Interaction Between Presentation Patterns of the Infographic (Static / Animated) and learning Styles (global/ sequential) in Adaptive Learning Environment and its Effect on the Development of Programming Skills of Secondary students

Prof. Dr. / Maher Ismail Sabry

Professor of curriculum and teaching methods and Education Technology- Faculty of education - Banha University

Ass. Prof. Dr. / Hany Abu El- Foutouh

Associate Professor of Education Technology faculty of specific education - Benha Universi

Enas Ahmed Anwer Mohamed Gouda

Supervisor of Computer and Information Technology Benha Educational Administration – Ministry of Education

Abstract:

T his research aimed at figuring out the effect of interaction between Presentation Patterns of the Infographic (static/ animated) and the learning styles (global/sequential) in an adaptive learning environment and its Effect on the Development of Programming Skills of Secondary school students, To such a purpose, a PHP- based programming skills list and an adaptive learning environment- related criteria have been prepared. Instruments of the study consisted of an achievement test and an observation sheet.The research's sample was (20) secondary school students who are classified into four experimental groups according to their favorite patterns of the Infographic and the suitable learning styles for them. The results show a positive effect of such interaction between the patterns of the Infographic and the learning styles in an adaptive learning environment for the purpose of boosting the programming skills of the secondary school students, and the efficiency of the adaptive electronic learning environment in providing content to each student,

as the results of cognitive achievement and the observation sheet between groups were close, The most important recommendations were that more attention should be accorded to the use of infographics interacting with learning styles, and adaptive electronic learning environments in the educational process because of their positive impact on the cognitive achievement and skill performance of high school students, taking into account the criteria for their design and production, and publishing via the Internet, in addition to appreciating the individual differences between the students and their educational preferences in presenting the electronic educational materials. The researcher suggests that more studies about the relationship between infographic (Static/animated) and learning styles (global/sequential) in an adaptive learning environment and their effect on improving the programming skills of the preparatory school pupils should be conducted. Another thing that has to be done is about researching the effect of the interaction between the interactive infographic and other learning styles on the development of the programming skills of the secondary school students.
Key words: Infographic - learning styles- adaptive learning environments- PHP-based programming skills.

Introduction:

In the middle of the information revolution, the rapid technological development and the internet, it has become necessary to use some modern technologies and employ them in the field of education and learning, including infographics and adaptive electronic learning environments, taking into account students' learning styles for the sake of the success of the educational process.

The infographic is one of the vital ways in the educational environment to convey the information, data and the complicated scientific concepts easily and clearly, In recent years, some studies are conducted to figure out the positive aspects of using the infographic in

communication, This allows those in charge of the educational process to invest these aspects in supporting the teaching and learning processes (Abd El-Basset, 2015).

Going deep into the study of learning styles, it makes us always strive to develop, the educational ways are very diverse, This made researchers develop some models that seek to divide them in general, and has led to the emergence of many models of learning styles over the past twenty-five years and increased interest in the idea that students learn in a variety of ways, and that one method of learning does not produce satisfactory results for all students (Coffield & et al., 2004).

Personal learning services are the basis in the field of online learning as there is no fixed learning path that fits all learners, however traditional learning systems ignore these demands and provide the same educational content for all students , and this approach is not effective with all learners with different backgrounds and abilities, and for content design adaptable learning, we must consider providing educational content according to the learner's specific needs (Yarandi, Jahankhani & Tawil, 2013, p. 2).

Problem and Questions of the Research:

The research problem is that the PHP-based programming skills of the secondary school's students are not that good, that's why it needs to be enhanced. To fulfill this goal, there should be an interaction between the infographic (static/ animated) and the learning styles (global/sequential) in an adaptive learning environment. The research questions are manifested in the main question as follows: "What is the interaction between the patterns of the Infographic and the learning styles in an adaptive learning environment in addition to its effect on honing the

programming skills of the secondary school students? The main question is divided into the following sub-questions:

- Q1 what are the PHP-based programming skills in the curriculum of computer and information technology that needs to be honed for the secondary school's second grade students?
- Q2 what are the criteria of designing and producing an adaptive learning environment that is related to the infographic (static/animated) and the learning styles (global/sequential) of the secondary school second grade students?
- Q3 what is the educational design of the adaptive learning environment?
- Q4 what is the effect of the interaction between the infographic (static/animated) and the learning styles (global/sequential) in an adaptive learning environment on honing the cognitive aspect of the PHP-Based programming skills of the secondary school second grade students?
- Q5 what is the effect of the interaction between the info-graphic (static/animated) and the learning styles (global/sequential) in an adaptive learning environment on honing the performance aspect of the secondary school second grade students regarding the programming skills?
- Q6 what is the difference of significance between the experimental groups results in the post application of the cognitive attainment test and the performance observation sheet?

Research methodology and variables:

The research belongs to the category of developmental research, and testing the causal relationships between the independent variables and their effect on the dependent variables.

- The independent variable: that is about the interaction between the static or animated infographic and a sequential or global learning style in an adaptive learning environment.
- The subordinate variables: they include the following:
- The cognitive aspect that is related to the PHP-based programming skills.
- The performance aspect that is related to the PHP-based programming skills.
- The classification variable: which include the learning styles (global/sequential), and its translation by Abu Hashem (2012, p.1307).

Research sample and experimental design of research:

The research sample consisted of 20 students from "El-Shoban El- Muslimeen" school in Benha educational administration. Those students were classified, according to the learning styles scale of fielder and Silverman in addition to the Patterns of the Infographic that each student prefers, into four experimental groups.

Table (1) the quasi-experimental design of the independent and subordinate variables in the current research

The pre-application of the research's tools	The experimental methodology of the research's groups			The post application of the research's tools
- An cognitive **test** - an **observation sheet** -the learning **style scale**	**Learning style**		**Infographic**	-An cognitive **test** -An **observation sheet**
	global	**sequential**		
	G 1	**G2**	**Static**	
	G3	**G4**	**Animated**	

Experimental methods of the research:

An adaptive electronic learning environment that includes an infographic (Static/animated) interacting with learning styles (global/sequential) as a tool for experimentation with the current research, and it was prepared and designed electronically by the researcher.

Measurement tools:

The objective of this research was to develop PHP-based programming skills. Therefore, the following measurement tools have been prepared: an cognitive test to measure the cognitive aspect of the programming skills, An observation sheet to measure the performance aspect of the programming skills, and A learning style- determining scale (Fielder & Silverman scale).

The Theoretical Framework:

1- Infographic

What is Infographic:

Infographic is defined as a visualization of data or ideas that tries to convey complex information to an audience in a manner that can be quickly consumed and easily undestood (Smiciklas, 2012, p.3), and (El-Shehri & El-Adil, 2018, p.207) define it as a design that transforms theoretical information into pictorial information in an interesting, easy and abbreviated format.

The importance of Infographics in supporting educational content:Infographic is of great importance in the teaching and learning processes, and there are many studies that have confirmed the effectiveness of the infographic in the teaching and learning process, including the study of Mansour (2015, p.126), (El-Shehri & Obaid, 2016, p. 1) , (Jeevji, 2016, p. 163), and the study of

(Darwish, 2016, p. 312), (El-Zahrani, 2017, p. 84), (Afifi, 2018, p. 326), (Abu El-Dahab, 2018, p.1), (Abdel-Fattah, 2020, p.141), and (El-Sherbiny, 2021). Through these studies, the importance of Infographics in supporting educational content can be summarized in simplifying complex and large information, and the speed in providing information and communicating it to the recipient, Attractiveness and excitement in providing information and the ease of spreading Infographics through social networks.

Infographic Features:

The infographic has many features, including the following: (Smiciklas, 2012, P.11) & (Toth, 2013, P.449) & (Matrix & Hodson, 2014, P.23)

- Improved comprehension of information, ideas, and concepts improving retention and retrieval of information.
- Enhanced ability to think critically and develop and organize ideas
- Attracting attention, making images easy and quick to read, and helping to generate large amounts of information.
- Ease of dealing with infographic technology and ease of publishing through social networks.
- Present complex information quickly and clearly to the viewer and easily.
- Combines text and images, making them easier to understand than reading text only.

Infographic Patterns:

In terms of presentation: (Yavar, Mirtaheri, Farajnezam & Mirtaher 2012, p. 3), (Dur, 2014, p. 44), (Darwish & El-Dakhni, 2015, p. 266), (Hassan & El-Sayyad, 2017, 718)

indicate that there are several types of Infographic, which are as follows:

- Static Infographics: It is the use of images, symbols, numbers, maps, etc. with a set of colors on a specific topic and with a clear goal.
- Animated Infographics: It is the use of 2D and 3D animation related to data and information transfer techniques based on a specific scenario specific to a specific topic and with interesting and attractive production with special programs.
- Interactive Infographics: In this type of infographics, the user controls the information, which is a static illustration with the use of an interactive environment, and the user must be able to define his needs and by using the mouse and buttons by pressing or touching the navigation.

Infographic design criteria:
Criteria for a successful Infographic designs are as follows: (Dur, 2014, p. 48), (Dunlap, 2016, p. 16), (Hassan, 2016, p.18)

- Well Data analysis by the designer.
- Organizing the content and dividing it according to the level of importance and the associated meanings of the organization. Correct and effective visual coding is a guide for student focus and follow-up to the flow of information.
- Observing the hierarchy of information, to create a correct and effective story.
- Determining the audience to which the Infographic will be presented, and where it will be published.
- Paying attention to the interface and the navigation method in the case of interactive projects.

- Consistency of colors used to organize information and focus on the most important elements.
- Paying attention to the quality of implementation, and how to use the program to reach the best appearance of the Infographic.
- Avoiding patterns and special effects and trying to be creative, whether in gathering unexpected information or in presenting unusual drawings that are compatible with the data they symbolize.

