



# The Effectiveness of Flipped Classroom Presenting Types in Developing Programming Skills for Computer Science Students in Al Hamdania in Iraq

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The present research aims to measure the effectiveness of the pattern of providing Flipped classrooms in the development of programming skills among students of the Department of Computer Science, Faculty of Education, at the University of Hamdania, Iraq, and was based on an experimental design (2 x 1), which included two independent variables (Vodcasting). The second pattern of providing Flipped classroom, cognitive journeys (web quest) included one variable, which was: programming skills in C ++ language. The sample of the study consisted of 50 second year students from the Department of Computer Science, at the University of Hamdania, Iraq. The results of the study revealed that there were statistically significant differences at  $\leq 0.05$  between the average scores of the two experimental groups in the skill performance rate due to the basic effect of the different patterns of the Flipped classroom presentation (video vs. cognitive journeys), in favour of the group that studied using the Flipped classroom presentation style. This may be because the viewing of video increases a student's focus on the practical skill.

**Key words:** *Flipped classroom - cognitive journeys - programming skills.*



## Introduction

Software of all kinds has spread widely in the world, which has led different countries to teach programming courses to their students. This occurs even in pre-university education in the faculties of science, engineering and education, and the production of software can represent a substantial source of income for the state.

Although the concept of the Flipped classroom is a modern concept and is still forming, the idea is simply that what is done at home in traditional learning is done during class / lecture and what is done during class / lecture in traditional learning is done at home. The student is exposed to the subject outside the class, either through an educational video recorded by the teacher to explain a particular lesson, or via readings related to the subject of the lesson (Brame, 2013).

In the Flipped classroom, a traditional class or lecture is transformed, through available and appropriate technologies, into recorded lessons which are then placed online so that students can access them outside the class. This is to allow for other activities within the class, such as problem solving, discussions, and assignments. It is a form of learning in which online technology replaces direct teaching in the classroom. In this context, technology can take many forms, including video, PowerPoint presentations, improved e-books, podcasts, interaction with other students through online forums, etc., although video is the most commonly used. Basically, it is the teacher who produces the lectures and makes them available to students online at home and before attending class. (Atef Abu Hamid al-Sharman, 2015).

Inverted learning rearranges the time frame, and the way it is used, inside and outside the classroom to transfer learning control from the teacher to the student. Class time is then used in the Flipped classroom for active learning and to implement practical projects (Johanson et al., 2014).

Pillars of the Flipped classroom include 1) Flexible learning environments, 2) A change in the concept of learning: the focus is on the student, not the teacher, as a source of knowledge, 3) Careful thought regarding the division of content and analysis, and 4) the availability of qualified and trained teachers (Atef Abu Hameed Al-Shorman, 2015, pp. 167-168).

Video is also a key element in this mode of instruction. The teacher creates a 5-10 minute video clip and shares it with students on a website or social network, so the inverse classroom makes the best use of the teacher's time during class. The teacher leads students at the beginning of the class, then designs activities within class by focusing on the clarification of concepts and the correction of knowledge and skills, and is able to take into account individual differences between learners (Mull, 2012).



One of the most important educational strategies targeted towards, and based upon, the use of the Web is called a Web search strategy ("Web Quest Strategy") and is sometimes referred to as web tasks or cognitive journeys through the Web (Nabil Gad Azmi, 2014, p. 392).

The cognitive journey through the web is defined as educational activities that are primarily internet based and attempt to develop the learner's skills in searching for information, as well as in ,organising, interpreting and making decisions about it. The cognitive journey can be organised using multiple modes of information technology, and is prepared using the internet, where it can be a page group, or a single page with hyperlinks and communication mechanisms between learners, and teachers (Karami Badawi, 2009).

The researcher works as a teacher in the Faculty of Education at the University of Hamdania and is a graduate of the Department of Computer Science specialising in educational technology. Communication with colleagues from the Department of Computers regarding the problems they face in teaching the decisions of the department led to a consideration of how education technology and modern technologies can contribute to the solution of these problems and enhance the academic achievements of their students in programming skills. As a result, the researcher conducted a survey on students in the department, which included 70 male and female students of the department, about their academic backgrounds of programming and methods of presentation in lectures and computer labs. The results of the survey showed that students in Iraq are not studying any programming languages in their pre-university stage. These results also showed that although the lectures are presenting the methods of writing the code of the programming language, the duration of the lecture does not allow sufficient time to ask questions, and the videos shown on YouTube channels are mostly Indians whose English is unclear. In addition, these results suggest that there is no logical arrangement of the material presented and that the lectures provide fragmented skills, which leads to low student scores in the achievement tests the students take. In light of these preliminary findings the researcher saw the need to overcome these problems. Reading about new research in this area, he also found that there is a relevant educational strategy within the strategies of integrated learning for this, known as the strategy of reverse learning (Flipped classroom) There are different ways to present this strategy that can lead to the solution of these problems, so there is a need to conduct this research to ensure the feasibility of this strategy in providing a solution to these problems.

