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Effectiveness of CS Unplugged Program in Developing Programming Skills for Eighth Grade Female Students

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Abstract:
This study aims at identifying the effectiveness of CS Unplugged program for developing programming skills among eighth-grade female students. The study tools consist of a test to measure the cognitive side of programming skills in Scratch language, in addition to a product evaluation card to measure the performance aspect of programming skills in Scratch language. The sample of the study consisted of (14) female students from the eighth primary grade in Khan Yunis Preparatory Co. School "C". The study applies quasi-experimental design. The results indicated there are statistically significant differences between the ranks of the students' grades in the programming skills pre- test application, and the ranks of their scores in the post application. The CS Unplugged program has a great impact on developing the cognitive aspect of programming skills. There are statistically significant differences between the ranks of the students' grades in the product evaluation card in the pre application, and the ranks of their scores in the post application as the average of the positive ranks is greater than the average of the negative ranks. The CS Unplugged program has a great impact on developing the performance side of programming skills. The study concluded with the most important recommendations, as there is need for the Ministry of Education to adopt the CS Unplugged program in the plan of teaching programming curriculum for the various stages; especially in light of the limited capabilities of the Gaza Strip.

Keywords: CS unplugged based program, CS Unplugged, Programming skills

فاعلية برنامج قائم على علوم الحاسوب بدون حاسوب في تنمية مهارات البرمجة لدى طالبات الصف الثامن

الملخص:
هدفت الدراسة إلى التعرف على فاعلية برنامج قائم على علوم الحاسوب بدون حاسوب في تنمية مهارات البرمجة لدى طالبات الصف الثامن. وتمثلت أدوات الدراسة في اختبار لقياس الجانب المعرفي لمهارات البرمجة بلغة Scratch، وبطاقة تقييم منتج لقياس الجانب الأدائي لمهارات البرمجة بلغة Scratch. وتكونت عينة الدارسة من (14) طالبة من طالبات الصف الثامن الأساسي في مدرسة خانيونس الإعدادية المشتركة "ج". اعتمدت الدراسة على التصميم شبه التجريبي. توصلت الدراسة إلى: وجود فروق ذات دلالة إحصائية بين رتب درجات الطالبات في اختبار مهارات البرمجة في التطبيق القبلي، ورتب درجاتهن في التطبيق البعدي، حيث إن متوسط الرتب الموجبة أكبر من متوسط الرتب السالبة. كما أن البرنامج القائم على علوم الحاسوب بدون حاسوب له أثر كبير في تنمية الجانب المعرفي لمهارات البرمجة. وجود فروق ذات دلالة إحصائية بين رتب درجات الطالبات في بطاقة تقييم المنتج في التطبيق القبلي، ورتب درجاتهن في التطبيق البعدي، حيث إن متوسط الرتب الموجبة أكبر من متوسط الرتب السالبة. وأشارت النتائج أيضاً إلى أن البرنامج القائم على علوم الحاسوب بدون حاسوب له أثر كبير في تنمية الجانب الأدائي لمهارات البرمجة. فيما أوصت الدراسة بمجموعة من التوصيات أهمها: ضرورة تبنى وزارة التربية والتعليم برنامج علوم الحاسوب بدون حاسوب في خطة تدريس منهاج البرمجة للمراحل المختلفة وخاصة في ظل محدودية إمكانيات قطاع غزة.

كلمات مفتاحية: مهارات البرمجة ، علوم الحاسوب بدون حاسوب، البرنامج القائم على علوم الحاسوب بدون حاسوب

Introduction:

IT and CS are among the major bases of society development, as economic development in many countries has been related to their IT companies' production of software. Software is now a necessity for individuals, as well as, for managing foundations. Moreover, education is the cornerstone in providing learners with the knowledge and skills required to adapt to the state- of-the- art in both knowledge and technology.

Therefore, teaching programing has become an integral part of developing education; for programming contributes to preparing learners for the future as it helps developing their skills in various fields such as resolving problems and critical thinking (Palestinian Curricula Center, 2018).

Based on the significance of programming, a publication of European Schoolnet 2015 has stated that 16 European countries have included programing in their curricula. Estonia has been the first country to teach programming in elementary schools, followed by UK, which made programming a basic non-optional school subject taught for all levels (Kaplancali and Demirkol, 2017).

According to the international trend to integrate programming in education, programming as a school subject has been proposed for studying in Palestinian schools from 5th grade to 9th grade. Scratch programming language has been taught in grades from 7th to 9th .