The programs used in designing the Infographic, include the following:

- Adobe Illustrator is one of the most powerful programs in creating and designing static Infographics, (Lankow, Ritchie, & Crooks, 2012, p. 63)
- Adobe Photoshop: Photoshop is one of the most popular programs used in static Infographic design (Abu El-Ata, 2009, p.11)
- Adobe Aftereffect: It is considered the first program in designing mobile Infographics, as it is characterized by easy handling of its tools (Fridsma & Gyncild, 2015, p.14).

The stages of designing the Infographic:

Shaltout (2016, pp. 150-151) indicated that there are stages for designing and producing educational Infographics, as follows:

- The study and analysis stage: during which the objectives, the educational material and the characteristics of the students are analyzed.
- Design stage: in which the scientific content is formulated so that it is easy to represent it visually, and the lines, colors and shapes are defined and the elements of interaction with the content are designed.

- Production stage: The prototype is produced by applying the formal scheme.
- Evaluation stage: In this stage, the Infographic is judged to ensure its integrity.
- The stage of publication and use: In this stage, the field use and application of the Infographic takes place.

Graphs and Learning Theories:

There are theories of learning that teachers should take advantage of while designing instructions for their students, including:

- Constructivism theory: Constructivism emphasizes building knowledge rather than transferring knowledge, as new learning depends on previous knowledge that the student can employ in understanding new information and experiences, and thus the learning process occurs (Dagar & Yadav, 2016, p.3). Using structural principles to produce patterns of graphs in a form that suits the student, her principles give preference to static and moving graphs.
- Gestalt theory: Gestalt theory asserts that learning depends on the individual's ability to perceive the general situation with which he is interacting and the nature of the relationships that exist between the elements of this situation. Gestalt principles describe how our minds organize individual elements into groups (Nassar & El-Shafi'i, 2012, p. 216). Gestalt principles for extracting patterns from graphs in a form that appeals to the cognitive processes of the human brain (Taylor, 2014, p. 11).
- Information Processing Theory: Describes how sensory inputs are received, transformed, crystallized, stored, retrieved, and used (Kandarakis & Poulos, 2008, p. 111).

An important principle of this theory is storage and its relationship to short-term memory capacity, where it refers to the process of taking and collecting separate pieces of information. In larger units, which helps to increase the amount of information that we can remember, and is less likely to forget the information, as the information is processed by dividing it into small units (Hassan & Al-Sayyad, 2017, p.730), in addition to a fixed graph that includes the segmentation of content and information to be processed. Graphs of small steps, which may be in the form of static images, graphics, arrows or text, thus information processing theory supports the method of static graphs.

- Binary coding theory: supports the use of visual forms in learning, as it assumes that information is stored in long-term memory in two forms: verbal (words and sentences) and non-verbal (visual) based on images (Paivio & Goetz, 1991 p.472) (Sadoski, Rieber (2000), p.127) He also asserted that the presence of images helps with remembering, because ideas are verbally and visually encoded, and therefore easy to retrieve and associate with symbolic terms, and thus this theory gives preference to a moving graph pattern versus a static pattern.

2- Learning Styles:

-What are the learning styles?

Grasha (2002, p. 41) defines learning styles as personality traits that influence a student's ability to obtain information, and Nzesei (2015, p. 8) defines them as distinct cognitive, emotional, social and physiological behaviors as being relatively stable. Indicators of how students perceive the environment. Learning, Interaction and Response, referenced in (Pedagogy & Practice, 2004,

pp. 16-17), (Bachler, McDaniel, Rohrer & Björk, 2009, pp. 105), (Gilakjani & Ahmadi, 2011, pp. 469-470). (Smiciklas, 2012, p. 11), (Nidhi & Tay, 2017, p. 18-20) indicate that there are patterns of learning methods, namely visual learning, where ideas, concepts, data and information are associated with images, and auditory learning, where the student learns through Listening sensory (sensory) learning where the student learns through the practice of motor activity rather than listening to a lecture or simply providing information.

- Importance of Learning Styles:

Learning methods are of great importance in the teaching and learning process, as knowing students' learning styles makes it easier for the teacher to prepare his lessons in a way that takes into account the individual differences among students and their ways of learning, The student's understanding and knowledge of his learning styles increases his academic excellence and distinction, and is also important factor in determining practical results. Teaching and learning, and although educational psychologists do not differ much on the importance of learning styles, many theories have emerged that dealt with learning styles.

- Learning styles theories:

There are many theories that dealt with learning methods, including: Kolb's theory, Honey & Mumford's theory, Romero & Tepper's theory, Felder & Silverman's theory, (Jaber & Qaraan 2004, pp. 23-26), (Graf & etal., 2007, p.3), (Khamis 2018, p.493) that the Felder & Silverman scale consists of forty-four items of focused choices, to evaluate Performance in four standard bipolar categories are:

- (Active - Reflective Style).

- (Sensing - Intuitive Style).
- (Visual – Verbal Style)
- (Sequential - Global) The sequential student tends to learn through precise sequential steps, and the total student tends to think holistically about the situation, and understands the information in a random way without knowing the connections (Ahmed, 2003, p.47)

Based on the aforementioned theories that dealt with learning styles, more than one model of learning styles models for applied use appeared.

-Learning styles models:

There are many models of learning methods, including the following: (Khamis, 2018, p. 492)

Kolb model (Kolb, 1984), (Honey & Mumford model, 1982), Felder & Silverman model (Felder & Silverman, 1988), and all models of learning styles emphasize the need to address individual differences among students, and in order for learning to be more effective, it must be designed and and organized to suit students with different learning styles (Jaber and Qaraan, 2004, p. 16), and the Felder & Silverman model has proven its effectiveness in many adaptive learning systems, and it is considered the most suitable model for the field of educational technology (Graf, Kinshuk & Liu, 2008, p.482) (Dung & Florea, 2012, p.172). Therefore, the researcher chose the Felder & Silverman learning style model, where most other learning styles models classify students into a few groups, while Felder and Silverman describe The learning style of the learner in more detail, distinguishing preferences on four dimensions, depending on inclinations, arguing that students with a high preference for a particular behavior

can also behave differently sometimes, as this model has proven effective in many adaptive learning systems.

-Learning styles in adaptive learning environments:

Learning styles that refer to students' preferred ways of learning play an important role in adaptive learning systems, by knowing the different styles of students, the system can provide valuable advice and instructions to students and teachers to improve the student learning process (Truong, 2016), individual differences among students have an impact It is significant on their learning outcomes (Rukanuddin, Hafiz & Asfia, 2016, p.15), and it has been stated (Surjono, 2011, p.2351) that students can be divided into global and sequential according to their preferred learning styles, whether visual, auditory or kinesthetic. , since most students prefer learning in general, while sequential students tend to learn in a linear way, i.e. follow logical paths step by step.

3- Adaptive e-learning environment

-What is the adaptive e-learning environment system?

Adaptive learning environments are defined as learning systems that are able to change their activity to provide educational content and a pedagogical method for each student according to his characteristics, as these characteristics differ from person to person and are organized in the student model (Fröschl, 2005, p.27)), and Sonwalkar defined (Sonwalkar, 2005). , p.2) Adaptive learning environments as technological systems that are designed to adapt to the educational preferences of each student, and that allocate educational content based on these preferences.

-Characteristics of the adaptive e-learning environment:

The adaptive learning environment has several characteristics, the most important of which are mentioned

by: (Koch, 2001, p.33), (Brusilovsky & Maybury, 2002, p.32), (Magoulas, Papanikolaou & Grigoriadou, 2003, p.514), (Whittenburg, 2011). , p.26), (Knutov, Bra & Pechenizkiy, 2011, p.167) (Izumi, Fathers & Clemens, 2013, p.11), (Nash, 2013).

- Structure: The adaptive learning system consists of three components: the domain model, the student model, and the adaptive model.
- Personalization and Adaptation: It means transforming student learning into a unique individual experience for each student.
- Diversity: It means that the adaptive system includes a variety of educational content.
- Interactive: It refers to the system's ability to interact with students, as it assesses students adaptively, determines skill and knowledge levels, and then adjusts the learning content based on their knowledge.
- Prediction: It means the ability of the system to predict the future behavior of students, based on their interaction with the system.

-Objectives of the adaptive e-learning environment:
   Adaptive learning environments have many goals, the most important of which are the following: (Brusilovsky & Peylo, 2003, p.161), (Esichaikul, Lamnoi & Bechter, 2011, p. 342), (Khamis, 2018, p. 468)
- Delivering the content that suits the student at the appropriate time for him.
- Providing content in an educational manner that takes into account individual differences and educational differences among students.
- Providing multiple tracks according to learning methods and according to different educational strategies.

- Providing reports for student assessment and learning process guidance, and continuous feedback to students.

-Importance of the adaptive e-learning environment:

Adaptive learning environments are of great importance in the teaching and learning process, and the whole idea of adaptive learning is that there is no educational style that suits all kinds of needs of students, and there are two approaches to adaptation that have been introduced in this area, the first is the flexibility with which the system comes out based on some knowledge about the student, and the second is The ability of the system to respond and modify according to the needs of the student, the former is controlled by the system while the latter is controlled by the students (Magoulas, Papanikolaou & Grigoriadou, 2003, p.11), and the goal of using adaptive learning is to increase student grades, success rate, as well as increase Competence for Students and Teachers (Kakish & Pollacia, 2018, p.72), (Wu, Chen & Chen, 2017, p.905 also reported that these adaptive systems are able to measure and account for student level variation during the creation of a course Learning, and making continuous assessments of student modeling integrated into adaptive learning systems during the learning process, which helps to provide appropriate learning for each student. Several studies have emphasized the importance of the adaptive environment in supporting the teaching and learning process, including: Hamada (Hamada, 2011), and Marwa's study Al-Mohammadi (2016), the study of Ahmed Al-Attar (2017), and the study of Wu, Chen, and Chen (Wu, Chen & Chen, 2017, p.912).

