Computational thinking according to sensory modeling among university students

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Abstract
The current research aims to identify: -
Computational thinking according to sensory modeling among university students. To achieve the objectives of the research, the researcher followed the descriptive approach. This required the provision of two research tools, the first to measure computer thinking and the second to measure sensory modeling. The researcher verified their validity after presenting them to a group of arbitrators. The researcher selected (378) male and female students appointed for the research and used the following statistical means: (Pearson correlation coefficient, excellence equation, t-test for two independent samples and the researcher reached several results:
- University students (research sample) have a level of computational thinking.
- The university students (the research sample) have a level of sensory modeling.
Based on these results, the researcher came up with a number of conclusions, recommendations and proposals .

Keywords : Computational Thinking – Sensory Modeling

Chapter one
Introduction into the research

first ; The Problem of the Research:

Computational thinking skills are an extension of 21st-century skills, or can be considered a tool for developing problem-solving skills as one of the most important features that characterize critical thinking, and are an essential part of the curriculum, which made many global

education systems adopt the teaching of such skills in the curriculum and at early stages of the basic stage. CT Computational thinking will work extensively as a core practice to equip young people to formulate and solve problems in the digital world; therefore it is not surprising to demand its integration into education from kindergarten through the twelfth half (119, 120, 2019). Kong

Computational thinking is concerned with how to process information such as computers. It contributes to training to face many challenges by taking an analytical and systematic approach through a series of steps (algorithms) to solve problems. It is expected that the need for new jobs will increase. For example, in space science, we may need observers, explorers, surveyors and perhaps planetary mining engineers. Self-driving cars need engineers specializing in the creation and development of smart roads, analysts and developers, as well as the functions associated with artificial intelligence enhanced for humans.

However, there is a problem that: 74.5% of students are not familiar with mastering some of the visual thinking skills of the computer and information technology course and that 70.3% of students have a desire to deal with visual thinking. Moreover, some education systems around the world have introduced computers at the basic stage for only one purpose, which is to develop computer thinking skills, in addition to integrating other digital skills with curricula for other subjects, which leads us to think carefully about such decisions for global education systems that have given the utmost importance to the development of such skills and benefit from the experiences of countries such as Britain, Finland, Australia, and Singapore, which went to call the national capabilities on computer thinking skills.(Al-Hamoud 2009, p. 223)

And that students may differ in their sensory preferences, as those with (auditory) preference differ from those with (visual) preference and those with (motor) preference. (Based on what has been stated

Theresearch problem is determined by answering the following question

What is computational thinking according to the sensory modeling of university students?

Second: Significance the of research:

Because of its power in the ICT industry, countries such as Korea, Taiwan, and China have launched national systemic reforms to address the current movement in computational thinking education.

It provides an information base that enables decision makers in educational institutions to achieve the objective s of education by activating the skills of the twenty-first century by introducing the "**Computational Thinking Course".**

The importance of computational thinking skills, which are part of the 21st century skills useful for solving many difficult problems, has become another basic skill added to the four skills (critical thinking, creativity, cooperation and communication) to be taught to all students and that the ability to solve computational problems and logical and algorithmic thinking has become a prerequisite for all fields in implementation of the initiative of the United States of America "Computer Science for All" in 2016 (Mujahid 2018: 271-272).

Students of all ages also need to develop computational thinking skills because they need the analytical ability to read, write and calculate. "Computational thinking works like a computer scientist to help students better understand other disciplines. When students learn computational thinking, they will develop and enhance many aspects of thinking skills, as well as helping students solve problems and address them in an innovative way. They can also apply the concept of computational thinking in many areas (., 2018, Abuhussain150)

Therefore, they are essential skills for everyone living in the information society, which has led countries to adopt different policies for school systems in terms of learning computer programming and coding skills.

Third : Research Objectives: The current research aims to identify: -

1- Computational thinking among university students.
2- Sensory modeling among university students
3- Computational thinking of university students according to sensory modeling.
4- Statistically significant differences in the level of computational thinking according to sensory modeling

Fourth : The limits of the research : The current research includes the students of the University of Babylon in the scientific and human

faculties - the initial study - in the morning for the academic year 2022-2023 .

Fifth : Terminology : -

First - Computational Reflection: Identified by:

Grover and Pea (201 7) : A way of thinking about the problems we face in life , based on steps that humans or machines can follow to understand the problem, analyze it, and formulate the solution in a way that humans and computers can understand and apply . (pea, 2017&Grover)

The procedural definition of computational thinking: It is the degree to which the students of the research sample get their answerto the computational thinking test prepared for this research .

