

To verify the apparent validity of the card, its initial image was shown to a group of arbitrators specialized in educational technologies and digital graphic design. The arbitrators gave their opinions on the appropriateness of the paragraphs of the card and the clarity of its language. Depending on their opinions, some criteria were excluded and others modified.

To verify the Internal Consistency Validity of the card, correlation coefficients were calculated between the degrees of each product evaluation phrase with the overall degree of the criterion measured by the Person Correlation Coefficient. Statistical processing with SPSS program showed that the correlation coefficients of each phrase of the product evaluation card and the total score of the product card are positive, and statistically significant at the significance level (0.01) or less. All values of correlation coefficients were statistically acceptable as they ranged between (0.510-0.848) and all of them are statistically significant, which indicates the validity of the internal consistency, which indicates the suitability of the product evaluation card to measure what it was prepared to measure.

2.3.4.2 The stability of the card

To verify the stability of the product evaluation card, the card stability coefficient was calculated using Cronbach's Alpha coefficient. After conducting the statistical processing, it was found that the the stability coefficient of the product evaluation card was statistically acceptable, where it was (0.842), and this indicates that the product evaluation card has a large stability degree. Moreover, the agreement coefficient method between the evaluators was used, in order to calculate the stability of the scorecard. (10) Digital graphics products were evaluated for the students of the pilot sample of (30) students, by two observers, the researcher and one observer from within the Department of Learning Technologies at the University of Jeddah. Then, the agreement ratio for this dual observation was calculated by Cooper's equation:

Agreement percentage = number of agreement times / (number of agreement times + number of disagreement times) * 100

After calculating the percentage between the observers, it was (86.4%), which is a statistically acceptable percentage to indicate the stability of the product evaluation card, and its reliability for conducting the targeted observation process.

4.4.2 The Scale of motivation towards digital graphics

The researcher developed the motivation scale after reviewing some of the existing scales in the relevant literature, with modifications made to suit the nature of the current study. This tool aims to measure the motivation towards digital graphics design by students. The scale consists of several axes: attention, turnout, effectiveness, and continuity.

4.4.1.2 The validity of motivation scale

To verify the validity of the apparent scale, the scale was presented in its initial form to a group of arbitrators specialized in educational techniques, psychology and statistics. The arbitrators made their opinions about the appropriateness of the paragraphs of the scale, and the clarity of its linguistic formulation. Accordingly, some paragraphs were excluded and others modified. The scale in its final form consists of (21) paragraphs, (6) of which belong to the focus of attention, in addition to (5) paragraphs for each of the remaining axes.

To verify the Internal Consistency Validity of the motivation scale, the researcher calculated the correlation coefficients between the degrees of each of the motivation scale phrases with the total score of the axis to which it belongs, using the Person Correlation Coefficient. After performing the statistical treatment using the SPSS program, it was found that the correlation coefficients of each of the phrases of the motivation scale with the total degree of the axis you measure are positive, and statistically significant at the significance level (0.01) or less. In addition, all the values of the correlation coefficients were statistically acceptable and significant, which indicates the sincerity of the internal consistency, and that indicates the appropriateness of the motivation scale to measure the targeted dimensions. Moreover, the researcher calculated the correlation coefficients between the total score of each of the axes of the motivation scale with the total score of the scale using the Pearson correlation coefficient. After performing the statistical treatment, it was found that the values of the correlation coefficients for the four axes in the total score of the trend scale came with statistically acceptable values that ranged between (0.671-0.810), and all of them were positive and statistically significant at the significance level (0.01) or less. That indicates the availability of a high degree of internal consistency for the axes of the motivation scale.

4.4.2.2 The stability of motivation scale

To verify the calculation of the stability coefficient of the motivation scale using Cronbach's Alpha. After conducting the statistical treatment, it was found that the values of the stability coefficients for each of the axes of the scale and the scale as a whole were statistically acceptable, as the values of the stability coefficients of the axes ranged between (0.713-0.803). The value of the overall stability

coefficient of the motivation scale axes was (0.741), which indicates a large degree of stability, and therefore the scale is valid for application and reliable to obtain reliable results.