-Components of the adaptive e-learning environment system:

There are three basic components of an adaptive learning system, which are as follows: (Akhras & Self, 2002, p.2),

(Shute &Towle, 2003, p.108), (Park & Lee, 2004, p.651) (Fröschl, 2005, p.20), (Aroyo & et al., 2006, p.5), (Esichaikul, Lamnoi & Bechter, 2011, p.344), (Khamis, 2018, p.474)

- Domain Model: The content. The domain model contains information about the knowledge domain of the course content. The domain model may also contain information related to the learning activity, such as workflow, participants, and roles.
- Learner Model: It is the user's profile, where the system tries to exploit and develop the capabilities of the individual by bringing alternatives for his learning to adapt to the student and his strengths and weaknesses.
- Adaptation Model: Where this model applies the theory of adaptation, and attempts to enhance the individual's ability, by meeting the requirements of available educational opportunities, and developing the skills necessary for success, the adaptation process can be described in three stages: (retrieving information about the user - processing information to create and update the user model - use the user model to provide adaptation).

By carefully reviewing the studies and research on adaptive learning up to 2021, we find that the objectives of adaptive learning can be categorized into four types of adaptation: adaptive content, adaptive assessment, adaptive presentation, and adaptive navigation, the most common being adaptive evaluation and Adaptive Evaluation and Adaptive Navigation (Mohamed Farag, 2021).

4- Programming skills in PHP

-The concept of programming skill and its characteristics:

El-Sawy (2018, p. 308) defines it as a set of competencies and objectives related to the computer and ICT course, which students have to master and progress to in the classroom and in practical life situations, and El-Mardani et al. (2019, p. 543) defined it as the ability of students to Pick the right things and write the right code accurately and quickly, using an integrated development environment, and real-time programming skill. The research is defined as the ability of a second year high school student to use PHP programming codes for a glossary project in a correct, fast and accurate manner. The current research includes the following basic skills: The first skill: creating a database using MySqual, the second skill: creating a website using Express web, and the third skill: dealing with PHP, the skill has two sides, the cognitive aspect and the performance aspect, and they are related to each other, so both sides must be developed to gain skill, according to Zaitoun (2000, p. 120) and Mahmoud (2007, p. 33). Five characteristics:

- The first characteristic: that skill expresses the ability to perform an action or process, and often this action or process consists of a group of offers or smaller operations, which are offer simple sub-operations or sub-skills or simple responses performed in a sequential and consistent manner, so they seems compatible with each other.

- the second Characteristic: A skill typically consists of a combination of mental (dominated by mental performance, such as problem-solving skills and

innovative thinking skills) and social (dominated by social functioning, most notably social skills at home and school).

- The third characteristic: the performance of the skill depends on knowledge or information, as knowledge or information is an indispensable part of this performance.
- The fourth characteristic: developing and improving the performance of the individual through training or practice. Training to perform the skill is a prerequisite for learning it. Training should be through purposeful repetition and accompanied by reinforcement in order to improve performance.
- Fifth characteristic: the performance of the skill is evaluated with the criterion of accuracy and speed in achievement together.

- What is PHP, its features and characteristics?

PHP is a general, open-source, linear programming language directed at developing web pages, which facilitates its inclusion in HTML and its rules borrowed from C, Java, and Perl. The main objective of this language is to create and develop interactive web pages, which is an abbreviation for the words of the Personal Home Page (Bassiouni, 2004, p.7), (Bashir, Haque & Nath, 2015, p.105), indicated that PHP is one of the most popular programming languages that are used in creating websites, and it is one of the languages that the web server interprets. and implement its own code, and many want to learn it because of its simplicity, and it uses PHP to create dynamic web pages, i.e. pages with variable content; This content changes as a result of interaction with the user.

There are many features and characteristics of the PHP language, and the most important of them can be summarized in the following: (Williams & Lane, 2004, p.18), (McCown, 2012, p.2), (Amish, & Abu El-Saud, 2013, p.5), (Walia & Gill) , 2014, p.27) (Prokofyeva & Boltunova, 2017, p.52)).

An open source language, PHP includes free and open source libraries, compatible with many operating systems, compatible with any web server, easy to learn as it is based on C and Java, and supports many types of databases such as: MySQL, Oracle, dBase, and features Flexibility, we do not need to declare the variable and its type, but the compiler recognizes the type of the variable through the value assigned to it in the assignment clause, and PHP codes are written between the opening tag <? php and the closing tag <?, and the statements must be terminated with a semicolon ";", and PHP codes are done Embed them inside the HTML code.

In order to set up a PHP environment in order to develop and run PHP web pages, three basic components must be installed on our computer system: (Williams & Lane, 2004, p.19), (Gilmore, 2010, p.9), (Adly, Mansour, Youssef, El-Salmouni, 2015, p. 12), (Walia & Gill, 2014, p.25), (TutorialsPoint, 2015, p.11)

- A program to make a PC a server, as php works with almost all web server programs, such as Apache (Apache Server); It is available for free.
- Database, PHP works with almost all database software, but the most popular is the freely available MySQL database.
- A plugin used to write code in PHP and send it to a web browser.

- Stages of learning PHP programming skills:

Learning programming skills generally goes through three stages, the first stage: the cognitive stage, the second stage is the fixation stage, and the third stage is the self-control stage. In this paper, the stages of learning and developing PHP programming skills are as follows:

- Cognitive stage: It is the stage of identifying programming skills in PHP, and it is summarized in providing students with a set of information and knowledge that represents the cognitive aspect of the skill.
- The installation stage: It is the skill development stage, during which the student practically solves the activities and sends them to the researcher's e-mail to correct errors and correct the way the skill is performed, and send it to the student, and the student corrects the errors until the student reaches the target proficiency level, where the student is trained to acquire sub-skills Through the activities involved in arranging their sequence so that it becomes a complete skill, as it must be practiced. As a whole, and in the development stage, the practice has two functions: to install and develop the skill.
- The stage of self-control: where the gradual development takes place from the stage of accuracy in performing the skill to the stage of accuracy and speed together in performance, as a result of repeated performance practice.

- Skills measurement and assessment methods:

- The method of evaluating PHP programming skills in the current research is determined by two aspects; the cognitive side and the performance side:

- Evaluation of the cognitive aspect: it is the aspect concerned with information and knowledge related to learning the skill, and this aspect is evaluated using the cognitive achievement test.
- Evaluation of the performance aspect: it is the aspect of the student's ability to perform the skill with the required speed and accuracy. This aspect is evaluated through the analytical method: where the skill to be evaluated is analyzed into a set of steps that the student should take, and this analysis is done through observation sheet to measure the level The student's performance of these steps.

Methodological procedures for research:

- Preparing a list of programming skills in PHP language: where sources were identified to extract the list of skills: through reviewing previous studies and research, and analyzing the content of the e-book on the topic of computer and information technology. The second year of secondary school, and the list was seized by presenting it to a group of jury members and making the necessary adjustments according to their opinions and suggestions to reach the final picture of the list.
- Preparing a list of standards for designing and producing an adaptive e-learning environment: Where sources were identified for deriving the list of standards by reviewing previous studies and research related to the standards for designing adaptive e-learning environments, putting the list in its initial form and presenting it to a group of jury members. Where the judges' opinion was that the list is good, there is a logical sequence of criteria, and suitable for adaptive e-learning environments, and the list was finalized.

- Instructional design for the adaptive electronic learning environment:The adaptive electronic learning environment has been designed that includes the Infographic (static / animated) interacting with learning styles (global / sequential), and according to the model of Khamis 2015, where four types of content were designed: (static/ sequential) and (animated / sequential), (static / global), and (animated / global) according to the following steps:

The first stage: the pre-planning and preparation stage, where the following took place in this stage:

1- The researcher designed and produced an adaptive electronic learning environment with the help of specialized programs in the design and production of websites, with the help of a programmer specialized in making some modifications in order to adapt to the environment, and solve some problems after publishing the environment on the Internet.

2- Determining the responsibilities and tasks: All the steps of the educational design for the adaptive electronic learning environment have been identified and carried out, and the appropriate educational content has been determined to develop programming skills in the PHP language of second-grade secondary school students, from the scheduled e-book for the subject of computer and information technology, and the identification of learning resources and information management in the learning environment Adaptive electronic, represented in the Infographic (static/ sequential) interacting with learning styles (global / sequential) in addition to some additional resources such as websites on the Internet as support resources, and the researcher designed and programmed the

main interface of the adaptive electronic learning environment according to the initial design that I developed.

3- Allocation of financial resources and support methods: The researcher provided financial resources and bore the material cost.

The second stage: the analysis stage, in which the general purpose of the research was determined, the educational needs and the general characteristics were determined: the (20) students of the second grade of secondary school - at the Muslim Youth School - Banha - Qalyubia Governorate, were enrolled in the first semester of the academic year (2020- 2021), and there is homogeneity among the participants, as it will be mentioned later in the pre-test of the research tools, and it was ensured that all the participants wanted to learn online, had the ability to deal with the computer and the Internet and had e-mail, and the educational content of the course was also analyzed. Computer and information technology book for the second secondary grade, with the aim of determining the cognitive and performance aspects of programming skills in the PHP language, and then designing and producing adaptive electronic content according to the interaction of Infographics and the learning methods proposed by the current research to develop these aspects. The source of the analysis was the book of computer and electronic information technology for the second grade of secondary school. The general objectives and sub-objectives of the course were identified, the consistency of the analysis was ascertained, and the situation, resources, constraints, and the situation were analyzed. Educational, resources, and resources to find out the possibilities available to the participants. The researcher chose the research sample

from from those having a computer and connected to the Internet, and one of the most important capabilities available that helped in the completion of the research is the availability of a computer lab in the school and all the devices are modern, which contributed greatly to the completion of the tasks The research requires. There were some constraints and obstacles that the woman faced while preparing for the application of the research experience, the most important of which is the lack of free time for the students due to their preoccupation with the schedule and class periods in other subjects. Therefore, the researcher implemented the experiment in computer classes, and some reserve classes during the school day in coordination with the school administration, and the small number of students to attend the school due to the circumstances of the spread of the Corona virus, so the researcher worked on that by communicating with some students through the WhatsApp program, and the Internet was cut off. On the devices in the lab, due to a breakdown in the Internet in the school, the researcher overcame that by bringing her own portable router to broadcast the Internet to the laboratory computers, and to the students 'mobile phones.