Second - Sensory Modeling: Defined by: -

1- fleming and Bonwell , (1987) : It is a method that reflects the difference between individuals in their compatibility with the outside world. This method has three dimensions. The first dimension is the verbal method that prompts individuals to store information in the form of verbal symbols. The second dimension is the visual method that prompts individuals to store information in the form of images. The third dimension is the motor method that prompts individuals to store information in the form of movement or activity . (fleming and Bonwell, 1987 , p 42)

Procedural definition of sensory modeling: The degree to which the coating of the research sample obtains their answer on the sensory modeling scale prepared for this research .

Chapter Two: Theoretical Background

The first axis: - Computational thinking

Computational thinking has received a great deal of attention over the past several years, and is among the latest contemporary trends in the development of thinking skills, and it has become a major skill to live in the twenty-first century, and information technology has been included among the most important sciences that students receive in their educational stages, but the computer courses are still largely focused on teaching students how to operate and deal with technologies instead of learning to develop and innovate new technologies, so our students are still to some extent recipients of technology and not developers of it .

(https ://www.new-education.com)

- Characteristics of computational thinking: - Computational thinking includes the following characteristics

- Analyzing and Organizing Data Logically
. • Data modeling, abstraction and simulation
. • Formulate issues such as those in which computers may help
. • Identify, test and implement possible solutions
. • Automating solutions with algorithmic thinking
. • Mainstream this process and apply it to other issues.

(20-23 2011 , p Barr& stepheneson ,)

Computational Thinking Skills: - Computational Thinking Skills

First, think of the solution algorithm.

An algorithm is a set of sequential steps that accurately and unambiguously describes all the steps needed to solve a problem.

Second : Problem Decomposition:

It is the process of dividing a complex and large problem into a set of mini-problems so that it can be managed, solved and grouped to reach the full solution of the original problem.

Third : Abstraction:

It is intended to focus on the basic problem and leave the details and information unimportant , and is used in simulation and modeling programs where the focus is only on the basic processes and leave the details ineffective .

Fourth : Evaluation

Is the process of ensuring the efficiency and effectiveness of the solution in writing the steps of the solution and achieving the desired result

Fifth : Generalization

It is the process of generalizing the solution to related problems and applying it to other situations that are similar or similar to them by recognizing the patterns in them. (, p 281 wing , 2011)

The second axis: - Sensory modeling:

The concept of sensory modeling: The method of preference for sensory modeling is one of the cognitive methods that have received the attention of many researchers. We collect information through our senses , and then realize this information in order to understand the world around us. (fleming, 1988) believes that the method of sensory modeling from the means of extracting information from the environment through human sensory mechanisms, represented by visual, auditory and motor sensations are details that an individual can use in the field of work and learning, which is a simple and short store well received by individuals and according to their sensory abilities and mental faculties . (fleming, 1988 , p 383)

- Theories on which sensory modeling is based:

Sensory modelling is based on two basic theories:

Detection Theory: The role of sensation is limited to providing the individual with information , while perception interprets this information, i.e. sensory stimuli, and formulates them into understandable images.

B - Neurological theory: It was previously assumed that the brain sees the visible body, so the brain begins to search the memory for a template identical to this body and when this template is found, the process of sensory perception is carried out.Murphy , 1995 , p. 284) .

Chapter: 3
Research Methodology and Procedures

Research Methodology : -

The researcher followed the descriptive approach; as it is the most appropriate approach to study this research, as this approach is interested in studying the variables of the research by describing the phenomenon accurately and expressing it qualitatively and quantitatively. Quantitative expression gives us a numerical description that shows the amount or size of this phenomenon and the degrees of its association with other phenomena. As for qualitative expression, it describes the phenomenon and explains its characteristics . (Obeidat et al., 289:2012)

The research community and its sample:

Research Community : The current research community includes all individuals who carry the data of the phenomenon that is being searched, (Daoud and Abdul Rahman,66:1990). The current research community has been identified as the champion of the scientific and humanitarian colleges at the University of Babylon, which numbered 22,280 students, for the academic year 2022-2023. It is distributed between 9,790students (44%) and 12,490 students (56%) .

The research sample: The sample means a group of individuals representing a part of the community where they are withdrawn from the original community according to an appropriate scientific method (Harris, 2003, 45) .

In determining the size of the sample, the researcher relied on the equation (Stephen), according to which the sample size was (378) male and female students, which constitutes (44%) of the research community, and (166) male students by (56%) and (212) female students by (56%).