**Research Problem:** Low level of performance skills for second-year students in the Department of Computer Science, Hamdania University, in the subject of programming, which appears in the results of performance tests they have.

Research Objectives: Developing C ++ programming skills among students of Computer Science Department in Iraq.

Research Questions: The researcher suggests that the answer to the following main question may lead to the solution of the research problem: What is the effectiveness of using a flipped classroom approach on the development of programming skills among students of the Department of Computing, faculty of Education in Iraq?

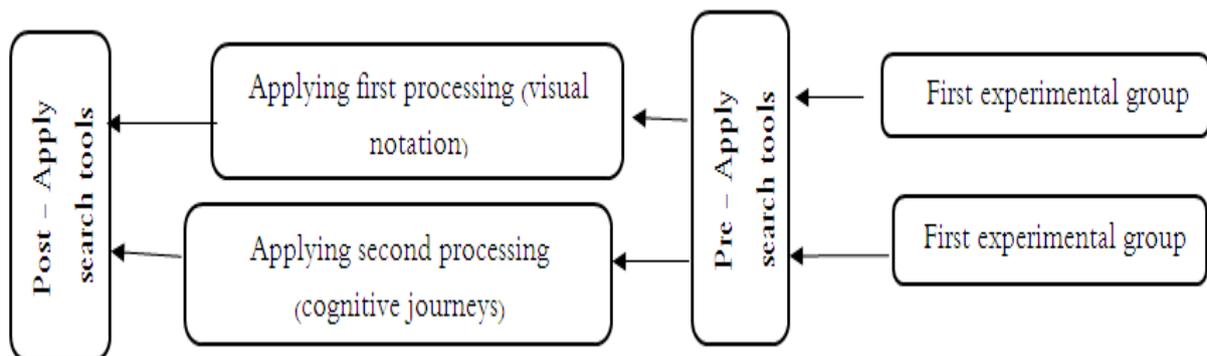
This main question also involves two sub-questions:

- What is the effectiveness of cognitive journeys on the development of programming skills among students of the Department of Computing, College of Education in Iraq?
- What is the effectiveness of visual codification on the development of programming skills among students of the Department of Computing, College of Education in Iraq?

### Research Importance

- Directing the attention of those who teach programming skills in C ++ to the most appropriate ways to present the inverse classroom strategy in teaching these skills.
- The methods of introducing a Flipped classroom can be useful for the development of other programming languages among students of the Department of Computing.
- The methods of presenting this strategy can be useful in developing the skills of other subjects of a different nature.

The experimental design of the study used a pre-and-post test approach, involving two experimental groups. Figure 1 provides an illustration of this design.



**Figure 1.** Illustration of the experimental design of the research

### Research hypotheses

H1 – That there will be a statistically significant difference at the level (0.05) between the average scores of the students of the second experimental group (who study using cognitive journeys) between the pre and post applications in the note card programming skills in the Department of Computer Science, in favour of the post application.

H2 – That there will be a statistically significant difference at the level (0.05) between the average scores of students of the first experimental group (who study using visual notation) between the pre and post applications in the observation skills of programming skills in the Department of Computer Science, in favour of the post application.

H3- That there will be a statistically significant difference at the level (0.05) between the mean scores of the post-achievement test for the students of the first experimental group (who study using visual notation) and the second experimental group (who study using the cognitive journeys) in the observation skills of the programming material in the Department of Computer Science for the first group.

Methods used in research:

The analytical description method is used in the experimental analysis, study and design stages to measure the effectiveness of process at the evaluation stage.

Research tools: - Note card for the course of programming for the Department of Computer Science in Iraq.

### **Experimental processing materials**

- 1 - educational site designed through lectures (VOD casting)
- 2 - educational site for the development of programming skills using cognitive journeys (Web quest).

### **Independent variables**

- A. An educational site based on visual codification provided to students of the Department of Computer Science in Iraq.
- B. An educational site based on cognitive journeys provided to students of the Department of Computer Science in Iraq.