The third stage: the stage of designing electronic content and in this stage the following took place:

1- Formulation of educational goals and their analysis: in which the educational goals were formulated and analyzed, where the general objectives were defined, and they are four general goals, where the content was divided into four educational topics, and each topic has a general educational goal from which sub-goals are branched out, and the behavioral (procedural goals) have been identified. Cognitive and performance,

2- Defining the structure of adaptive electronic content: The main and subsidiary educational topics included in the adaptive electronic content have been precisely defined; It was represented in four main topics, from which a number of sub-topics are branched out, and the main topics were: The first educational topic: Identifying some basic concepts and terminology associated with creating a website that deals with databases, and the second educational topic: Creating a database for the computer terminology project using MySQL program The third educational topic: Creating a site using the Expression Web program, and the fourth educational topic: Creating the illustrated computer glossary site pages (dealing with the PHP language)

3- Determining tests and Scales: the researcher prepared the research tools which are: cognitive test, observation sheet and Learning Styles Scale.

The cognitive test: Preparing an electronic cognitive achievement test in light of the educational content and the list of skills to measure the cognitive aspects related to PHP programming language skills. The test items were formulated in one style, which is the multiple choice pattern and number. Its vocabulary items reached (36), with four alternatives available for each of its items. Simplicity and clarity were taken into consideration when formulating the vocabulary test.. The test instructions are clear in the environmental user manual, whereby all questions are mandatory, and only one answer is chosen for each question, and the test scores were graded for each item, and thus the final score of the test was (36)) A form was developed to correct the test, and the test was modified with a reliability calculation The test and validity, the

calculation of the coefficient of ease and difficulty and the coefficient of the swan j Discrimination test,), the presentation of the test was performed on a group of jury members to ensure its validity, the researchers made modifications recommended by the judges, including: modifying the wording of some vocabulary and replacing one question with another, and confirming it Judging the validity of the test, the researcher found that the real time of the test (40 minutes) the test was completed, and it was produced electronically, by placing it in the adaptive electronic environment.

The observation sheet: To measure the performance side of programming skills in language PHP, an observation sheet was prepared observation sheet, was determined to build the sheet items on the objectives and educational content and the list of skills that have been developed previously, was the sheet settings calculates the reliability and honesty of the sheet and display the sheet on a group of jury members to verify the validity of the sheet, The researcher made some modifications, according to the opinions of the jury members, such as modifying the wording of some phrases and the merging of some clauses, and the observation sheet was put in its final form,

Learning Styles Scale: Learning Styles Scale: To determine the students' learning styles, a measure was prepared to determine the psychological learning styles (holistic / sequential) which refers to the item number in the scale of the whole for (Felder & silverman) the items associated with style of learning (holistic / sequential) , and to verify the appropriate measure of the research sample and suitability to the Egyptian environment , the reliability and validity of the scale was presented to a group

of gentlemen jury members from specialized education and curriculum technology and teaching methods, it has been prepared measure electronically; And apply it electronically through the environment.

4- Defining the learning strategies. general learning strategy for adaptive content was defined by setting a general plan organized with specific educational procedures. To achieve educational goals within an adaptive electronic learning environment, the researcher relied on a Problem Solving Strategy through activities, as it is one of the appropriate strategies for learning and developing programming skills.

5- Determining the methods of interacting with the content within the environment, namely: interaction with the environment and the user interface, interaction with the content, and interaction with the teacher.

6- Defining activities and assignments. Learning activities and assignments that serve the learning process and are related to the educational content provided through the environment have been identified.

7- Organizing content sequences and activities, the content is organized; according to the interaction of the Infographic (static / animated) with the learning styles (global/ sequential), to the four types.

8-Identifying electronic sources which have been identified in light of the standards of educational design, pedagogical aspects, and standards of the technological field.

9- Describing of electronic media and resources, namely: written texts, still images, video production (animated Infographics) using Adobe After Effects CC 2019,

voiceover recording of videos using Voice Recorder, and production of activities using Multiple choice Quiz Maker. 18.0) to produce the first activity; As it is a self-test for the student, and the rest of the activities are questions that are practically solved to produce the illustrated Dictionary of terms. Infographic design (static / animated) for educational content according to learning methods (global/ sequential), using previous studies and opinions of some experts in the field of educational technology to know better Programs for designing and producing Infographics (static / animated) for content the educational. (Adobe Illustrator) was chosen to design and produce static Infographics, and (Adobe aftereffect) program for designing and producing animated Infographics, according to the following stages: the study and analysis phase, the design phase, the evaluation phase, publishing and use, and the adaptive fixed content were compiled using (Adobe Illustrator CC) program according to each learning style, as well as the use of (Easy Movie Maker) to process the videos, and thus the content was produced in its four modes, and in this step the physical production requirements were also determined. And humanity as well as a plan and timetable for production.

10- Preparing of instructions and directions: Instructions for using the adaptive electronic learning environment have been prepared, a user guide (pdf file).

11- Designing Interface: After reviewing some adaptive environments and interactive websites, and perusing their interaction interfaces through studies related to research related to research variables to choose the appropriate general shape for the adaptive electronic learning environment interface for searching.

12- Designing E-content scenario: A scenario is designed to describe the electronic content screens within the adaptive e-learning environment and the educational content they contained.

fourth stage: the stage of developing electronic content: In this stage, the electronic content was developed within the adaptive electronic learning environment, where the introduction included (welcome - content list - educational guidance - educational objectives - links to other units - learning conditions - pretest), and the body included (electronic educational texts - educational activities - Multimedia - links to other materials), and the conclusion included (exercises with results or self-evaluation - references).

Fifth stage: the stage of evaluating and improving electronic content:

1- Conducting an exploratory study on a sample of students to ensure the quality of the content, in this step the researcher experimented the content in an adaptive electronic learning environment according to the interaction of Infographics and learning methods on a sample of second-grade secondary school students, which is a representative sample of the current research sample, to avoid problems that could be It occurs during the application of the basic experiment, to treat it before conducting the basic experiment, as well as to ensure the clarity of the adaptive e-learning content with its four treatments, and the clarity of the desired objectives of it, and it is as follows:

- Collecting information and observations related to the environment and identifying the difficulties that students

face in order to address them before conducting the basic experiment.

- Collecting information on students 'interaction with the environment, and students' observations on their use of the environment to ensure the clarity of the content and its intended goals.
- Identifying, avoiding, and treating the difficulties that the researcher may face during the basic experiment.
- Experimenting tools to ensure their integrity and the integrity of the database reports.
- In order to conduct the pilot study, the following steps were followed:
- Choosing a hosting company, and contracting with it, which is: https://www.hostgator.com
- Reserving an address for the adaptive electronic learning environment, which is: http://elearning-php.online
- Uploading the website containing the electronic content on the Internet.
- equipping the place for carrying out the exploratory study in the school computer lab at the School, where it was ascertained that the devices were available, and that they had good specifications suitable for the application, and the researcher provided the Internet with her own portable router.
- Downloading the programs required to conduct the pilot study on the laboratory computers and these programs are XAMPP and Expression web.
- Conducting an exploratory study on a sample of (5) second-year secondary school students at the "El-Shoban El- Muslimeen" in the first semester of the school year (2020 -2021) in the period from (10/19/2020) to (11/2/ 2020) for a period of two weeks; Where the researcher

met with the exploratory sample students at the beginning of the application, and the goal of the adaptive electronic learning environment proposed in the current research was explained, and how to deal with it, and the students' registration in the adaptive electronic learning environment, and the research tools were applied to them , and their interaction with the test was followed up. And the scale of learning styles and activities were also applied. Students were allowed, at the end of their study of electronic content through an adaptive electronic learning environment, to record their observations about the environment in terms of content, static and animated Infographic design, tools available in the environment, the help system and user's a guide for the environment, and then the research tools were applied to the pilot study sample. On the other hand, the tools were represented in (the cognitive achievement test and the skill performance observation sheet in PHP language, on Monday (11/2/2020), and the results of the exploratory study revealed the validity and stability of the research tools, and all students showed their satisfaction in dealing with the electronic Adaptive learning environment. in terms of the method of registration in the environment, as well as the electronic content with its four processors, as well as their admiration for the design method, And the method of presentation and ease of interaction, and students preferred to use the (WhatsApp) program to communicate with researchers to send activities or request assistance.

2- The opinions of experts and specialists in the content: Sending the environment address on the Internet, data for

entering the environment, and a form for environmental arbitration in light of the list of design standards that the researcher prepared in a previous step.

3- Required modifications, The modifications were as follows:

- Providing the environment with various methods of assistance, as this was provided with a detailed explanation of how to register to enter the environment, in the user guide attached in the form of a file on the environment home page, showing the steps for registering in the environment as a new user or logging in, and a detailed explanation showing the user how to deal with the environment as a whole.
- Provide more instructions within the content screens.
- Adding links to resources related to the course content.
- Communicating with students via Whats App to send activities or request assistance from researcher instead of e-mail.

4- Making the modifications revealed by the results of the formative evaluation process through the exploratory experiment on a sample of second grade secondary school students, and the results of the arbitration for the adaptive electronic learning environment, after reviewing the research supervisory body.

5- The final version of the environment, in the light of the opinions of the referees, and the results of the exploratory experience of the environment and the modifications, the validity of the environment for application and its suitability for conducting the basic research experiment was confirmed.