Many programs aiming at simplifying programming concepts for students in order to improve their programing skills, such as Computer Science Unplugged Program aka CS Unplugged. This program depends on promoting computer sciences and simplifying its topics in general and programing in particular. It has been considered an effective approach to move from Computer Science Unplugged to full programing using computer (Tanabe et al, 2015).

It is a series of educational activities that teach computer science through games and puzzles while using cards, colors and motions (Bell,2018).

The program has been internationally approved and supported. It has also received recommendations for merging into the school curricula from KG to high school; as it presents the topics of computer sciences in a different manner and through catching activities (Bell et al., 2009).

The programming concepts are explained apart from PCs and through different series of activities depending on several tools. Afterwards, students get to apply such concepts to PCs (Tanabe et al.,2015).

These activities, in addition to, helping students to understand the concept of programing logic, urge them to work and practice group thinking to solve problems; and they also offer students the basics of any programming language (Pusztai,2018).

Therefore, such program offers a good approach to teaching programming skills, as proven through previous studies, which confirmed the effectiveness of computer sciences unplugged in teaching and simplifying programming concepts. The major studies included Hermans and Aivaloglou (2017) that has aimed at identifying the most effective method to start teaching programming using both plugged or unplugged methods, to facilitate understanding the programming concepts. According to the findings, it has been proven that the group, which started with unplugged activities showed more confidence in understanding the programming concepts and

used more varied masses during programming in comparison to the other group and with better effectiveness. It has also showed that teaching Scratch through publications and unplugged lessons, as well as, the students' presence in class away from PCs and applying unplugged teaching methods have improved their self- efficacy.

Tanabe et al. (2015), conducted a study that has suggested a new approach to move from unplugged Computer Science into comprehensive programming, through performing image depicting activity in four steps; starting from the first unplugged step and ending with writing the program in Java language, has showed very positive responses in terms of performing the activity. The study has also recommended the possibility to use such proposal as an effective activity in teaching programming, with the necessity to design more activities to improve students' skills in programming.

The study of Al- Amer et al.(2015) also has aimed at simplifying the concepts of programming provided in App Inventor through deploying the activities of computer sciences unplugged. The results have shown that the activities had a positive impact on simplifying students' programming concepts and their ability to design their own projects using App Inventor depending on the concepts provided to them through unplugged activities.

Some studies aimed at examining the effectiveness of deploying computer sciences unplugged in introducing programming concepts and in ensuring that the students actually have learned through these activities; Arora (2019), has aimed at measuring the impact of deploying unplugged CS among teachers on changing the methods of introducing computer sciences effectively. One of the main outcomes has shown applying the computer sciences activities facilitates merging computer thinking skills practically into school curricula and they also help teaching students computer concepts in school playgrounds instead of setting before the computer screens all the time. Moreover, results have suggested that performing such activities allowed improving the cooperative learning skills of students. The study of Rodriguez et al. (2017) has aimed at investigating whether students do actually learn through unplugged computer sciences activities and the extent to which such students keep the information introduced to them through such activities. The results have shown that student learn the concepts introduced to them through the unplugged activities and keeping them, with the necessity to reconsider the content of activities, in order to be attractive and can retain students' attention.

In addition, other studies such as the study of Bell & Vahrenhold (2018) and the study of Pusztai (2018) have examined unplugged computer sciences, in terms of its nature, origin, benefits, activities' application simplicity as well as its positive effect on students.

According to the results of the studies, the effectiveness of unplugged computer sciences in simplifying the computer sciences concepts in general as well as the programming concepts has been confirmed. Also due to the scarcity of studies of unplugged computer sciences in Arab World and according to our knowledge, only one study has been applied in the Arab World i.e., Al- Amer et al. (2015), we argue that it is necessary to build a program based on the philosophy of unplugged computer sciences in order to develop programming skills in Scratch.

Study Problem:

Through discussions held within the research team, the researchers have addressed the study problem on multiple levels. One of the team members, who is an eighth-grade programming teacher, noticed that female students in her class are excited about learning Scratch and like it as it resembles Lego and because interacting with its interface is easy to build breaks of different and attractive colors to get the programming sections and seeing the outcome directly before them, but after finishing a section of the curriculum and accumulating the skills during performing activities inside the computer lab. When the female students have been asked questions such as: what the outcome would be if we change one brick for another or when a brick is deleted, the female students faced hard difficulty to answer such type of questions and following the bricks one by one in the programming section. Same applies when offering them an outcome and asking them to install the right bricks to get it.

However, expecting the outcome of programming sections is a desired type of tests, as such problem has been confirmed through analyzing the scores of term tests of the academic year 2019-2020, that yielded low ratios of the question about that skill- expecting the outcome of performing the programming section- compared to other questions.