### **Dependent variable.**

Skill performance rate for C ++ programming skills measured using a performance note card.

### **Research Limitations**



- Human Limits: The research sample is limited to students of the first stage, Department of Computer Science.
- Spatial limits: College of Education, University of Hamdania, Iraq.
- Objective Limits: Cognitive and Performance Aspects of C ++ Programming Skills for Second Year Students.
- Time limits: the research is applied in the second semester of the academic year 2018/2019

### **Research procedures**

1. Conducting an analytical survey of scientific literature and studies related to the subject of research, with a view to preparing the theoretical framework for research; and using them to direct the hypotheses and analyse/discuss the results;
- 2- Analyse and refine C ++ programming skills to ensure correctness and completeness of analysis;
3. Analyse the scientific content of programming skills in both its performance and cognitive aspects, and reformulate it by judging it in light of the objectives of this unit, the adequacy of the scientific content to achieve the specified objectives, and the extent to which the content relates to these objectives;
4. Preparing an observational checklist for skill performance;
5. Designing a scenario for presenting the flipped classroom according to the experimental design of the research;
6. Production of experimental processing materials - (visual recording / cognitive journeys) - and presenting these materials to experts in the field of educational technology for verification;
7. Conducting a pilot study for the experimental processing materials and measuring tools, in order to measure their stability and identify the most important difficulties that the researcher and the research participants may face when conducting the basic experiment;
8. Selecting the research sample;
9. Applying the pre - observation card;
10. Presenting the experimental processing materials “the two ways of providing flipped classroom” to the research participants according to the experimental design of the research.
11. Applying the post - observation card, after presenting the experimental processing materials;
12. Calculate the grades of the students of the experimental groups in the skill performance rate;
13. Conduct statistical processing of the results and then analyse the data, calculate the extent of change in their skill performance rate, and compare the results of the application, discussing and interpreting them in the light of the theoretical framework, studies and associated theories; and



14. Make recommendations in the light of the results achieved, as well as proposals for future research.

### **Search Term Definitions**

**Effectiveness:** Effectiveness is defined as the impact resulting from student C++ testing in terms of achievement and skill performance.

**Flipped Classroom:** Flipped classroom is defined as a particular pattern of integrated learning in which initial e-learning is presented to the student at home, and then followed by activities and exercises within the classroom environment with their teacher and peers, in order to reach mastery.

**Podcast:** Podcasts are defined as 5-10 minute videos explaining a particular programming skill, which are uploaded to a special YouTube channel.

**Web Quest:** A Web Quest is defined as an educational tool for learning in which learners interact with learning resources available on the Internet to develop their programming skills.

### **Theoretical framework**

#### ***Flipped Classroom Definition***

Atef Abu Hameed Al-Shorman (2015) defines the Flipped classroom as the pattern in which students are taught outside the classroom through educational videos placed on the Internet, where students watch them at home to understand concepts and ideas through them, followed by in-classroom learning, where the teacher answers students' questions and deals with problems that students may have encountered while trying to understand the follow-up videos. Follow-up videos are uploaded to the Internet by the teacher to explain each lesson, and students are required to take notes and develop questions from these for use as part of their in-class learning.

Ibtisam Saud Al-Kuhail(2015), defines the Flipped classroom as a deliberate learning and teaching strategy that employs instructional technology (video, etc.) to deliver student content before and outside the classroom to employ class time to solve homework and to effectively practice knowledge through various activities, with the possibility of activating media. In social learning, it is one type of mixed learning.

(Haytham Atef Hussein, 2017) defines the Flipped classroom as a learning environment in which teachers pair what is happening in the classroom with what is required of learners tasks and assignments at home, through the preparation of the subject of the lesson through videos



posted on one of the learning networks. Students can view them at home using their computers or smartphones before attending the class, while class time is devoted to discussions, workshops, collaborative projects, and exercises.

Badr Owaid Al-Fulaij (2016) defines the Flipped classroom as the teacher reversing the normal classroom learning situation - which would traditionally present the lecture inside the classroom and then solve problems at home by following a series of procedures. Importantly, students are asked to take notes and develop questions about the follow-up video used in a Flipped classroom, and are then integrated into small groups to initiate different discussions and activities, and to find solutions and answers to their various questions within the in-classroom phase of learning.