Search Tools

First : Computational thinking: In order to measure the extent to which the students of the University of Babylon possess the skills of computer learning as a technology of e-learning, and to achieve the objectives of the research, the researcher prepared a test for computational thinking, as an appropriate tool to explore and measure the trends and views of students in different educational situations, as well as it is accurate in diagnosis when its items are specific and clear, and it is possible to obtain data that facilitates the identification of results, because it gains the theory of the applied side of the test. The test was designed according to four axes, the first was devoted to the characteristics and personal information by (6) items , the second to the skills of using onlyhardware and physical components of the computer by (8) items , the third was to the skills of using educational software by (10) items , and the fourth was to the skill of using networks and communications by (10) items , and thus its items (34) became a paragraph, and after the researcher was briefed on the literature that studied computer thinking, he got the items

related to the subject, which was based on the educational curriculum of computer colleges and information technology,
As well as the researcher relied on the preparation of the test in the light of the desk review, on only Debate as well as previous research to develop it as a research (Abbasi, 2013) and (Karawani, 2010) with the adaptation of items to suit the current research and subjectedT items except testing to validity and reliability .

Logical analysis of items

This process refers to identifying the test representation of the variable to be measured. In order to verify this, the test items were presented in their initial formulations to (18) arbitrators specialized in educational and psychological sciences to express an opinion on the validity and soundness of the drafting of the test items and its suitability for the component to which they belong. The results showed that the calculated value of the test ranged between (12,8- 20), which is higher than the tabular (K2) value of (3,84) at the level of significance (0.05) and the degree of freedom (1).

Experience clarity of instructions and items

To verify the clarity of the test instructions and items , and determine the appropriate time to answer , the researcher applied the computer thinking test to a random sample of 40 male and female students. It was found that the items of the test and its instructions were sacrificed to the sample members, and the time taken to answer the test was calculated and it appeared that it ranged between (12–16) minutes and with an average time of (13) minutes. A time of (five seconds) was specified to answer each question and it was noted that it is a suitable time as the time specified in the answer did not exceed only a very small number of students, noting that the researcher has relied in determining the time on what was indicated by some sources that the items of the test are based on and Table (1) shows this .

Table (1) Sample Experience Clarity of Instructions

College Name	Gender	No.	Total
Information Technology	Males	20	20
Education for Human Sciences	Females	20	20
Total			40

Statistical analysis of items

Statistical analysis is an important condition in research procedures.

Hence, the researcher applied the research tool to the statistical analysis sample of (378) students who were selected in the random class method with a proportional method, and then the test was corrected and the following characteristics were extracted:

Distinctive power

Distinctive power is the indicator of differences between respondents with high scores and those with low scores in the attribute to be measured. Distinguishing power depends on the method of the two peripheral groups, as the overall scores of individuals are divided into two categories (the upper group and the lower group), and then the differentiation coefficient is found between the scores of the two groups for each item separately. (Gregory, 2015,P: 130)

Therefore, the researcher followed the following steps in finding the distinguishing power:

1- The measurement tools were applied to the statistical sample of (378) male and female students, and then the researcher corrected the test.
2- Order the overall test scores in descending order.
3- Selecting (27%) of the forms with high scores to represent the higher group, and their number was (2.10)
4- Selecting (27%) of the low-grade forms to represent the minimum group (2.10)
5- Extracting the coefficient of excellence using the discrimination equation to test computational thinking:

After extracting the results of the discriminating power of the test items , which ranged between (0,215 – 0,709) and when compared to the Abel

standard, it appears that all test items are higher than (0,19), which means that all test items are statistically significant .

Difficulty and ease coefficient

The difficulty of the test vocabulary is one of the characteristics that have an important role in the reference tests of the group or standard and may affect the answers of individuals about their vocabulary. The vocabulary included in these tests should make a careful distinction between the levels of the trait to be measured. The vocabulary that all individuals answer or cannot answer is not useful in revealing the differences between individuals in what the test measures.

The test can distinguish as much as possible between the individuals examined, as if the average level of difficulty of the vocabulary it contains is about (0.50), that is, it can answer (50%) of them for each of its vocabulary. (Reynolds & Livingston, 2014,P: 232)

Accordingly, the difficulty of the test items was calculated according to the method of the two peripheral samples. As the scores of each respondent were collected on the test items to obtain the overall score for the test, and then they were ranked in descending order from the highest grade to the lowest grade and then selected (27%) of the answers that represent the higher grades by (2.10) students and(27%) of the answers that represent the lower grades by (2.10) students.