5.4.2 Cognitive types Scale (Tolerance/Intolerance of ambiguity)

The researcher developed the Cognitive Styles Scale after reviewing some scales in the relevant literature, with modifications made to suit the nature of the current study. This tool aims to classify the experimental group members according to the cognitive type (tolerance / intolerance of ambiguity). Since this scale is used based on scales used in previous studies, this scale has a high degree of validity and reliability without the need to measure it statistically.

3. Results:

a. Presenting Results of the First Hypothesis:

To test first hypothesis, two-way ANOVA was used to address the dimensional measurement scores to test the cognitive aspects, and to identify the significance of the differences between groups in relation to the cognitive aspect of digital graphics design skills in terms of the impact of the interaction between the two types of infographics (static, motion) and the cognitive style (tolerance\ intolerance of ambiguity) on these cognitive aspects. The table (1) shows the results of the two-way analysis.

Table 1: The results of the two-way analysis of variance between the two types of infographics (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) on the cognitive side of digital graphics skills

Variance source	Sum squares	Free Degrees	Average squares	F value	Sig. α<0.05
Infographic type (static, motion)	133.496	1	133.496	2.576	0.111 (Not significant)
Cognitive style (tolerance\ intolerance of ambiguity)	149.109	1	149.109	2.877	0.043 (Significant)
Infographic style x cognitive style	142.925	1	142.925	2.758	0.100 (Not significant)
Error	5441.253	105	51.821		
Total	66801.000	109			

Through reviewing the results from the previous table (1) related to the interaction between the infographic style and the cognitive style, it is clear that (F) value reached (2.758) and that the significance level is (0.100), and this value is not significant at the significance level (α<0.05). This indicates to accept the hypothesis, and that there are no statistically significant differences at the level (α < 0.05) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in the development of cognitive aspects of graphic design skills digital

education technology students at the University of Jeddah, and table (2) illustrates these differences.

Table 2: The difference between the averages of the infographic groups according to the cognitive method used in the cognitive aspect of digital graphics skills for the achievement test

Cognitive type / Infographic style	ambiguity tolerance	ambiguity intolerance
Static infographic	24.808	24.759
Motion infographic	24.885	24.250

It is clear from the table (2) that the average scores of students with a cognitive tolerate ambiguity style and depend on static infographics are close to the average of the students who depend on motion infographics. The same is true for students with an intolerance ambiguity cognitive style who depend on static infographics in comparison with students with the same cognitive style and who depend on the motion infographic. There is no significant difference between the average scores, and this difference has no statistical effect, which indicates that there is no effect of interaction between the two infographic styles in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing Cognitive aspects of digital graphics design skills, and thus the hypothesis is accepted.

b. Presenting Results of the Second Hypothesis:

To test second hypothesis, two-way ANOVA was used to treat the dimensional measurement scores of the observation card and the results evaluation card. It was used to identify the significance of the differences between groups in relation to the performance aspect of the digital graphics design skills in terms of the impact of the interaction between the two types of info-graphics (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) on these performance aspects. The following tables (3) and (4) clarify the results of the two-way analysis of both the observation card and the results evaluation card.

Table 3: Results of two-way analysis of variance between infographic styles (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) on the performance aspect of digital graphics skills for observation card

Variance source	Sum squares	Free Degrees	Average squares	F value	Sig. α<0.05
Infographic type (static, motion)	3300.405	1	3300.405	5.213	0.064 (Not significant)
Cognitive style (tolerance\ intolerance of ambiguity)	27828.916	1	27828.916	43.957	0.000 (Significant)
Infographic style x cognitive style	10442.365	1	10442.365	16.494	0.000 (Significant)
Error	66475.417	105	633.099		
Total	700601.000	109			

Table 4: The results of the two-way analysis of variance between the two types of infographics (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) on the performance side of digital graphics skills for results card