### *Steps to implement Teacher-Flipped Classroom*

1. Planning: Setting goals and selecting content to achieve goals, and setting active calendar dates to ensure the achievement of goals.
2. Pre-class content: Prepare the electronic content of the material and make it available to students before the classroom. This content is required to be attractive and interesting and provides a clear, understandable and appropriate approach to the learning objectives, which may vary from presentations, video, web survey or knowledge trips and others.
3. Determine pre-class learning activities: Prepare activities that students will perform before they attend the classroom to motivate and encourage them to learn.
4. Identify learning activities during the classroom: The teacher to prepare appropriate strategies to ensure students master the lesson, which is the main goal of using reverse learning to overcome the obstacles of the traditional classroom, answering students' questions, and changing the role of the student from recipient to active learner, as well as clarifying the role of the teacher as facilitator.
5. Post-class activities: Preparing enrichment and therapeutic activities and assignments and preparing for the next lesson.
6. Formative and final evaluations: Evaluations in which the objectives are confirmed. The purpose of these evaluations is to evidence the ability of students to carry out assignments, and master the lesson, through tests. (Haitham Atef Hussein, 2017)

Advantages of the Flipped Classroom (Ibtisam Bint Saud Al-Kuhail, 2015, p. 90):

- 1. Flexibility:** In the timing of the presentation of the content, where the student can review the content in a timely manner as well as stop having to ask the teacher to explaining their teaching in the video again and again.
- 2. Efficiency:** The use of e-learning in conjunction with traditional face-to-face learning gives reversible learning the advantages of both electronic and face-to-face modes.



- 3. Increasing interaction** between teacher and student: Where the interaction is not limited to the time of the classroom, but within the classroom and outside of class time through educational videos and electronic tests.
- 4. Changing the classroom management style.**
- 5. Transparency.**
- 6. Overcoming the lack of qualified teachers as well as the absence of teachers.**
- 7. Development of lifelong learners.**
- 8. Increasing participation in the materials.**
- 9. Helping students with different abilities to excel.**
- 10. Students are allowed to control how much information they need to know.**
- 11. Helping to overcome many problems of bad behaviour within the classroom.**
- 12. Consistency with the requirements and data of the digital age.**
- 13. Helping students who are academically stumbling.**
- 14. Helping students of all levels to excel, especially those with special needs.**

#### *Studies dealing with the effectiveness of Flipped Classroom*

There are many studies that point to the effectiveness of the Flipped Classroom, including Ismail (2015), who showed the effectiveness of using the inverse learning strategy in the development of cognitive learning, and the skill performance of geographic research skills as a whole, with each sub-skill separately learned for the benefit of the experimental group.

The study by Hassan (2015), showed the effectiveness of the Flipped Classroom based on visual codification in the development of cognitive learning, focusing on the skill performance of designing electronic tests for the benefit of the experimental group. The study by Khallaf (2016) showed that students displayed superior of the inverse learning patterns based on peer teaching compared to their counterpart students using the inverse learning pattern, based on an investigation of both the cognitive and performance side of motivation to achieve the use of social software in education.

And the study by Khalifa (2016) resulted in the presence of both the provision of guidance before the presentation, and cognitive method only in the development of the cognitive side, and the quality of the product not the performance side of the production of electronic courses. The study by Zahid (2016) found a high effectiveness for the application of the Flipped Classroom strategy using the Blackboard system, and the application of WhatsApp, on the cognitive achievement of the course of teaching methods, and also found a high indication of the trend towards online education for the experimental group. The results of the study indicated the effectiveness of the achievement of ninth grade students in English grammar using the Flipped Classroom strategy. He suggested adopting the strategy of Flipped Classroom in the educational process in Jordanian educational institutions, and the need to organise workshops to analyse and identify the modules of the curriculum that can be used in accordance with the strategy of the Flipped Classroom. The study by Qeshta (2015) also found the impact of the



strategy of the Flipped Classroom in the development of both the acquisition of concepts and reflective thinking skills of the research participants.

In the study by Findlay & Mombourquette (2014), no difference was found between the Flipped Classroom and the traditional method. This study presented three suggested solutions to make teaching through the Flipped Classroom effective: Students should be informed about the purpose of the Flipped class and give them the opportunity to express their opinion, students must be persuaded of the importance of the Flipped classroom in order to get involved in the learning process, and teachers must abandon the traditional method of learning by learning to master the implementation of the Flipped classroom, not just video recording and have students solve assignments in class. The study conducted by Mok (2014) at the Faculty of Information Systems at the University of Singapore, found that students who studied a course in programming through the Flipped classroom strategy identified having the option to re-watch the video of the lecture multiple times before going to class and being able to control their learning as a major advantage of learning through the Flipped classroom approach. In addition, the study by Overmyer (2014) found that untrained classroom teachers were at least as traditional as those who had studied in the traditional way. Experienced teachers in investigative and collaborative learning were more successful with the Flipped classroom model.