Sixth stage: the publishing, distribution and management phase: The electronic content, with its four processors, was loaded in its final form through the adaptive electronic learning environment control panel, and the researcher has all the powers to control access to the electronic content. On the display platform for the adaptive electronic learning environment, so that the content did not appear to the student until after he is registered in the environment and after he has answered the initial test and the learning methods scale first, then the environment is automatically directed to the appropriate content for it, and the researcher carries out all responsibilities and tasks, in terms of preserving the environment, and monitoring the progress of Students in learning through the environment database, providing continuous assistance and feedback to students, as well as following-up the adaptive e-learning environment and electronic content. To know the reactions of students and users, and to study the possibility of developing it in the future.

The exploratory experiment of research: Its steps were explained previously.

Conducting the basic research experiment:

Preparing for the experiment: obtaining the approvals of the competent authorities to conduct a research experiment on the research sample in the first semester (2020-2021), and preparing the place for the implementation of the basic research experiment.

Selecting research sample and preparating students for the experiment: The basic research experiment was conducted on a intended sample of second-grade secondary students consisting of (20) students who have skills in

dealing with computers school Internet sites and have the desire. To participate and learn through an adaptive electronic learning environment, the researcher met these students at the beginning of the application and explained the purpose of the experiment, how to interact with the main interface of the environment, adaptive electronic content, activities, how to communicate with the researcher, and the time plan required to study educational content through the environment, The learning styles scale was applied to divide the students into experimental groups, and follow up the registration of students after their division according to the application of the learning styles scale in the adaptive electronic learning environment, and how they interact with the user interface of the environment.

Applying the pre-search tools: The student was allowed to register in the environment, as the environment in the event that the student registered allows him to log in, and then the pre-test is opened for the student to snswer. In order to ensure group parity, the researcher used the one-way analysis of variance (ANOVA) to discover group parity by calculating the significance of the differences between groups in the scores of the pre-tests on Monday (10/19/2020), and it became clear that there is a convergence in the results of the prior application of the experimental groups. In the arithmetic mean and standard deviation, indicate of the equivalence of the experimental groups in the pre-measurement of the research? Thus any difference that appears in the subsequent application is due to the independent research variables.

Following-up of the experiment: After completing the initial application and ensuring the equivalence of the

experimental groups, the basic experiment of the research was conducted from (Thursday 5/11/2020) to (Monday 11/30/2020), and they were initially divided into two groups. The first group studied through the static Infographic, and the second through the animated Infographic according to the students' desire, and then the researcher directed the students to enter the environment again so that the environment directs them to the appropriate educational content and the process of entering the e-learning environment was followed on a daily and continuous basis. Throughout the application period, as well as the response to WhatsApp messages, students' responses to educational activities were followed up, directed and provided with support, and continuous feedback.

Applying the telemetry tools: All the research tools were applied to the sample of the basic research experiment, and the tools were (cognitive achievement test, and the performance observation sheet for programming skills in PHP language after students finished studying educational content and solving educational activities on (Thursday 11/26/2020) and Monday (11/30/2020), where the researcher directed the students to enter the environment and take the final exam (post-test for cognitive achievement), and the computer and information technology teachers at the school helped the researcher in applying the observation sheet.

Research results and their interpretation

Results related to cognitive achievement of experimental groups:

The first hypothesis validity test, which states " There are no statistical differences of ≥ 0.05 between the arithmetic means of the degrees of the experimental groups in measuring the cognitive understanding that is related to the PHP-based (static/ animated). programming skills. This is due to the main effect of the infographic"

Table (2): One-way analysis of the variance of the Infographic (fixed / animated) in terms of the effect on cognitive achievement

source of the contrast	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.200	1	3.200	3.200	.090
Within Groups	18.000	18	1.000		
Total	21.200	19			

The second hypothesis validity test, which states" There is no statistical differences of ≥ 0.05 between the arithmetic means of the degrees of the experimental groups in measuring the cognitive understanding that is related to the PHP-based programming skills. This is due to the main effect of the learning style (global/sequential)".

Table (3): One-way analysis of variance of learning styles (global / sequential) in significance effect on cognitive achievement

source of the contrast	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.800	1	.800	.706	.412
Within Groups	20.400	18	1.133		
Total	21.200	19			

The third hypothesis validity test "There is no statistical difference of ≥ 0.05 between the arithmetic means of the degrees of the experimental groups in measuring the

cognitive understanding that is related to the PHP-based programming skills. This is due to the main effect of the interaction between the Infographic (static/ animated) and the learning style (global/sequential)".

Table (4): Two-way ANOVA for Info graphics (static / animated) and learning styles (global / sequential) and the interaction between them in terms of the effect on cognitive achievement of Programming skills for research groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Infographic (static / animated)	3..200	1	3.200	3.122	.096
Learning style (global sequential)	.800	1	.800	.780	.390
Infographic * learning style	.800	1	.800	.780	..390
Error	16.400	16	1.025	-	-
Corrected Total	21.200	19	-	-	-

Through the results of applying the achievement test to the experimental groups, the arithmetic averages were calculated for the static and animated Infographics, and the standard deviations were calculated, as shown in the following table:

Table (5): The number of group members, means, and standard deviations, for the experimental groups that used the Infographics (fixed / animated) interacting with learning styles (global / sequential) in an adaptive electronic learning environment in the post application of the cognitive achievement test.

Infographic	Learning style	N	Mean	Std. Deviation

static	global	5	29.80	.837
	sequential	5	29.80	.837
animated	global	5	31.00	1.000
	sequential	5	30.20	1.304

The results of tables (2), (3), (4), (5) indicated the following:

There are no statistical differences of≥ 0.05 between the mean scors of the experimental groups in measuring the cognitive understanding related to the PHP-based programming skills. This is due to the main effect of the Infographic (static/ animated)

There is no statistical difference of ≥ 0.05 between the mean scors of the degrees of the experimental groups in measuring the cognitive understanding related to the PHP-based programming skills. This is due to the main effect of the learning style (global/sequential).

There is no statistical difference of ≥ 0.05 between the mean scors of the degrees of the experimental groups in measuring the cognitive understanding related to the PHP-based programming skills. This is due to the main effect of the interaction between the Infographic (static/ animated) and the learning style (global/sequential).

These results indicate the efficiency of the adaptive electronic learning environment in providing content to each student according to the type of Infographic he prefers and his appropriate learning style for him, as the results of the cognitive achievement of the fixed and moving Infographics were close, and the results were close according to the holistic and sequential learning methods, as well as the results of cognitive achievement were close. According to the interaction of the Infographic (static /

animated) with learning styles (global/ sequential), and that the effect is due to the adaptive learning environment, and the content provided to each student according to his preferred infographic and his appropriate learning style for him in learning.

Table (6) the mean and standard deviation of the research groups in the pre and post cognitive achievement test for programming skills in PHP language

Variable	application	Infographic	Learning style	Mean	Std. Deviation
Achievement test for cognitive understanding of programming skills in	pre	static	global	11.40	1.673
			sequential	12.00	2.345
		animated	global	12.20.	2.280
			sequential	10.60	1.517
	post	static	global	29.80	.837
			sequential	29.80	.837
		animated	global	31.00	1.000
			sequential	30.20	1.304

It is evident from the previous table that the mean scors of the four research groups in the post application is higher than the arithmetic average of the same groups in the pre-application of the cognitive achievement test for programming skills in PHP language, which is an arithmetic mean of more than (82%) from the high end of the cognitive achievement test score (36 marks). This indicates the efficiency of the interaction between the display patterns of the Infographic (static / animated) and the learning styles (global / sequential) in the adaptive electronic learning environment in developing the cognitive achievement of programming skills in PHP.

Results related to the skill performance of experimental groups:

The fourth hypothesis validity test "There is no statistical differences of≥ 0.05 between the mean scors of the degrees of the experimental groups in the observation sheet of the PHP-based programming skills. This is due to the main effect of the infographic (static/ animated)".

Table (7): One-way analysis of variance of the infographic (fixed / animated) In terms of the effect on skill performance

source of the contrast	Sum of Squares	D f	Mean Square	F	Sig.
Between Groups	.200	1	.200	.159	.695
Within Groups	22.600	18	1.256		
Total	22.800	19			

The fifth hypothesis validity test "There is no statistical difference of ≥ 0.05 between the arithmetic means of the degrees of the experimental groups in the observation sheet of the PHP-based programming skills. This is due to the main effect of the learning style (global/sequential)".

Table (8): One-way analysis of variance of learning styles (total / sequential) In terms of the effect on skill performance

source of the contrast	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.200	1	.200	.173	.682
Within Groups	20.800	18	1.156		

Total	21.000	19			

The sixth hypothesis validity test " There is no statistical differences of ≥ 0.05 between the arithmetic means of the degrees of the experimental groups in the observation sheet of the PHP-based programming skills. This is due to the main effect of the interaction between the infographic (static/animated)　　　and　　　the　　　learning　　　style (global/sequential)".

Table (9) Analysis of variance (ANOVA) two-way for the infographic (static / animated) and learning styles (global / sequential) and the interaction between them in terms of the effect on skill performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Infographic (static / animated)	..200	1	.200	.143	.710
Learning style (global / sequential)	.000	1	.000	.000	1.000
infographic * learning style	.200	1	.200	.143	..710
Error	1.400	16	22.400	-	-
Corrected Total	22.800	19	-	-	-

Form the results of applying the observation sheet of skill performance to the experimental groups, the arithmetic means were calculated for Infographics (static/ animated) interacting with the learning styles (global/ sequential), and the standard deviations, as shown in the following table:

Table (10): Number of group members, means, and standard deviations For experimental groups in the observation sheet

Infographic	Learning style	N	Mean	Std. Deviation
static	global	5	58.40	1.140
	sequential	5	58.60	1.140
animated	global	5	58.80	1.304
	sequential	5	58.60	1.140

The results of tables (7), (8), (9), (10) indicated the following:

- There are no statistically significant differences at the level of significance (05,0) between the mean scores of the experimental groups (second grade secondary students) in the observation sheet for programming skills in PHP language due to the basic effect of the infographic model (static / animated).
- There are no statistically significant differences at the level of significance (05,0) between the mean scores of the experimental groups (second grade secondary students) in the observation sheet for programming skills in PHP language due to the basic effect of learning styles (global/ sequential).
- There are no statistically significant differences at the level of significance (05,0) between the mean scores of the experimental groups (second-grade secondary students) in the observation sheet for programming skills in PHP language due to the basic effect of interaction between Infographics (static / animated) and learning styles (global/ sequential).