In addition to other hardships the teachers have been facing in teaching programming, these are, repeated power outage which hinder practical application of such skills, and the large number of students that outnumbers the PCs inside the computer lab, so the female students do not have equal chances in practicing on individual PCs and that the students do not have the secondary skills such as using the mouse and keyboard. Hence, students would get lost between pulling the bricks and setting the right values which draws their attention from the basic objective of performing the activity.

Furthermore, seeing the outcome directly shown on the screen during building the programming sections limits the students' thinking; because when the teacher asks them about what would happen when they replace one brick for another or what if they delete a certain brick, or change the place of the brick within the programming section, they wouldn't think about it but rather hold the mouse to find the answer on the PC. The PC is placed before them and they do not need to think to find the answer. It is the same scenario when a person, who has a calculator in his reach, is asked about a simple math problem, he would use the calculator instead of thinking because it would give him the answer directly without any mental effort to be exerted.

Programming classes usually take place at computer lab such as programming language that focuses on the final outcome. Yet, focusing on the right manner and the correct order for bricks to get such outcome is not usually adequate and the time dedicated for class in the lab might not be enough to acquire the programming skill in full details, so it is necessary to find a solution for these obstacles. CS unplugged has been reached during the search for solution for these problems. According to the aforementioned, it has provided the suitable approach to develop the scratch programming skills for female students; because it has enhanced their understanding of programming through performing a series of activities away from PC, in order to ensure students' understanding of the program requirements and its algorithm and expecting the correct outcome before starting actual programming process.

The study problem can be defined through the following main question:

What is the effectiveness of CS unplugged program in developing programming skills among eighth grade female students?

The main question would branch into the following sub questions:

1. What are the programming skills that should be developed among eighth grade female students?
2. What is the program based on CS unplugged in developing the programming skills among eighth grade female students?
3. Are there any statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the programming test?
4. Are there any statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the outcome evaluation card?

Study hypotheses:

1. There are no statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the programming test.
2. There are no statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the outcome evaluation card.

Study objectives:

The study aims at achieving the following objectives:

1. Setting a list of the programming skills that should be developed among eighth grade female students.
2. Setting the general image of the CS unplugged based program in developing the programming skills of eighth grade female students?
3. Identifying the statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application of programming test.
4. Identifying the statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application of outcome evaluation card.

Study Significance:

The study significance lies in:

1. This study might help the curricula planners in developing the programming curriculum of eighth grade through the inclusion of CS unplugged program in the programming curriculum.
2. The study offered a CS unplugged based program teachers might use in teaching programming skills for eight grade or simulating it to design a similar program for other school subjects.

3. The study offers a guide for teaching programming skills for eighth graders which is based on the philosophy of CS unplugged that might help teachers in summer classes.
4. Researcher might use the study's tools in measuring programming skills.
5. This study can become a reference for CS unplugged researchers.
6. This study might direct researchers' attention towards studying other aspects that this study has failed to cover.

Study limitations:

1. **Human limitation:** a sample of eighth grade female students of UNRWA schools in Khan Yunis Governorate, South of Gaza Strip, for the Academic year 2020- 2021 .
2. **Time limitation:** the study was performed in the first term of the academic year 2020- 2021.
3. **Spatial limitation:** this study was applied in Khan Yunis Preparatory Co. School "C".
4. **Subject limitation:** this study was limited to the programming textbook of eighth grade that is based on Scratch language.

Study Terminology:

1. Programming skills:

"Users' ability to use coding process through using bricks and putting them on top of each other while putting such in the right order for each brick represents a certain order to get a certain program, thus making the coding process familiar and easy to use" (Nikiforos et al., 2013).

2. CS Unplugged:

One of the forms of active learning that depends on the methodology of teaching computer sciences concepts using interactive activities based on games, puzzles, cards, strings, colors and motion away from using the PC (CSUnplugged.(n.d),website).

3. CS unplugged based program:

A series of experiences, activities and teaching and evaluating methods designed on the basis of teaching computer sciences using unplugged physical interactive activities using bricks to develop the Scratch programming skills of eighth grade female students.

Study Approach and Procedures:

Study Approach:

The study has deployed quasi experimental design for the experimental group and the independent variable of the study, that is, program based on CS Unplugged examined to measure its impact on the dependent variable, that is, the programming skills.

Study sample:

The study sample consisted of (14) eighth grade female students of Khan Yunis Preparatory Co. School "C", UNRWA, during the academic year 2020- 2021. The school has been selected on

purpose for it is located near the researcher's house and her previous place of work. As for the students, they have been randomly selected.