### **Research Methodology**

The methodological procedures for the research included educational design of the research processors through the content of the programming language in C ++, which is taught to students of the second year in the Department of Computer Science, University of Hamdania, developing and reviewing the research tools, identifying the research sample, composing the experimental design, and conducting a pilot study for the research. These procedures are detailed as follows:

**First:** the stage of the internal evaluation: This phase included assessing the requirements of the teacher and the learner and e-learning environment through the following steps, as displayed in table 1:

**Table 1:** Assessment of the learning environment in order to implement a Flipped classroom strategy

S	Band	Availability		Notes
		Avai lable	Not available	
1	Experiences of learners: These include the availability of practical experiences in the use of computers and the Internet.	✓		
2	Requirements to be met in the learning environment: This task includes making sure that all requirements associated with the Flipped Classroom environment are met by the designer, the student and the learning environment	✓		
3	Technological Infrastructure: Includes all the devices required to complete the search experience, such as a computer with the appropriate training capabilities to train and load the program Dev-c ++, and with the application connected to the Internet at an appropriate speed	✓		

**Second: Initialisation phase:** Not necessary to provide all the necessary capabilities to use the reverse learning in this stage of the evaluation.

**Third: Analysis Phase:** This phase included the following tasks:

1. Identify the needs and characteristics of learners: The characteristics of learners were determined in the light of the following general characteristics: Students of the Second Year, Department of Computing, Hamdaniya University, Iraq.

Students do not have prior knowledge of the course or similar courses.

All students in the same age bracket and educational stage.

2. Determining the general objectives of the computer course, to develop C ++ programming skills by training students in the reverse learning environment.

**Fourth: the design stage:** 1. Define the procedural objectives of the educational content. Based on the previous definition of the general objectives of the training module and its content, the behavioural objectives for each subject and field were formulated in a procedural manner that can be observed and measured. A list of behavioural objectives for each content lesson was prepared and presented to a group of referees. Based on the consensus of 80% of the opinions of the arbitrators, who identified a list of objectives \* for the content of the lessons and activities and the number of (50) goals, the following table shows the elements of this list.

**Table 2:** Designing the list of objectives and the contents of the training unit and activities

General goal	Behavioural goals			content	Linked to Goals		Adequacy of content		Appropriate activities to achieve goals	
	After studying the unit the student should be able to:				Linked	Not Linked	Adequate	inadequate	appropriate	inappropriate
Goal phrase	Goal phrase	agree	Not agree							

2. Designing the appropriate educational content for the virtual classroom: The researcher identified the elements of educational content needed to achieve the objectives, and then presented these elements to experts and specialists in the field of educational technology and curricula for the purpose of verifying them. The views of the experts and the arbitrators resulted in the following: All the themes of educational content received a percentage associated with the objectives of more than 80%. All the themes of educational content received a percentage associated with achieving the goals of more than 80%, which means that the percentage of agreement on the adequacy of the content to achieve behavioural goals is high.

3. Designing the appropriate multimedia to be presented through reverse learning in two types of presentation: In the light of the nature of scientific material, which is programming in C ++ language, video clips and cognitive journeys were designed.

4. Design of activities and tasks of distance learning: The activities were designed to interact with the content of the lesson from video clips and links to websites with content within the learning management system (Moodle), in line with the achievement of educational objectives and the pattern of providing reverse learning and commensurate with the content provided.

5. Design of teaching and learning strategies for reverse learning: The researcher designed the patterns of reverse learning based on a set of criteria drawn from previous studies.

6. Designing interfaces and interactions: Intraregional, between remote participants. The site included several methods of interaction, namely: 1-The interaction between the student and the content, 2-The interaction between the students and each other with the teacher, and 3-Interactions between the student and the interface interaction site.

7. Designing the assessment tools: These are the tools and tests through which the researcher seeks to measure the research goals, and are directly related to the performance scales specified in the objectives, namely the skill performance note. The researcher will elaborate on the preparation of the practical performance note in the part of the preparation of research tools.