After that, the difficulty equation was applied to test computational thinking. It was found that the degree of difficulty of the test items ranged between (0,328 – 0,714). According to Bloom and Downey, the difficulty of the accepted items ranges between (0.20) and (0.80) .

Kline, 2005,P: 96 ; Reynolds & Livingston, 2014,P: 232) .

Thus, it appears that all test items are acceptable in terms of their difficulty, and therefore all items have been approved

(**Internal Consistency):**

The main objective of internal consistency, which is an important measure of research procedures, through which it is possible to know whether each of the test items is on the same path as the test and can be verified through the following: -

1- The method of linking the score of the item to the total score of thetest

This type of correlation method is done by finding the correlation relationship between the degree of respondents on each of the items of the S-measured and their overall score that they receive when they respond to all the items of the scale or test. Items with a high correlation coefficient are then retained and items with a low correlation coefficient are deleted. Gregory, 2015,P: 142-143)).

If we have two variables, one of which is double-degree (that is, the degrees of each individual are either true or zero) and the other is continuous (that is, the total degree), then we can use the binary chain correlation coefficient (Point Bissell) as in the correlation coefficient of the variable of computational thinking. In this way, the correlation between the degree of each test item can be extracted with the total degree of (378) form that was subjected to statistical analysis

The correlation coefficients of the computational reasoning test ranged between (0,162 – 0,527) and when compared to the table value of (0,098) at the level of significance (0.05) and the degree of freedom (376) shows that all items are statistically significant .

2- The method in which the degree of the item is related to the degree of the field to which it belongs.

The researcher used the point bicerial correlation coefficient for the computational thinking test to find the correlation between the degree of each item of the test and the degree of the field to which each item belongs. It was found that all the values of the correlation coefficients of the item with the total degree of the field to which it belongs are higher than the tabular value of the correlation coefficient of (0,098) at the level of (0.05) and the degree of freedom (376).

3- The method of field degree correlation with the total score of the test

Use the Pearson correlation coefficient to find the relationship between the score of each test area and the overall score of the test and show that all test items are statistically significant .

Psychometric Characteristics of Computational Thinking:

1- Validity : -

The researcher used several methods to extract the validity of the computer thinking test as follows:

1- **Face validity:** For the purpose of verifying the apparent validity of the computer thinking test, the items of the test were presented in its initial form to a number of arbitrators specialized in the Department of Educational and Psychological Sciences. In the light of the observations of the arbitrators, the researcher amended the wording of some items and did not delete any of its items after he made the necessary adjustments in the light of the notes.

2- **Construct validity :** The researcher verified this type of validity through two indicators:

A- **Distinctive power** : The distinctive power of the computational thinking test was calculated

(B) Internal consistency: The researcher verified the internal consistency of the computational thinking test through the coefficient of correlation of the score of each item with the overall score of the test in addition to calculating the correlation of the score of the item with the field and the field with the overall score of the test. Accordingly, all test items were approved at the level of significance (0.05)

2- **Reliability** : The extent to which the test measures the true amount of the attribute to be measured. The test scores are fixed if the test measures a particular attribute in a consistent manner in different circumstances that may lead to measurement errors. Reliability in this sense means consistency or accuracy in measurement . (Allam , 2000,p. 131)

The researcher verified the reliability of the scale using two methods:

1- Coefficient of Alpha Cronbach Method:

This method is calculated by dividing the scale into several parts and then calculating the average reliability coefficient of the fractions. The extracted reliability coefficient is called the homogeneity coefficient. The researcher adopted this method to find the reliability value of the test by subjecting the sample answers to the statistical analysis of (378) students. After using the Alpha Cronbach method, it was found that the reliability coefficient for testing computer thinking as a whole is (0,756). This

means that the reliability index in the Alpha Cronbach method for internal consistency is a good indicator.
According to Reynolds & Livingston (2014), a good reliability coefficient is not less than (0,70) . (Reynolds & Livingston, 2014,P: 156)

2-**Test-Retest Method** : This method is to reapply the test again to the members of the same group after two weeks and then calculate the correlation coefficient between the scores obtained by the sample members in the first and second time.
To achieve this, the computer thinking test was applied to a sample of (40) students from my faculty (information technology, education for the humanities) who were randomly selected from both faculties equally, and then the forms were corrected and grades were set. Using the Pearson correlation coefficient, the reliability coefficient reached (0.77), which together is the same as the reliability of the hand .