Study Tools:

In order to achieve the objective of the study, that is, identifying the effectiveness of CS Unplugged Program in developing the programming skills of eighth - grade female students, the drawing and motifs programs unit of the eighth-grade programming book has been analyzed to extract a list of the cognitive skills and performance skills that aim at achieving through the program, that have been presented to the evaluators and evaluating them.

First: Test of the cognitive domain of the Scratch Programming skills

According to the results of the analysis of eighth grade programming textbook in terms of the cognitive objectives, the cognitive test that is related to the objectives has been built according to the following:

1. **Identifying the general purpose of the test**, that is; measuring the cognitive aspect of the programming skills of eight grade.
2. **Preparing a table of specifications:** the table has been prepared.
3. **Writing the test items:** after designing the table of properties, the cognitive test of the programing skills has been prepared according to the properties table. The test is made up of thirty items as multiple choices test.
4. **Test validity:** the test validity has been verified through:
   a. **Evaluator's validity:** the test has been introduced to a group of evaluators to give their opinions and notices about:
      - The extent of representing the test of programming skills in the drawings and motifs programming unit of the eighth-grade programming book.
      - Sound linguistic and practical form.
5. **Test score evaluation:** one degree has been allocated for each item of the test.
6. **Application on the pilot sample:** the test has been applied to a pilot sample consisting of 15 ninth grade female students with the objective of:
   a. **Setting the time required for the test:** the testing time has been set through calculating the means of time required for the first student to finish the test and the last student to finish. The time required to finish the test is 35 minutes.
   b. **Calculating Internal consistency validity :** the Internal consistency validity has been checked through applying the test on the pilot sample and Pearson correlation factor has been calculated between the scores of each of the test items, as well as, the total score of the test, through SPSS, and it has showed that most of the items were correlated with the test total score, in a statistically significant manner at 0.01, 0.05, except for 4 items that were not statistically significant, and they have been rewritten due to their importance. This has shown that the test is internally consistent.

c. **Calculating the test reliability coefficient:** the test reliability has been tested through:

Split-Half method: the test reliability has been tested through dissecting the test items into two parts, the odd number questions and the even number questions. Pearson Correlation coefficient between the two parts has been calculated and then the correlation coefficient has been rectified using Spearman Brown coefficient due to the equality of the two items parts. It has shown that Spearman Brown reliability coefficient of the cognitive test is 0.75, which is a value suitable for reliability.

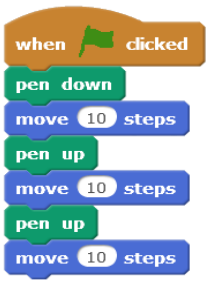
d. **Calculation of questions difficulty coefficients**: the difficulty coefficients have been calculated for each of the test items and they were found to vary from 0.20- 0.80 and the difficulty means has shown 0.49. These results have been significant in terms of suitability of items' difficulty degree as the difficulty coefficients has varied between 0.20- 0.80.

e. **Calculation of questions distinguish coefficients:** the test items distinguish degree has varied between 0.26- 0.78, with means of 39.6%, thus suggesting that all test items are within the acceptable level of difficulty and distinguish coefficients.

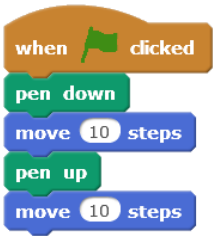
7. **Final form of the cognitive test of the programming skills:** after verifying the validity and reliability of the cognitive test of the programming skills, the test has been in its final form consisting of 30 items and figure (1) shows an example of one test item:

- the programming section that gives the following dashed line (- - -) :

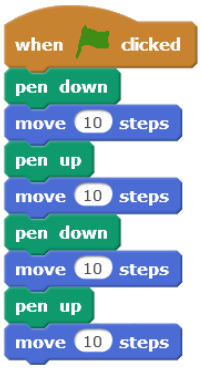
a.



b.



c.



d.

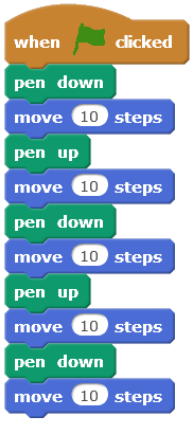


Figure (1): an example for one test item

Second: Outcome evaluating card of the performance aspect of the Scratch Programming skills: According to the results of analyzing the eighth-grade programming book in terms of performance skills, an outcome evaluation card of the performance skills has been built as per the following steps:

1. **Setting the general purpose of outcome evaluation card:** that is, measuring the performance aspect of the programming skills among eighth grade female students, in the drawings and motifs programming unit of the first term programming book.
2. **Forming the items of the outcome evaluation card:** the outcome evaluation card, in its primary form, consists of 11 items. A triple evaluation scale has been set to evaluate the programming

skills among eighth grade female students. Certain determinants have considered upon writing the items, such as, the items should describe the skills expected from the student during learning situation, the item should be short, notable, measurable and does not entail more than one explanation for judging the performance.