**Fifth: Production Stage:** The production phase included the following steps: 1- Produce video clips and cognitive journeys to provide reverse learning. 2- Produce interfaces for Intraregional interactions. 3-Production of assessment and evaluation tools.

**Sixth: Evaluation Stage:** 1. Initial evaluation of the site: The site was presented to a group of educational technology specialists after giving them a username and password. Based on the

opinions of the arbitrators, the required modifications were made and the site was ready for field use.

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\* Appendix No. (1) The names of the arbitrators

\* Appendix NO (2) Rapporteur's objectives

2-Pilot the site on the survey sample: Based on the above, the researcher conducted a pilot experiment on a group of students of the second year in the Department of Computer Science (non-study sample), The number of students was (5) and the pilot experiment targeted the following: 1. Ensure the clarity of the objectives of the site, and achieve content for the desired objectives, and ensure that the training site was free from any technical defects related to the use of students - make sure the site and its tools were appropriate to the level of students and their skill in using it. 2. Adjust the study tools. 3. Modification and final output of the site: Here the researcher took notes that were extracted from the experiment in the activation of some inactive links, and the identification card was identified in its final form. Accordingly, the researcher made the necessary adjustments. The site was available in its final form from the following link: [www.almister.com/moodle](http://www.almister.com/moodle) .

4. Feedback: For the phases of model building, feedback was the result of negotiation by the arbitrators for each stage, starting from the analysis phase and judging the general objectives, followed by the design phase and its analysis of the procedural objectives and content, and leading to the evaluation phase of the arbitration of the research tools, which is the scorecard. Total Quality Standards: The researcher adopted the standards of designing and producing virtual classrooms from Samie, 2016. Then, the researcher considered these criteria in implementing the strategy of providing reverse learning to measure its effectiveness in developing programming skills in C ++ language for the research sample (\*).

**The second axis:** Building the measurement tool and approvals: The researcher designed the measurement tool, to ensure the achievement of the objectives set in advance, where the researcher designed and used the following tools: The Observation Card :

Determining the Objective of the Observation Card: The observation card was aimed at evaluating the practical aspects of programming skills in C ++ in the second phase of the Faculty of Education, at Hamdaniya University. Sources of building the observation card: The card was constructed in the light of the analysis of educational content and access to the skills to be developed and the work of the observation card accordingly: The vocabulary of the card was formulated in terms of phrases explaining the performance required to be carried out by the learner, which included programming skills in C++ language for second-level students at the Faculty of Education of Al-Hamdania University. When selecting the skills to be included in the note card, 5 master skills were identified, of which 35 sub-skills included programming in C ++ language for these students. When drafting the list of skills to be included in the



observation card, the present research took into consideration the following: The skills should be procedurally defined and easily observable, the term describes only one sub-skill that is not composite, avoid the use of negation in the drafting of the vocabulary of the card, the card allows the observer to record the performance as soon as possible so as not to mix with the previous or subsequent performance.

The method of assessing the performance level: The method of assessing the performance level, following the opinion of several experts on the use of a three-level division pattern, was determined as involving two levels for this research, wherein level two awarded 2 degrees for the student who performed the entire skill himself, and level one awarded 1 one degree for the student who performs some sub-skills within the basic skill. Level 0 received nothing and all students were allowed to follow up again until the skill was fully learned and able to be performed. Students were assessed immediately in the sense that students were followed during the conduct of the skill without delay or postponement.

Adjusting the observation card - Validity of the observation card: The researcher presented the card to (9) arbitrators, who were asked to give their opinions on the card in terms of: whether or not the card was suitable for the goal for which it was set, the validity of the sub-skill sequence, the extent to which the sub-skill is related to the basic skill, the validity of the card for the application and the accuracy and clarity of the wording of the card in terms of vocabulary.

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### **List of cognitive journey criteria**

During the meeting with the arbitrators, the researcher found significant agreement in terms of the card's suitability for the purpose for which the goal was set, which was to measure the performance of students in each skill, the ability of the card vocabulary to express the measurement of skill, and the accuracy and vocabulary of the vocabulary.