Variance source	Sum squares	Free Degrees	Average squares	F value	Sig. α<0.05
Infographic type (static, motion)	2306.313	1	2306.313	10.817	0.064 (Not significant)
Cognitive style (tolerance\ intolerance of ambiguity)	6519.308	1	6519.308	30.578	0.000 (Significant)
Infographic style x cognitive style	1460.157	1	1460.157	6.849	0.010 (Significant)
Error	22386.603	105	213.206		
Total	362362.000	109			

By reviewing the results in Table (3) and Table (4) in the third line related to the interaction between the infographic style and the cognitive style, it becomes clear that the (F) value amounted to (16,494) and that the significance level is (0.000) in the observation card and this value is a function of the significance level. ($\alpha < 0.05$), and the (F) value was (6.849) and that the significance level was (0.010) in the results evaluation card, and this value is also significant at the significance level ($\alpha < 0.05$). These results indicate that the hypothesis is not accepted, and that there are statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation type (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the performance aspects of digital graphics design skills among students of Educational Technology in the experimental groups at the University of Jeddah, and the following tables (5) and (6) explain these differences.

Table 5: The difference between the averages of the infographic groups according to the cognitive style used in the performance aspect of the digital graphics skills of the observation card

Cognitive type / Infographic style	ambiguity tolerance	ambiguity intolerance
Static infographic	75.154	62.759
Motion infographic	105.769	54.179

Table 6: The difference between the averages of the infographic groups according to the cognitive style used in the performance aspect of the digital graphics skills of the results evaluation card

Cognitive type / Infographic style	ambiguity tolerance	ambiguity intolerance
Static infographic	54.846	46.690
Motion infographic	71.385	48.571

It is clear from the previous table (5) that the average degrees of the ambiguity tolerant students who used the motion infographic (105.769) increased compared to the ambiguity tolerant students who used the static infographic (75.154). The increase in the average of the degrees of the ambiguity tolerant students who used the static infographic (75.154) compared with intolerance ambiguity students who used static infographics (54,179) for the observation card. The same applies to the previous table (6), which clarifies the high degrees average of the ambiguity tolerate students who used the motion infographic (71.385) compared to the tolerate ambiguity students who used the static infographic (54.846). The increase in the average of the degrees of the ambiguity tolerant students who used the static infographics (54.846) compared to intolerance ambiguity students, who used static infographics (46.690) for the results evaluation card. This indicates that there is a noticeable difference between the average performance scores, and that this difference has a statistical effect, which indicates the existence of an impact of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the performance aspects for digital graphic design skills. Therefore, the hypothesis is rejected.

c. Presenting Results of the Third Hypothesis:

To test third hypothesis, two-way ANOVA was used to treat the dimensional measurement degrees of the motivation scale, and to identify the significance of differences between groups in relation to motivation towards digital graphics in terms of the effect of the interaction between the two types of

infographics (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) on motivation. Table (7) clarifies the results of the two-way analysis.

Table 7: Results of the two-way variance analysis between the two types of infographics (static, motions) and cognitive style (tolerance\ intolerance of ambiguity) on motivation

Variance source	Sum squares	Free Degrees	Average squares	F value	Sig. α<0.05
Infographic type (static, motion)	8.029	1	8.029	0.164	0.687 (Not significant)
Cognitive style (tolerance\ intolerance of ambiguity)	350.641	1	350.641	7.147	0.009 (Significant)
Infographic style x cognitive style	122.238	1	122.238	2.492	0.117 (Not significant)
Error	5151.400	105	49.061		
Total	536795.000	109			

By reviewing the results from the previous table (7) in the third line related to the interaction between the infographic type and the cognitive style, it is clear that the (F) value reached (2.492) and that the level of significance is (0.117). This value is not significant at the significance level ($\alpha < 0.05$), which indicates acceptance of the hypothesis, and that there are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing motivation towards digital graphics among students of Educational Technology in experimental groups at the University of Jeddah. Table (8) illustrates these differences.