3. **Setting scores estimation system:** after writing the card items, a scores estimation system for students' performance has been designed according to a gradual scale, consisting of three verbal estimations representing the student's practice score. These are; high, medium and low and the determinants set the amounts by giving the scores 1,2 and 3 for the verbal estimations respectively. These estimations mean:
   - 3= high which means that the student has acquired the skill and uses it correctly, Moreover, the resulting shape shall be identical to the given shape.
   - 2= medium which means that the student has acquired the skill, but does not use it correctly and the resulting shape shall be correct but not identical to the given shape.
   - 1= low which means that the student has failed to acquire the skills.
4. **Preparing the primary form of the outcome evaluation card:** according to what has been mentioned above, the outcome evaluation card for measuring the programming skills has been prepared and it consists of 15 items.
5. **Calculating Outcome evaluation card validity:** to verify the validity of the outcome evaluation card it has been introduced in its primary from to a group of specialists to judge it and apply the modifications according to their notices.
6. **Pilot application of the outcome evaluation card:** the outcome evaluation card has been applied to a pilot sample consisting of (15) female students, with the purpose of:
   a. **Calculating Internal consistency validity:** Pearson correlation factor has calculated between the scores of each of the outcome evaluation card items, as well as the total score. It has shown that all the items have been correlated with the outcome evaluation card total score, in a statistically significant manner at 0.01.
   b. **Calculating the reliability of the outcome evaluation card:** the reliability coefficient has been calculated through:
      1. **Evaluators' agreement:** In agreement with a computer teacher from another school to evaluate the outcomes of the pilot sample students (n= 15) according to the outcome evaluation card. After extracting the cards data, the matching between evaluators using Cooper equation and the card's reliability coefficient scored 0.98, which is an acceptable reliability value.
      2. **Cronbach Alpha coefficient:** the outcome evaluation card's reliability has been estimated through calculating Cronbach Alpha with score of 0.789, which is acceptable.
7. **Outcome Evaluation card's final form:** after verifying the card's validity and reliability, the card has been in its final form that consists of 11 items.

Study Materials: to achieve the study objectives, the following materials have been prepared, as shown in figure (2**).**

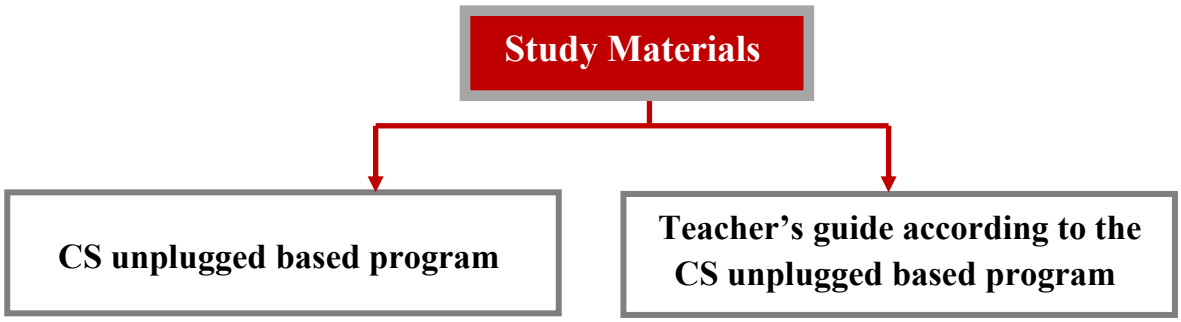


Figure (2): Study Materials

First: the CS unplugged based program: the general design model ADDIE has been deployed in building the program and the figure 3 shows the steps:

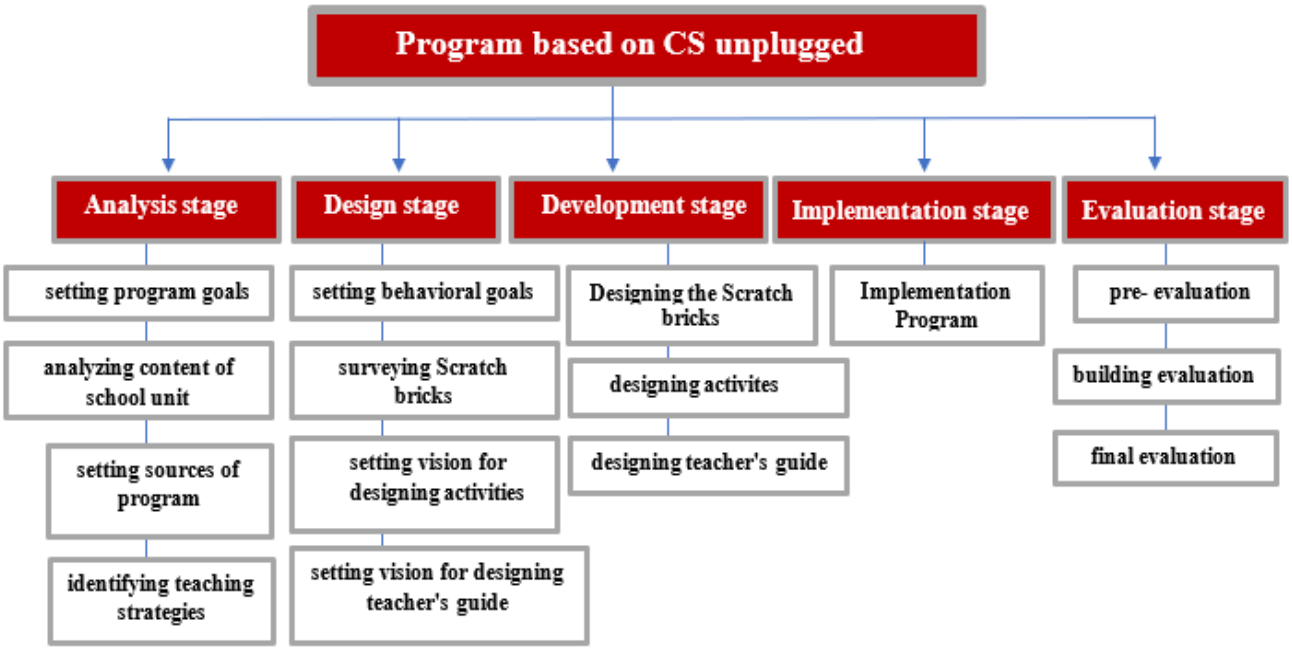


Figure (3): CS unplugged based program

First stage: Analysis:

- **Setting the CS unplugged based program goals**; the following goals have been set:

a. Program's general goals:

- Developing programming skills among eighth grade female students in the drawings and motifs programming unit of the first term programming book.
- Following different given programming sections and writing or drawing outcomes or results, unplugged.

- Forming different programming sections through given outcomes or results.

b. **Setting the programs special goals:** the student is expected to achieve the following goals after finishing the program:

1. Controlling the direction and movement of the cursor using a go to the direction and move brick.
2. Moving the cursor to different locations on the platform through certain given coordinates through the go and slide brick.
3. Drawing straight lines in different directions, sizes, and colors.
4. Drawing dashed lines in different directions, sizes, and colors.
5. Drawing different angles in different colors, sizes, and directions.
6. Drawing regular geometric shapes.
7. Drawing different motifs.

- **Analysis of the study unit content:** the drawings and motifs programming unit of the programming curriculum of eighth grade has been analyzed to extract a list of cognitive goals and performance skills.
- **Identifying the educational sources of the program:** it is necessary that the Scratch bricks to be available during the program, as well as skill developing activities and a teacher guide for the CS unplugged program.
- **Identifying the teaching strategies that shall be used to execute the program:** a series of strategies that will be used in class have been identified, such as, dialogues and discussion and cooperate work as the female students have been divided into five groups each of them consisting of three students except one group that consists of two students.

The Second Stage: Design:

- **Forming the behavioral goals:** a series of behavioral goals to be developed was formed and composed.
- **Survey of the Scratch Bricks of the skills of the unit:** the bricks of the skills discussed in the drawings and motifs unit of the Eighth-grade curriculum are surveyed to be designed through Photoshop software to be later printed and depicted on foam.
- **Planning a vision for designing the activities:** a series of activities with the theme for training in the targeted skills and the elements and skills subject of training are set for each activity.
- **Planning a vision for designing the teacher's guide:** a vision of the teacher's guide is set according to the CS unplugged based program to deploy all the activities to be designed within the guide.