These results indicate the efficiency of the adaptive e-learning environment in providing content to each student according to the type of Infographic he prefers and the

appropriate learning style for him, as the results of the observation sheet for the static and animated Infographics were close, as well as the results were close according to the global and sequential learning methods, and the results of the observation sheet were close . According to the interaction of the Infographic (static / animated) with learning styles (global/ sequential), and that the effect is due to the adaptive learning environment, the content provided to each student according to the Infographic and his preferred learning style in learning.

Table (11) the mean and standard deviation of the research groups in the pre and post observation sheet for PHP programming skills

variable	application	Infographic	Learning style	Mean	Std. Deviation
Achievement test for cognitive understanding of programming skills	Pre	static	Global	8.40	1.140
			sequential	8.60	1.140
		animated	Global	8.80	1.304
			sequential	8.60	1.140
	Post	static	Global	58.40	1.140
			sequential	58.60	1.140
		animated	Global	58.80	1.304
			sequential	58.60	1.140

The previous table shows that the mean scors of the four research groups in the posttes is higher than the mean scors of the same groups in the previous posttest of the observation sheet, as the mean scores of the four groups is more than (97%) of the maximum score of the observation sheet (60 degrees), and this indicates the efficiency of Infographic interaction with learning styles in an adaptive e-learning environment in developing the performance aspect of programming skills in PHP language.

Interpretation of results according to the results of previous studies:

Since there are no previous studies that brought together the research variables, the researcher will interpret the results of the current research in light of previous studies that dealt with each of the research variables separately, as follows:

- The results of the research regarding Infographic and its effectiveness in the educational process are in agreement with the results of the studies of: Dor (2014), Darwish & El-Dakhni (2015), (Siricharoen & Siricharoen, 2015, p.558), Mansour (2015). Khalil (2016), Darwish (2016), Omar (2016), (Alshehri & Ebaid, 2016), Morsi (2017), Hassan & El-Sayyad (2017), Salem (2017), El-Shehri (2018), Afifi (2018), and Abu El-Dahab (2018).

- The results of the research differed with regard to infographic patterns (static / animated) with the results of the study of: Tversky & Morrisony (2002), (Mayer & et ail., 2005), Darwish & El-Dakhni (2015), Al-Zahrani (2018), Hassan (2016), El-Sayed (2018), Afifi (2018), El-Ghamdi (2019), Abdel Fattah (2020) whose results revealed that there are statistically significant differences between the mean scores of the research groups This is due to the main effect of infographic patterns (static / animated).

- The results of the research regarding learning styles were in agreement with the study of: Lau & Yuen (2009), Daoudi (2007), Tolba (2011), Gilakjani & Ahmadi (2011), Bidabad & Yamata (2011). Bidabadia & Yamata (2010), Tabalan (2015), El-Sayed (2017).

- The results of the research regarding adaptive electronic environments are in agreement with the study of:

Hamada (2011), El-Muhammadi (2016), El-Attar (2017), as well as the results of the research related to developing programming skills through e-learning environments and learning from During the web with the study of: Debradine & Jay (2004), El-Qushayri (2002), Youssef (2007), El-Ghamdi (2010), Badr (2012), Atiyah & etal. (2019), El-Mardani & etal. (2019).

The previous results can be interpreted in light of the following considerations:

- Good design of static and mobile infographics, and good design for an adaptive electronic learning environment in light of the design and production standards suggested by the research, which facilitated dealing with the environment and its components, encouraged the student to continue learning, and then achieved the educational goals, and helped to increase the cognitive achievement and performance of PHP programming skills.
- Providing educational content within an adaptive electronic learning environment according to each student's preferred Infographic and the learning style of each student, as educational content (Infographics interacting with learning styles) appropriate to each student was presented.
- Diversity of tests and activities: such as pre and formative testing that allows the student to self-assessment, and the manner in which activities appear in the environment according to the learning style.
- Ease and speed of access to the environment through search engines, as well as the ability to view it through many computers or mobile phones, browse content and deal with its components.

- Communication and cooperation during learning through the communication tools available in the environment.

Interpretation of results in light of theories related to research variables:

- Constructivist theory: It helped students build their knowledge and discover the relationship between information through Infographics in the style that each student prefers.
- Felder and Silverman's theory: This theory contributed to directing the student to the appropriate learning style for him through the learning style scale (global/ sequential) and thus helped to learn better for each student, and it appeared in the post-measurement results of the cognitive achievement test and a observation sheet the performance.
- Behavioral theory, where the behavioral theory contributed to the researcher's consideration of the students' characteristics related to the cognitive and performance aspects necessary to study the educational content through the adaptive electronic learning environment, as well as the behavioral theory which helped the students in their awareness of the educational content provided through the static and animated Infographics interacting with the holistic and sequential learning styles This helped them process the information provided to them through experimental treatments.

Refrances

- Abdel-Aty H. El-B. (2006). Designing an online course from the constructivist and objective perspectives and measuring its effectiveness in developing achievement, critical thinking and the trend towards Internet-based learning among students of the Faculty of Education, Alexandria University, **PhD thesis**, Faculty of Education, Alexandria University.

- Abdel Basset H. M.(2015). The basic pillars of using and activating infographics in the teaching and learning process, **e-learning magazine**, Mansoura University, v (15).
- Abdel Fattah S. M. (2020). The interaction between the infographic style and the gamification strategy for developing visual thinking skills and cognitive achievement among educational technology students, **PhD thesis**, Department of Educational Technology, Faculty of Specific Education, Benha University.
- Abu El-Atta M. M. (2009). **Essential reference for Adobe Photoshop CS4 users**, Compu Science, Al Arabiya for Computer Science, Cairo.
- Abu El-Dahab M. M. (2018). Designing a web-based learning environment based on static infographics (vertical - horizontal) and its impact on developing user interface design skills for students of the Department of Information Science, **Twenty-fourth Conference of the Specialized Libraries Association**, Arabian Gulf Branch: Big Data and its Investment Prospects: The Path Towards Knowledge Integration, Specialized Libraries Association Arabian Gulf Branch, Sultanate of Oman, 1-39..
- Abu Hashem E. M. (2012). Structural validity of the Felder and Silverman model of learning styles for university students, King Saud University **Journal of Educational Sciences and Islamic Studies**, Saudi Arabia, 24(4), 1316-1289.
- Abu Raya M. Y. (2006). The foundations of designing an educational website on the Internet and measuring its impact on the achievement of students of the Faculty of Educational Sciences in the subject of computer use in education at Al-Isra University, **Journal of the Union of Arab Universities**, v (46), 389-351.
- El-Adly T. A. H., Mansour A. A., Youssef M. Y., Al-Salamouni A. (2015). **Information and Communication Technology: Web site design project**, second grade of secondary school, General Administration for the Development of Computer and Information Technology, Curriculum and Instructional Materials Development Center, Egyptian Ministry of Education.
- Afifi M.K. (2018). The interaction between the two types of "fixed and mobile" infographic design and the two e-learning platforms "Blackboard, WhatsApp" and its impact on developing visual learning design skills and realizing its elements, **Journal of Education for Educational, Psychological and Social Research**, Faculty of Education, Al-Azhar University, (37),. 177 (1), 259-339.

- Ahmed I. I. (2003). Goal orientations and learning methods in relation to the academic achievement of students of the College of Education, **Journal of the College of Education**, Ain Shams University, p.(27), c(2), 33-72.
- Akhras, F. N., & Self, J. A. (2002). Beyond intelligent tutoring systems: Situations, interactions, processes and affordances, **Instructional Science,** 30(1), 1–30.
- Ardito, C., De Marsico, M., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V., &Tersigni, M.(2004, May). Usability of e-learning tools, In Proceedings of the working **conference on Advanced visual interfaces** (pp. 80-84).
- Aroyo, L., Dolog, P., Houben, G-J., Kravcik, M., Naeve, A., Nilsson, M. & Wild, F. (2006). Interoperability in Personalized Adaptive Learning, **Educational Technology & Society**, 9 (2), 4-18.
- Arum, N. S. (2017). **Infographic: Not Just a Beautiful Visualisation**, Obtenido de: https://cutt.us/l5lHI
- El-Attar A. S. (2017). An adaptive e-learning model based on learning style (active/reflective) and educational preferences (individual/group) and its impact on developing programming skills and critical thinking among educational technology students, **PhD thesis**, College of Girls, Ain Shams University.
- Badr Y. A. (2012). A proposed training program based on the Internet to develop programming skills for teachers of the second cycle of basic education in the light of their training needs, **Master's thesis**, Department of Educational Technology, Institute of Educational Studies, Cairo University.
- Bashir, G. M. M., Hoque, A. S. M. L., & Nath, B. C. D. (2016). E-learning of PHP based on the solutions of real-life problems, **Journal of Computers in Education,** *3*(1), 105-129.
- Bassiouni A. (2004). **PHP Language - Web Pages Development and Internet Programming,** Cairo: Scientific Books House for Publishing and Distribution.
- Brusilovsky, P., Farzan, R. & Ahn, J. W. (2006). Layered Evaluation of Adaptive Search, **In Workshop on Evaluating Exploratory Search Systems at SIGIR** (pp.11-13).
- Chiu, C. C., Vicente, K. J., BUFFO-SEQUEIRA, I. L. A. N., Hamilton, R. M., & McCRINDLE, B. W. (2004). Usability assessment of pacemaker programmers. **Pacing and clinical electrophysiology**, 27(10), 1388-1398.
- Çifçi, T. (2016). Effects of Infographics on Students Achievement and Attitude towards Geography Lessons, **Journal of Education and Learning**, 5(1), 154- 166.

- Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). **Learning styles and pedagogy in post-16 learning: A systematic and critical review**, Published by the Learning and Skills Research Centre.
- Concannon, F., Flynn, A. & Campbell, M. (2005). What campus-based students think about the quality and benefits of e-learning, British **Journal of Educational Technology**, 36 (3), 501–512.
- Dagar, V. & Yadav, A.(2016). Constructivism: A Paradigm for Teaching and Learning, **Arts and Social Sciences Journal**, 7(4), 1-4.
- Dalton, J. & Design, W. (2014). **A Brief Guide to Producing Compelling Infographics**, London School of Public Relations.
- Darwish M. S. (2016). The effectiveness of using infographic technology on learning skill performance and cognitive achievement for the long jump competition, Scientific **Journal of Physical Education and Sports Scienc**e, Faculty of Physical Education for Boys, Helwan University, c. (77), 312-342.
- Darwish O. M. & Al-Dakhni A. A. (2015). Two patterns of presenting infographics (fixed/mobile) via the web and their impact on developing visual thinking skills for autistic children and their attitudes towards it, **Egyptian Association for Educational Technology**, Egypt, Vol. (25), c. (2), 265-364.
- Damyanov, I. & Tsankov N. (2018). The Role of Infographics for the Development of Skills for Cognitive Modeling in Education, **International Journal of Emerging Technologies in Learning (iJET)**, 13(1), 82- 92.
- Davids, M. R., Chikte, U. M., & Halperin, M. L. (2013). An efficient approach to improve the usability of e-learning resources: the role of heuristic evaluation, **Advances in physiology education**, 37(3), 242-248.
- Davids, M. R., Chikte, U., Grimmer-Somers, K., & Halperin, M. L. (2014). Usability testing of a multimedia e-learningresource for electrolyte and acid-base disorders. **British Journal of Educational Technology**, 45(2), 367-381.
- Depradine, C. & Gay G. (2004). Active participation of integrated development environments in the teaching of object-oriented programming, **Computers & Education**, 43(3), 291–298.
- Dung , P. Q. & Florea, A. M. (2012). An approach for detecting learning styles in learning management systems based on learners' behaviours, in **International Conference on Education and Management Innovation** (Vol.30, pp.171- 177).

- Dunlap, J. C., & Lowenthal, P. R. (2016). Getting graphic about infographics: Design lessons learned from popular infographics. **Journal of Visual Literacy**, 35(1), 42-59.
- Dur, B. I. U. (2014). Data Visualization And Infographics In The Visual Communication Design Education At The Age Of Information, **Journal of Arts and Humanities.** 3(5), 39- 50.
- Esichaikul, V., Lamnoi, S., & Bechter, C. (2011). Student Modelling in Adaptive E-Learning Systems. **Knowledge Management & E-Learning: An International Journal**, 3(3), 342-355.
- Felder, R. M. & Silverman, L. K. (1988). Learning and teaching styles in engineering education, **Engineering Education**, 78(7), 674–681.
- Ferreira, J. (2014). Infographics: An introduction, **Technical Report**, Centre for Business in Society, Coventry University.
- Farag M. (7/3/2021). The objectives of adapting education, accessed on 8/3/2021), from the **Facebook website**, and the website link: https://cutt.us/YqHNw
- Fridsma, L. & Gyncild B. (2015). **Adobe Creative Cloud, After Effects CC**, Classroom in a Book® 2015 release, The official training workbook from Adobe.
- Fröschl C. (2005). User Modeling and User Profiling in Adaptive E-learning Systems, **Master's Thesis**, Institute for Information Systems and Computer Media (IICM), Faculty of Computer Science, Graz University of Technology, A-8010 Graz, Austria.
- El-gazzar, A. E. (2014). Developing E-Learning Environments for Field Practitioners and Developmental Researchers: A Third Revision of an ISD Model to Meet E-Learning and Distance Learning Innovations, **Open Journal of Social Sciences**, 2(2), 29-37.
- El-ghurab I. M. (2003). **E-learning: Introduction to non-traditional training**, Egypt, Arab Administrative Development Organization.
- Gilakjani, A. P. & Ahmadi, S. M. (2011). Paper title: The Effect of Visual, Auditory, and Kinesthetic Learning Styles on Language Teaching, **International Conference on Social Science and Humanity** (vol.5, pp. 496-472).
- Gilmore, W. J. (2010). **Beginning PHP and MySQL: from novice to professional**, Apress.
- Govender, I. (2006). Learning to Program, Learning to Teach Programming: Pre-and In-service Teachers' Experiences of an Object-oriented Language (**Doctoral dissertation**, University of South Africa).

- Graf, S. (2007). Adaptively In Learning Management Systems Focusing on Learning Styles. (**Ph.D. Thesis**), Faculty of Informatics, Vienna University of Technology.
- Graf, S., Viola, S. R., Leo, T. & Kinshuk .(2007). In-Depth Analysis of the Felder-Silverman Learning Style Dimensions, **Journal of Research on Technology in Education**, 40(1), 79-93.
- Grasha, A. F. (2002). **Teaching With Style : A Practical Guide to Enhancing Learning by Understanding Teaching and Learning Styles**, Ph.D., University of Cincinnati, Copyright©1996, 2002 by Alliance Publishers, United States of America.
- Hamada, A. K., Rashad, M. Z., & Darwesh, M. G. (2011). Behavior analysis in a learning environment to identify the suitable learning style. **International Journal of Computer Science & Information Technology (IJCSIT)**, 3(2), 48-59.
- Hasan, L. (2014). Evaluating the Usability of Educational Websites Based on Students' Preferences of Design Characteristics, **International Arab Journal of e-Technology**, 3(3), 179-193.
- Hassan F. H., Al-Sayyad W. A. (2017). The effectiveness of different styles of providing educational infographics in academic achievement and learning efficiency for primary school students with mathematics learning difficulties. **Journal of Educational Technology**, College of Education, Al-Azhar University, v. (175), 706-772.
- Hassan, H. G. (2016). Designing Infographics to support teaching complex science subject: A comparison between static and animated Infographics, A thesis submitted to the graduate faculty in partial fulfillment of the requirements for the degree of, **MASTER OF FINE ARTS**, Iowa State Universit , Ames, Iowa.
- Holsanova, J., Holmberg, N., & Holmqvist, K. (2009). Reading information graphics: The role of spatial contiguity and dual attentional guidance, **Applied Cognitive Psychology:The Official Journal of the Society for Applied Research in Memory and Cognition**, 23(9), 1215–1226.
- Honey, P. & Mumford, A. (1982). **The Manual of Learning Styles**, Peter Honey, Maidenhead.
- Imesh A. L. & Abu Al-Saud A. (2013). **Learn PHP Programming**, i(2), Free Software Foundation.
- Izumi, L., Fathers, F. & Clemens J. (2013). **Technology and Education**: A primer, Vancouver: Fraser Institute, Barbara Mitchell Centre for Improvement in Education, fraserinstitute.org.

- Jaber L. & Qaraan M. (2004). **Learning Styles - Theory and Practice**, Abdul Mohsin Al-Qahtan Foundation, Palestine.
- Kakish, K. & Pollacia L. (2018). Adaptive Learning to Improve Student Success and Instructor Efficiency in Introductory Computing Course, In Proceedings of the Information Systems Education **Conference Paper**, San Antonio, Texas USA, (vol. 34, pp. 72- 78).
- Kandarakis, A. G. & Poulos M. S. (2008). Teaching Implications of Information Processing Theory and Evaluation Approach of learning Strategies using LVQ Neural Network, **Wseas Transactions Onadvances In Engineering Education**, 5(3), 111-119.
- Khalil A. Sh. (2016). Patterns of "fixed / mobile / interactive" educational infographics and their impact on achievement and efficiency of mathematics learning among primary school students with mild intellectual disabilities, **Journal of Education for Educational,** Psychological and Social Research, Faculty of Education, Al-Azhar University, c(3), p. (169), 272- 321.
- Khamis M. A. (2015). **E-Learning Resources**: Part One (Individuals and Media) I (1), Cairo: Dar Al-Sahab for printing, publishing and distribution.
- Khamis M. A. (2018). **E-Learning Environments**: Part One, Cairo: Dar Al-Sahab for Publishing and Distribution.
- Knutov, E., Bra, P. M. & Pechenizkiy, M. (2011). Generic Adaptation Framework: a process-oriented perspective, **Journal of Digital information**, (12)1, 158-187.
- Koch, N. (2001). "Software engineering for adaptive hypermedia systems", **PhD thesis**, Ludwig-Maximilians University of Munich, Munich, Germany.
- Lankow, J., Ritchie, J., & Crooks, R. (2012). **Infographics: the power of visual storytelling,** Hoboken, N.J.: John Wiley & Sons, Inc.
- Lau W. W. F. & Yuen A. H. K. (2009). Exploring the effects of gender and learning styles on computer programming performance: implications for programming pedagogy, **British Journal of Educational Technology**, 40(4), 696- 712.
- Liaw, S. S., & Huang, H. M. (2007). Developing a Collaborative e-Learning System Based on Users' Perceptions. **Computer Supported Cooperative Work in Design III**, 751–759.