Calculate the stability of the observation card: The calculation of a coefficient of stability was undertaken, using multiple observers to evaluate the performance of each student. A survey was used to collect observer ratings, which were then used to calculate a coefficient of agreement between their estimates using the equation (cooper), where the researcher in conjunction with two teaching assistants in the college evaluated the skill performance of 3 students. These evaluations were calculated using the ratio of agreement between the researcher and colleagues for each student as follows:

$$\text{Agreement ratio} = \frac{\text{number of times observers agree} \times 100}{\text{Number of times observers agree} + \text{number of times observers disagree}}$$

**Table 3:** Inter-Observer agreement coefficients

Coefficient of agreement on the performance of the first student	Coefficient of agreement on the performance of the second student	Coefficient of agreement on the performance of the third student
84.4%	94.3%	87.2%

It is noted from table 3 that the average agreement of the observers on the performance of the three students is equal to (88.65) which is a high stability rate and indicates that the card is valid for use and applied to the research sample as a measurement tool.

Final form of the observation card: The completion of the control card in its final form consisted of 5 master skills that branched out to include 35 sub-skill descriptions of the actions required of the learner in each step of performance, as shown in Table 4.

**Table 4:** Basic Skills List

Serial	main skill		main skill		main skill
1	loops	2	function	3	Call by reference & by value
4	Array	5	pointer		

**Seventh: Application Stage:** This phase included the following steps: 1. Leave and enable reverse learning: The educational site was made available to students in its final form to start the research experiment, on Saturday, 20/4/2019 for the training year 2018/2019. 2. The application of reverse learning on students: Based on the previous steps, the name of the site has been identified under the title 'programming skills in C ++' and made available from the following link: <http://www.almister.com/moodle>. The researcher identified the user name and password for sample students so as not to allow access to non-students and to identify each student username and password in the first meeting with students. 3. Application of both types of reverse learning delivery: The researcher applied both types of reverse learning delivery, which have been identified in the design stage, during the period from 20/4/2019 to 4/5/2019.

**The third axis:** Experimental design of the research: The experimental design with two experimental groups “Two Groups Pre-Test - Post - Test Design” was used, as shown in Figure (1) page 3.

**The fourth axis:** The basic experiment of research: The process of applying the basic experiment of research has gone through several stages as follows: 1) Selection of the research sample: This was a sample of convenience, comprised of students from the second year of the

Faculty of Education, Hamdaniya University degree, using the second semester of the academic year 2018/2019. The number of this sample was 50 students. 2) Application of research tools tribally: Application of observation card: The application tribally of the observation card on the main sample of the research (experimental groups), took place on Thursday, 18/4/2019. 3) Implementation of the basic experiment: After the completion of the application tribally of the research tools, the basic experiment was implemented through the application of the two types of inverse learning (videos and cognitive journeys), where the researcher set the students and applications to start and finish the study of the training unit. This involved the study of the five training modules and took two weeks from 20/4/2019 to 4/4/2019, with students required to complete the unit on time. 4) Application of search tools tribally: After the completion of the search experience, the search tool (observation card) was applied in order to identify differences in the performance of the skill tribally and dimensionally. The observation card was applied on Saturday 4/5/2019 and their results were recorded and processed by appropriate statistical methods. Statistical treatments for small groups were conducted using the SPSS statistical software package, using the Mann-Whitney test and the Crosscalice Walse, and the results were analysed and interpreted in the light of the research hypotheses.

## Research Results and Interpretation

Viewing the results of the research questions, the first question asks “What is the effectiveness of the pattern of providing reverse learning in the development of programming skills among students of the Department of Computing, College of Education in Iraq?”. This question was answered by validating the research hypotheses via conducting statistical treatments on the data obtained through the basic research experiment, as will be shown later.

**Sub-question 1:** What is the effectiveness of cognitive journeys in developing programming skills among students of the Department of Computing, College of Education in Iraq? This question was answered by verifying the validity of the first hypothesis, which states: There is a statistically significant difference at the level (0.05) between the average scores of the first experimental group of students (who study using cognitive journeys), between the pre and post applications of the observations of the programming skills section. The computational mean for the post-application, the mean and the standard deviation were calculated, with the following results as shown in Table 5, which displays a summary of the results for the pre- and post-application of the observation card used to measure the performance aspect of programming skills in c++ according to the inverse learning Videos (Cognitive trips).

Table 5: Summary of results for the pre- and post-application of the observation card to measure the performance aspect of programming skills in c++

Inverted by cognitive journeys	Number	Mean	Standard deviation	Degree of freedom	t-test	significance
tribally		116.52	42.19	24	14.22	0.01

\* Appendix No. (6) degrees of basic experience

	25					
		2				
dimensional		232.64	16.88			

It is clear from the table 5 that there is a statistically significant difference between the average scores of the students tribally, the observation card and the telemetry dimensional for the telemetry dimensional (247.56) at the level of 0.01, and we thus accept the first hypothesis. To calculate the magnitude of this impact, the researcher calculated the value of 't-test' and 'ETA box'. The results are as follow, in Table 6.