Third stage: Development: this is where the designing process outcomes such as plans and scripts are interpreted into actual educational materials**.**

- **Designing the Scratch bricks of the skills of the unit:** after surveying the skills' bricks that shall be discussed in the drawings and motifs programming unit, the bricks shall be designed

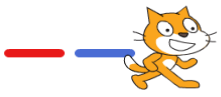
through Photoshop, through printing and cutting them in foam. The bricks then are distributed with colored pens in 5 bags, according to the number of groups and the figure (4) shows the scratch environment.

Figure (4): Scratch Environment

- Designing Activities: a whole series of activities has been designed to simulate the activities of CS unplugged program and figure (5) shows a model of the activities.

3. Using a scratch board, bricks and pens, build a programming section to perform the following:

a. Starting at the point x= 30, Y= 20, draw a dashed line to the right, with the length= 50, size= 10, and the distance in between= 10



b. Starting at the origin point, draw a dashed line with the length= 50, size= 5 and the second with the length= 50, size= 10 and the second is with length of 50, size= 5, and size= 10, and the distance in between= 10

c. Starting at the origin point, draw a dashed line with the length= 50, size= 5 and the second with the length= 50, size= 10 and the distance in between= 20

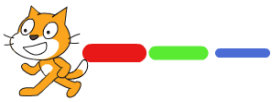


Figure (5): model of the activities

- Designing the teacher's guide: the teacher's guide is designed to contain 30 educational plans to teach programming skills within the drawings and motifs programming unit of the eighth-grade programming book, according to the CS unplugged based program.

Fourth stage Implementation:

- The Implementation process has been conducted in one of the summer rooms in the school and each group has received a bag containing a dissimilar series of bricks and a punch of colored

pens in addition to a magnetic board representing the Scratch platform. Each student has received a copy of the activities, the implementation depends on the designed teacher's guide.

- Implementation has covered sessions, (45) minutes each. (27) sessions have been implemented inside the class rooms and (3) sessions have been implemented inside the computer lab, After teaching a series of skills using the Scratch bricks and the board representing Scratch platform, in order to ensure that the students are not intimidated during the programming process through PCs on the post- application and also to ensure that the students acquire the secondary skills to interact with the Scratch platform through pulling bricks using the mouse and inserting values using the keyboard and identifying the bricks locations.

Fifth stage Evaluation: evaluation is used in the program using the following mechanism

- **Pre- evaluation:** through giving a short test at the beginning of each class to discover the previous experience represented in the skills offered in the previous class.
- **Building evaluation:** after explaining the targeted skill in every activity, the students have been directed to answer evaluation questions on the activity sheet. One part of the sheet has been solved cooperatively using the physical bricks and the board on which the scratch platform is pinned while some have been solved individually and directly by each student.
- **Final Evaluation:** at the end of each class to ensure that each activity's goals are achieved.

Second: Teacher's Guide according to the CS unplugged based program.

The teacher's guide has been designed according to the CS unplugged based program. The guide has contained a series of lessons made on the basis of the philosophy of the CS unplugged based program.

Study results and discussion:

1. **Results of the first question: to answer the first question, that is;**

   What is the CS unplugged based program in developing programming skills among the eighth-grade female students?

   After reviewing the previous studies that has tackled the CS unplugged based program, a special program based on the ADDIE model with five stages has been developed; these are: analysis, design, development, implementation and evaluation. Each stage consists of several steps.

2. **Results of the second question: to answer the second question:**

What are the skills to be developed among the eighth-grade female students?

   To answer that question the content of the drawings and motifs programming unit of the eighth-grade programming curriculum to achieve the skills list to be developed.

3. **Results of the third question: to answer the third question:**

   Are there any statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the programming test?

To verify this question the following hypothesis has been outlined arguing that:

- There are no statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the programming test.

  This hypothesis was tested through Wilcoxon Signed Ranks Test for two correlated samples to identify the differences between pre and post application on the cognitive test of the programming skills and the test has been applied to 14 female students of the study sample.

Table (1): Wilcoxon Signed Ranks Test results of two correlated samples for the differences between students' ranks on pre and post application of the cognitive test of the programming skills (n= 14)

Scope	Application		number	Ranks average	Ranks sum	Z value	P	Statistical significance
Testing programming skills	Pre/ post	Positive ranks	14a	7.50	105.00	-3.305	0.001	Statistically significant
		Previous ranks	0b	0.00	0.00			
		Quality	0c					

- Table indicated a statistically significant difference between the students score in the post application of the programing skills and their scores order in the post application, for the average positive ranks has higher than the average negative ranks.
- The size of the CS unplugged based program's impact on developing the cognitive aspect of the programming skills measured by the cognitive test of programing skills r_{prb}, the double correlation coefficient of the correlated pairs ranks. Table 2 shows that r_{prb} of the total score of the test is on the level of large impact degree, thus signifying that the CS unplugged based program has large impact on the cognitive aspect of the programing skills.