Table 8: The difference between the averages of the infographic groups according to the cognitive style used in the cognitive aspect of digital graphics skills of the motivation scale

Cognitive type / Infographic style	ambiguity tolerance	ambiguity intolerance
Static infographic	70.885	69.414
Motion infographic	72.462	66.750

It is clear from the table (8) that the average motivation of students with the ambiguity tolerance cognitive style who depend on static infographics is close to the average of the students themselves who depend on motion infographics. The same is true for students with the ambiguity intolerance cognitive style who depend on static infographics compared to students with the same cognitive style who depend on motion infographics. It is clear that there is no significant difference between the averages of motivation, and also that this difference has no statistical

effect, which indicates that there is no effect of interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in the motivation towards digital graphics. Therefore, the hypothesis is accepted.

4. Discussion:

There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the cognitive aspects of digital graphics design skills for students of Educational Technology in the experimental groups at the University of Jeddah.

The results related to the first hypothesis in tables (1) and (2) showed that the average scores of students with ambiguity tolerance cognitive style who depend on static infographics are close to the average of students themselves who depend on motion infographics. The same applies to students with the ambiguity intolerance cognitive style who depend on static infographics compared to students with the same cognitive style who depend on motion infographics. As there is no significant difference between the average scores, and this difference has no statistical effect, which indicates that there is no effect of interaction between the two infographic styles in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing cognitive aspects of digital graphic design skills.

As for the result that he reached regarding the lack of differences between the averages of students following the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the cognitive aspects of digital graphics design skills; the researcher attributes this result to the fact that students in the experimental groups, regardless of their cognitive style, were taught by the same learning style, which is the infographic technique, regardless of its motion or static type. As the same educational content was used with similar media, images, graphics and texts, that is, the cognitive educational content of the two patterns is the same, which enabled the different students in the cognitive style to deal with the knowledge content in a unified manner, as it enables students who are able to ambiguity tolerance as well as those who are unable to ambiguity tolerance to deal with the same knowledge content without any differences.

There are statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the performance aspects of digital graphics design skills for students of Educational Technology in the experimental groups in the University of Jeddah.

The results related to the second hypothesis in tables(3), (4), (5), and (6) showed that the average scores of ambiguity tolerance students who used motion infographics compared to ambiguity tolerance students who used static infographics is high. The average score of the ambiguity tolerance students who

used the static infographic is high in comparing to the ambiguity intolerance and who used the static infographic for the motivation scale. This indicates that there is an impact of the interaction between the two types of infographics in terms of the presentation method (static, motion) and the cognitive style (tolerance\ intolerance of ambiguity) in developing motivation towards digital graphics.

The researcher attributes the result that he reached in terms of the presence of differences between the averages of students regarding the interaction between the two types of infographics in terms of the presentation method (static, motion) and the cognitive style (tolerance\ intolerance of ambiguity) in developing motivation towards digital graphics, to the fact that the students in the experimental groups regardless the difference in their cognitive style and despite the fact that they studied with the same learning style, which is the infographic technique, regardless of its motion or static type. As the same educational content has been used with similar media, images, graphics and texts, the motivation towards learning among them will differ according to their personality and characteristics that depend mainly on the cognitive method more than the teaching technique used. The students who are ambiguity tolerate, their characteristics and personal traits will be more willing and eager to face the difficult situations they face, and take them as a challenge to them, which is what makes them show greater perseverance and motivation in solving problems and ambiguous situations. It will also become a source that individuals seek to enjoy with, which drives them towards it. Which makes them more adaptable and tend to use motion infographics, which is a little complicated compared to the static type, in which the information is fragmented into non-static segments, which requires focus and follow-up to acquire skills, which makes the ambiguity tolerant bearers feel enthusiasm, motivation and psychological satisfaction towards it compared to with ambiguity intolerant.