The value of 't-test', and ' $\eta^2$ ', which is the effect size of the first experimental group (inverted video learning):

Table 6: Overview of t-test and effect size for the first experimental group

Inverted video	t	t <sup>2</sup>	Degree of freedom	$\eta^2$	(d)	
observation card	14.22	202.20	24	0.89	5.81	0.01

Since the value of (d) is 5.81, which is greater than 0.8, it turns out that the magnitude of the impact is large, and indicating that the cognitive journeys helped students acquire skills to search for information on the Web, as well as increasing the motivation to obtain information from different sources. This demonstrates diversity in the ways of presenting one idea (texts, video), which is consistent with the studies of Abulfattah Ali (2019) and Karim (2015).

**Sub-question 2:** What is the effectiveness of visual codification in the development of programming skills among students of the Department of Computing, College of Education in Iraq? This question was answered by verifying the validity of the second hypothesis, which states: "There is a statistically significant difference at the level (0.05) between the average scores of the second experimental group students (who study using visual notation) between

the pre and post applications in the observation skills of the programming skills section Computer science in favour of post-application”. The mean and standard deviation were calculated for the visual notation strategy and the results were as follow in Table 7, which provides a summary of the results for the pre- and post-application of the observation card to measure the performance aspect of programming skills in c ++, according to the reverse learning video strategy (visual notation).

Table 7: Summary of the results for the pre- and post-application of the observation card to measure the performance aspect of programming skills in c ++

Inverted video	Number	Mean	Standard deviation	Degree of freedom	t-test	significance
tribally	25	117.88	39.42	24	15.27	0.01
dimensional		247.56	13.14			

It is clear from table 7 that there is a statistically significant difference between the average scores of the students tribally, the observation card and the telemetry dimensional (247.56), at the level of 0.01, and we thus accept the second hypothesis. To gauge the magnitude of this impact, the researcher calculated the value of 't-test' and 'ETA box' The results are as follow in Table 8:

Table 8: The value of 't-test ', and ' $\eta^2$ ' which is the effect size of the first experimental group (inverted video learning)

Inverted video	t	t <sup>2</sup>	Degree of freedom	$\eta^2$	(d)
observation card	15.27	233.17	24	0.90	6.24

Since the value of (d) is greater than 0.8, it turns out that the magnitude of the impact is large and the researcher attributes this result to the fact that the video clips provide direct experiences for learning, which is consistent with the findings of Harb (2018).

The third hypothesis states that there is a statistically significant difference at the level (0.05) between the average scores of the post-achievement test for the students of the first experimental group (who study using visual notation) and the second experimental group (who study using cognitive journeys) in the observation skills of the programming material in the Department of Computer Science. in favour of the first group. The arithmetic mean and

standard deviation were calculated for both groups and the results are as follow in Table 9, which provides a summary of the results of using the observation card to measure the performance aspect of programming skills in c ++ according to both visual notation and cognitive journeys.

Table 9: Summary of the results of using the observation card to measure the performance aspect of programming skills in c ++ according to both visual notation and cognitive journeys Pattern of inverted learning delivery	Number	Mean	Standard deviation	Degree of freedom	t-test	significance
video	25	247.56	13.14	48	3.48	0.01
Cognitive journeys	25	232.64	16.88			

It is clear from table 9 that there is a statistically significant difference between the average scores of the students of the observation card in the telemetry dimensional between the first and second groups in favour of the first group (visual notation) at the level of 0.01, and thus we accept the third hypothesis. The result is that video footage delivers skills directly and focused, increasing students' attention to explanation and thus gaining scientific skill easier and faster.



### **Study Recommendations**

1. Utilize the results of the current research at the applied level, especially if future research supports these results.
2. We should pay close attention to choosing the appropriate pattern for the delivery of educational content through reverse learning, in order to achieve the desired learning outcomes.
- 3 Universities should hold courses for faculty members to train them in the use of reverse learning.
- 4 Universities should also pay attention to the use of reverse learning in teaching practical courses.

### **Proposals**

1. Independent variables of research can contribute to the development of other learning outcomes, such as achievement or direction of the same material, or learning materials of the same applied scientific nature.
2. Independent research variables can contribute to the development of learning outcomes for different educational levels.
3. The interaction between independent variables with students' cognitive styles may contribute to changing the current research result.



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