Table (2): the impact of the CS unplugged based program on developing the cognitive aspect of programing skills

Scope	value T_1	value r_{prb}	Degree of Impact
Total score of programming skills test.	105	1	large

4. Results of the fourth question: to answer the fourth question:

Are there any statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the outcome evaluation card?

And to verify this question the following hypothesis has been built:

- There are no statistically significant differences at ($\alpha \leq 0.05$) between the students' scores in pre- application and their average scores in the post- application in the outcome evaluation card.

- This hypothesis has been tested through Wilcoxon Signed Ranks Test for two correlated samples to identify the differences between pre and post application of the outcome evaluation card of the programming skills and the test has been applied to 14 female students of the study sample.

Table (3): Wilcoxon Signed Ranks Test results of two correlated samples for the differences between students' ranks on pre and post application of the outcome evaluation card of the programming skills (n= 14)

Scope	Application		Number	Ranks average	Ranks sum	Z value	P	Statistical significance
Outcome evaluation card of programming skills	Pre/ post	Positive ranks	14a	7.50	105.00	-3.305	0.001	Statistically significant
		Previous ranks	0b	0.00	0.00			
		Quality	0c					

- Table 3 indicated a statistically significant difference between the students score in the post application of the programing skills and their scores order in the post application, for the average positive ranks has been higher than the average negative ranks.

Table (4): the impact of the CS unplugged based program on developing the performance aspect of programing skills

Scope	value T_1	value r_{prb}	Degree of Impact
Total score of the outcome evaluation card of programming skills.	105	1	Large

- The size of the CS unplugged based program's impact on developing the performance aspect of the programming skills measured by the evaluation card of programing skills r_{prb}, the double correlation coefficient of the correlated pairs ranks. Table 4 shows that r_{prb} of the total score of the test is on the level of large impact degree, thus signifying that the CS unplugged based program has large impact on developing the performance aspect of the programing skills.

Conclusion:

These results, which showed the significant impact of the computer science-based software without a computer in the development of the cognitive and performance aspect of programming skills measured by a test and the product evaluation card, can be attributed to several reasons.

One reason is that the proposed program is diverted from the traditional method in terms of planning and designing with consideration of the scientific approach in preparing the proposed program. The proposed programme also moved away from the traditional implementation, relying on several methods in its programme that combined discussion, dialogue, collaborative learning and practice training. Moreover, preparing the factors that

help to implement the program from the Scratch environment represented in the magnetic board on which the program platform is pinned as well as Scratch bricks that have been designed and distributed on bags. Each group has been provided with a magnetic board, colored pens and a bag containing Scratch bricks. One more reason is that the students have been provided with activities designed according to the program philosophy. They all have been done either collectively or cooperatively, and sometimes individually to ensure that the skills are acquired. Such activities have been reinforced with more similar activities. Another reason is that the female students have had real desire to involve into the experiment and learning programming through this new program, which raise their curiosity from the beginning after being introduced to the program, its philosophy and objectives. Not only this, the participants were highly enthusiastic and competitive during the activities and a feeling of accomplishment and confidence was built within them after being able to build varied programming sections during a short time. This confidence has been enhanced after their few visits to the school computer lab to enable them to implement their assigned tasks correctly. Furthermore, providing the previously built teacher's guide according to the philosophy of the CS unplugged based program is another reason that contributed to the positive results of the programme. One last reason that helps having positive impact on the students' programming skills is linking some skills together. Whenever a new skill is explained, it shall be merged with the previous skills to confirm them and at the same time to help them acquire new skills.

Study recommendation:

The current study suggests the following future studies:

1. Conducting studies tackling the development of a programming curriculum for different school levels in the light of previous research and studies, as well as the opinions of Scratch teaching experts.
2. Studying the effectiveness of deploying tools such as Dr.Scratch, in developing the programing skills and the computer thinking in addition to other tools that represent programing measurement; and working on analyzing the projects in order to evaluate the thinking skills which have never been addressed in Arabic studies beforehand and that seeks increasing the programing efficacy through their feedback.
3. Measuring the impact of teaching Scratch skills through activities such as animation, math activities and games on developing the programing and reflective, computer, etc thinking skills, as well as the students' attitudes towards programing.
4. Studying the effectiveness of the program based on CS unplugged in developing the programing skills in different languages and for different school stages.
5. Conducting studies about the program based on CS unplugged for developing the programing skills in addition to other thinking skills.

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