- Magoulas, G., Papanikolaou, K., & Grigoriadou, M. (2003). Adaptive Web-based learning: Accommodating individual differences through systems adaptation, **British Journal of Educational Technology**, 34(4), 511–527.
- Mahmoud Sh. M. (2007). The effectiveness of computer tutoring in developing programming problem-solving skills among students of the Faculty of Specific Education**, PhD thesis**, Institute of Educational Studies, Cairo University.
- Mansour M. M. (2015). The effect of using infographic technology based on Marzano's learning dimensions model on developing some concepts of cloud computing and the habits of a productive mind among students of the Faculty of Education, **Journal of the Faculty of Education**, Faculty of Education, Assiut University, 31(5), 126-167.
- El-Maradini M. M., El-Kurdi D. F. & Fathi S. M. (2019). Developing a diffuse learning environment and its impact on developing programming skills for preparatory stage students, **Journal of the College of Education**, College of Education, Kafr El-Sheikh University, 19(3), 523-550.
- Matrix, S. & Hodson, J. (2014). Teaching with Infographics: Practicing New Digital Competencies and Visual Literacies, **Journal of pedagogic development,** 4(2), 17-27.
- El-Mohammadi M. M. (2016). Designing an adaptive e-learning environment according to the learning methods in the computer course and their impact on developing programming skills and usability among preparatory stage students, **PhD thesis**, Department of Educational Technology, Graduate School of Education, Cairo University.
- Morsi A. A. (2017). The effect of the interaction between the two patterns of display and timing of the infographic in the e-learning environment on the achievement and attitude towards the learning environment among secondary school students, **Journal of Educational Sciences**, Al-Azhar University, Vol. (25), p. (2), 42-121.
- Motion User Manual (2012). **Motion 5 User Manual**, Publisher: Apple Inc.
- Nash, S. S. (2013). Adaptive Learning: Feedback and Mastery—Where Are We Today?, **Web blog E-Learning Queen**, from at https://cutt.us/sNwhf.
- Nassar W. M. & El-Shafei M. M. (2012). **Learning theories and their modern applications**, Riyadh, Dar Al-Zahra.

- Nidhi, S. K. & Tay, H. C. (2017). Styles of Learning Based on the Research of Fernald, Keller, Orton, Gillingham, Stillman , Montessori and Neil D Fleming, **International Journal for Innovative Research in Multidisciplinary Field**, ISSN-2455-0620, 3 (4), 17- 25.
- Niebaum, K.; Cunningham-Sabo, L.; Carroll, J.& Bellows, L. (2015). Infographics: An Innovative Tool to Capture Consumers» Attention, **Journal of extension,** 53(6), 1-6.
- Nzesei, M. M. (2015). A Correlation Study Between Learning Styles And Academic Achievement Among Secondary School Students In Kenya, **Master Thesis**, Department Of Psychology, University Of Nairobi.
- Omar A. M. I. (2016). The effectiveness of a proposed strategy based on infographics in acquiring scientific concepts, developing visual thinking skills, and enjoying learning science for fifth graders of primary school. **The Egyptian Journal of Practical Education**, The Egyptian Society for Practical Education, Vol.(19), c.(4), 268-207.
- Park, O.-c., & Lee, J. (2004). Adaptive instructional systems. In D. H. Jonassen (Ed.), **Handbook of research on educational communications and technology**, (pp. 651-684). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning Styles: Concepts and evidence. **Association for Psychological Science**,(9)3, 105-119.
- **Pedagogy and Practice :Teaching and Learning in Secondary Schools**, Unit 19: Learning styles, Digital Education Resource Archive (DERA), Ref: DfES 0442-2004 G.
- Prokofyeva, N., & Boltunova, V. (2017). Analysis and practical application of PHP frameworks in development of web information systems. **Procedia Computer Science**, 104, 51-56.
- El-Qushayri A. M. (2002). The effect of a proposed program on developing some programming skills for first-year secondary students in a computer course, **Master's thesis**, Faculty of Specific Education, Minia University.
- Race, P. (2007). **500 Tips for Open and Online Learning**, Second edition, RoutIedgeFalmer, published in the Taylor & Francis e-Library, London And New York.
- Rieber, A. L. (2000). **Computers, Graphics and Learning**, U.S., Dollars.
- Rukanuddin, M., Hafiz, K. D., & Asfia, R. (2016). Knowledge of Individual Differences of the Learners of Second Language Enriches Second Language Teaching. **Journal of Literature, Languages and Linguistics**, 19, 11-15.

- Sadoski, M., Paivio, A., & Goetz, E. (1991). A critique of schema theory in reading and a dual coding alternative. **Reading Research Quarterly***, 26*(4), 463-484.
- El-Sawy A. El-S. (2018). Developing a smart system based on interactive simulations to develop programming skills for preparatory stage students. **Journal of Specific Education Research**, v(51), 297-337.
- El-Sayed A. (2018). The impact of the difference in the two types of fixed and mobile infographics in developing digital citizenship skills among female students of the Higher Institutes of Computers, **Educational Technology - Studies and Research** - Egypt, v (35), 1-52.
- El-Sayed H. S. (2017). Designing an adaptive e-learning environment according to the Kolb model of learning styles and their impact on developing problem-solving skills and producing an informational portfolio for educational technology students, **Journal of Education Technology** - Studies and Research, v (33), 79-129.
- El-Sayed Y. M. (2019). Using two styles of feedback (detailed - brief) during the employment of digital learning object repositories and its impact on the quality of digital content design and motivation towards educational materials among students of educational technology, **Educational Journal of the Faculty of Education at Sohag University**, 63 (63), 1072-1205 .
- El-Shehri, M. A. & Ebaid, M. (2016). The Effectiveness Of Using Interactive Infographic At Teaching Mathematics In Elementary School, **British Journal Of Education**, 4(3), 1-8.
- El-Shehri, S. M. & Al-Adeel A. Kh. (2018). The effectiveness of an educational design based on visual learning with infographics on computer subject acquisition, International Journal of Educational and Psychological Sciences, **Arab Foundation for Scientific Research and Human Development,** Egypt, v (10), c. (4), 203-254.
- El-Sherbini O. O. (2021). The effect of the interaction between the infographic style (fixed / mobile) and the cognitive style (analytical / holistic) in an e-learning environment to modify alternative linguistic perceptions of preparatory stage students, **Master's thesis**, Faculty of Education, Damietta University.
- Shute,V, & Towle, B. (2003). Adaptive e-learning, **Educational Psychologist**, 38(2), 105-114.

- Shaltout M. Sh. (2014). The art of infographics between suspense and motivation to learn, **E-Learning Magazine**, Mansoura University, v (13).
- Shaltout M. Sh. (2016). **Infographic from planning to production**, i (1), Riyadh: Hala Printing Company.
- Siricharoen, W. & Siricharoen N. (2015). How Infographic should be evaluated?, Conference: The 7th **International Conference on Information Technology**, 25(1), 558-564.
- Smiciklas, M. (2012). **The power of infographics: Using pictures to communicate and connect with your audiences**. Que Publishing.
- Sonwalkar, N. (2005). adaptive learning technologies: from one-size fits all to individualization, **EDUCUSE**, 7, 1-11.
- Stash, N. (2007). Incorporating cognitive/ learning styles in a general-purpose adaptive hypermedia system, Eindhoven: Technische purpose adaptive hypermedia system, **(Ph.D. Thesis)**, Technische Universiteit Endhoven
- Surjono, H. D. (2011). The Design of Adaptive E-Learning System based on Student's Learning Styles, I**nternational Journal of Computer Science and Information Technologies,** 2 (5), 2350-2353.
- Taylor, T. (2014). **White Paper: Principles of Data Visualization-What We See in a Visual.** Kolkata: Fusion Charts.
- Toth C. (2013). Revisiting a Genre: Teaching Infographics in Business and Professional Communication Courses, **Business Communication Quarterly**, 76(4), 446-457.
- Tutorialspoint. (2015). **PHP Tutorial**, Retrieved from Tutorialspoint:https://www.tutorialspoint.com/php/php_tutorial.pdf.
- **Training Manual – Infographic Design** (2018). Research Methods for Mental Health in War and Conflict, Institute of Public and Community Health, Kcollege London, Birzeit University.
- Truong, H. M. (2016). Integrating learning styles and adaptive e-learning system: Current developments, problems and opportunities, **Computers in Human Behavior,** Elsevier, Vol.55, Part B,605-1248.
- Walia, E. S., & Gill, E. S. K. (2014). A framework for web based student record management system using PHP. **International Journal of Computer Science and Mobile Computing**, 3(8), 24-33.

- Weller, M. (2007). **Virtual Learning Environments: Using, Choosing and Developing your VLE**, Routledge, London.
- Whittenburg, J. B. (2011). Adapting to adaptive e-learning: Utilizing adaptive e-learning programs within educational institutions, **Doctoral Dissertation**, Faculty of the USC ROSSIER SCHOOL OF Education, University of Southern California.
- Williams, H. E., & Lane, D. (2004). **Web Database Applications with PHP and MySQL: Building Effective Database-Driven Web Sites**, " O'Reilly Media, Inc.".
- Wu, C., Chen, Y. & Chen, T. (2017). An Adaptive e-Learning System for Enhancing Learning Performance: Based on Dynamic Scaffolding Theory, **EURASIA Journal of Mathematics, Science and Technology Education**, 14(3), 903-913.
- Yarandi, M., Jahankhani, H. &Tawil, A-R. H. (2013). A personalized adaptive learning approach based on semantic web technology, **Webology**, 10(2), 1-14, Retrieved from www.webology.org/2013/v10n2/a110.pdf.
- Yavar, B., Mirtaheri, M., Farajnezam, M. S. & Mirtaher M. (2012). Effective Role of Infographics on Disaster Management Oriented Education and Training. In: Proceedings of the 27th **DMISA Conference on Disaster Risk Reduction 201**2, Disaster Management Institute of Southern Africa, Tzaneen, Limpopo Province, South Africa.
- El-Zaghloul I. A. R. & Al Mahamid Sh. A. (2007). **The Psychology of Classroom Teaching**, i (1), Amman - Jordan: Dar Al Masirah for Publishing, Distribution and Printing.
- Zaher El-G. I. (2009a). **E-learning from application to professionalism and quality**, Cairo: The World of Books.
- El-Zahrani Gh. B. A. (2017). The effect of different infographic patterns on developing academic achievement in the computer course among second year secondary school students, **Master's thesis**, College of the Arab East for Graduate Studies, Riyadh.
- Zaitoun H. H. (2000). **Teaching design, a systemic vision**, Cairo, the world of books, Volume One.

✱✱✱