5. Conclusion

The current research aims to investigate the effect of the interaction between the two types of infographics in terms of presentation type and cognitive style in developing digital graphics design skills and motivation towards it among undergraduate students in the Department of Educational Technology, College of Education, University of Jeddah, Saudi Arabia. The research resulted in a set of unique results, due to the absence of previous studies -as what the researcher knows- that deal with the impact of the interaction between infographics and cognitive style in developing the cognitive and performance aspects of digital graphics design skills and motivation towards them. Whereas, previous studies such as Al-Shay'i and Al-Zahrani (2018), Morsi (2017), Al-Mohammadi (2017), and Ozdamlı et al. (2016) dealt only with the impact of the applying the infographics on the performance, cognitive and motivational aspects of students and their attitude towards the learning environment in comparison with traditional educational environments. Whereas Hadiya, Al-Buhairi and Al-Saeed (2017) study, Asadi (2017), Li & He (2016), Başöz (2015), Balgiu (2014), Zarei, Zainalipour & Shahraki (2013) and Nuri (2007) dealt with the effect of cognitive style on

performance, cognitive and motivational aspects of learning. No previous study has combined the two aspects represented by the cognitive style and the infographic technique together, except for the study of Matar (2016), which is the closest to our study, but it examines the impact of the interaction between two modes of synchronous and asynchronous e learning, and the independent cognitive style that depends on these aspects. That is contradicted by our study, which is looking at a different educational style, which is the infographic technique and a different cognitive style as well, which is ambiguity tolerance or intolerance. The research reached a number of results, the most important of which are:

- There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the cognitive aspects of digital graphics design skills and motivation towards it among students of Educational Technology in experimental groups at the University of Jeddah.
- There are statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of infographics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the performance aspects of digital graphics design skills for students of Educational Technology in the experimental groups University of Jeddah.
- There are no statistically significant differences at the level ($\alpha < 0.05$) of the interaction between the two types of info-graphics in terms of presentation (static, motion) and cognitive style (tolerance\ intolerance of ambiguity) in developing the motivation towards digital graphics among students of Educational Technology in experimental groups at the University of Jeddah.
- The motivation towards learning among students varies according to their personality and characteristics, which depend mainly on the cognitive method rather than the teaching technique used.

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أثر التفاعل بين نوعي الإنفوجرافيك والأسلوب المعرفي وأثرهما في تنمية الجوانب المعرفية والأدائية لمهارات تصميم الرسوميات الرقمية والتحفيز تجاهها لدى طلاب تقنيات التعليم بجامعة جدة

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الملخص

يهدف البحث الحالي إلى معرفة تأثير التفاعل بين نوعي الإنفوجرافيك من حيث العرض والأسلوب المعرفي في تنمية مهارات تصميم الرسوميات الرقمية والتحفيز نحوها لدى طلاب البكالوريوس في قسم تقنيات التعليم بكلية التربية بجامعة جدة، بالمملكة العربية السعودية. ولتحقيق ذلك تم استخدام المنهج التجريبي، وتكونت عينة الدراسة من (109) طالباً، تم تقسيمهم إلى أربع مجموعات تجريبية حسب الأسلوب المعرفي وتقنية الإنفوجرافيك المستخدمة في التعليم. توصل البحث إلى عدد من النتائج أهمها: عدم وجود فروق ذات دلالة إحصائية عند مستوى (α <0.05) للتفاعل بين نوعي الإنفوجرافيك من حيث العرض (الثابت، المتحرك) والأسلوب المعرفي. (تحمل/ عدم تحمل الغموض) في تنمية الجوانب المعرفية لمهارات تصميم الرسوميات الرقمية والتحفيز تجاهها لدى طلاب تقنيات التعليم في المجموعات التجريبية بجامعة جدة. وفي ضوء ما تقدم قدم البحث مجموعة من التوصيات أبرزها: ضرورة توظيف تقنية الإنفوجرافيك في أنماطها الثابتة والمتحركة في تدريس مقرر الرسوميات الرقمية وغيرها من المقررات.

الكلمات المفتاحية: الإنفوجرافيك، الأساليب المعرفية، تحمل/ عدم تحمل الغموض، الجوانب المعرفية، الأداء، مهارات تصميم الرسوميات الرقمية، التحفيز.