1- Descriptive Properties of Research Tools

The researcher calculated the descriptive characteristics,to test the computational thinking to know the proximity of the degrees of the sample of discrimination of the temperate type and table (2) shows that: -

Table (2) Descriptive Characteristics of Computational Thinking

	Descriptive Properties	**Score**
-1	Arithmetic Mean	23,276
-2	Mean	21
-4	Variance	64,636
-5	deviation,	8,039
-6	Range	41
-7	Twisting!	187
-8	Kurtosis	598
-9	The high point.	45
10	Lowest score	4

Second : Sensory Modeling: -

Preparation of scale items : For the purpose of preparing the items of the sensory modeling scale, the researcher was briefed on many of the measures previously prepared, previous studies and literature related to the current research. As a result , the researcher obtained (10) items from the general sources. The researcher also adopted a scale (Fras Sehil, 2011) to know the preference for sensory modeling, and it was adapted according to the research sample, as the scale consists of (20) items for each item containing three answers. The answer is determined by the test position, i.e., choosing one of the three answers, and each item of the test items has a degree. After that, the researcher collected the items , so I have (34) items for measurement .

Logical analysis of items

For the purpose of determining the validity of the items in the sensory modeling scale, the initial items were presented to (18) arbitrators specialized in educational and psychological sciences to verify the accuracy of the items and their suitability for what they were designed to measure. The researcher used a Ka2 square for one sample and the results showed that the calculated value of the test ranged between (14,6- 19), which is higher than the Ka2 table value of (3,84) at a level of significance (0.05) and a degree of freedom (1).

Experience clarity of instructions and items

In order to verify the clarity of the scale items and detect the ambiguous items to be reformulated, the difficulties facing the application process and the time taken to apply the scale, the researcher applied the sensory modeling scale to a random sample of the research community, amounting to (40) students. As a result, it was found that the instructions and items of the scale were clear and that the time taken to respond ranged between (12–16) minutes with an average time of (13) minutes andthetable (3) shows this .

Table (3) Experiment sample Clarity of instructions

College Name	Gender	No.	Total
Information Technology	Males	20	20

Education for Human Sciences	Females	20	20
Total			40

Statistical analysis of items

Statistical analysis is one of the important conditions in the research procedures. The following is an explanation of the procedures for statistical analysis of the sensory modeling scale:

1-**Distinctive power**: The researcher followed the following steps in finding the distinctive power: -

6- The measurement tool was applied to the statistical sample of (378) male and female students, and then the researcher corrected the measurement tools.
7- Order the total scores for a scale in descending order.
8- Selecting (27%) of the forms with high scores to represent the higher group, and their number was (2.10)
9- Selecting (27%) of the low-grade forms to represent the minimum group (2.10)

Extracting the coefficient of excellence using the (T-Test) test for two equal samples in relation to the sensory modeling of the scale as a whole, and all the items of the scale appeared to be statistically significant .

(Internal Consistency):

The researcher verified this using the following statistical methods: -

- The method of correlation of the score of the item with the total score of the scale: In order to find the relationship of the item with the total score of the sensory modeling scale, the researcher used the correlation coefficient (Pearson). It appeared that the values of the correlation coefficients ranged between (0,125 – 0,420) and when compared to the table value of (0,098) at the level of significance (0.05) and the degree of freedom (376), it was found that all items are statistically significant

Psychometric Characteristics of Sensory Modeling Scale

1. **Validity**

The validity of the sensory modeling scale was verified by: -

- **Face validity**

This was achieved when the items of the scale were presented in its initial form to a group of arbitrators specialized in the Department of Educational and Psychological Sciences, who approved the validity of the items of the scale .

Construct Validity

The researcher verified this type of validity through two indicators:

A- **Distinctive power**: The distinctive power of the sensory modeling scale was calculated

(b) **Internal consistency:** The researcher verified the internal consistency of the sensory modeling scale through the coefficient of correlation of the score of each item with the total score of the test, in addition to calculating the correlation of the score of the item with the field and the field with the total score of the test. Accordingly, all test items were approved at the level of significance (0.05)

2- **Reliability** :

The researcher extracted the reliability of the sensory modeling scale in two ways:

Coefficient of Alpha Cronbach Method:

The researcher relied on the statistical analysis sample scores of (378) students to calculate the internal consistency in the Cronbach method. It turned out that the value of the alpha coefficient is (0, 822). This means that the reliability index in the Cronbach method for the internal consistency of the scale is good.

The Test-Retest Method :

The researcher adopted the same procedure used in applying the computational thinking test to the same random sample and using the Pearson correlation coefficient

The reliability coefficient (0,804) of the sensory modeling scale.

Descriptive Properties of Research Tools

The researcher calculated the descriptive characteristics of the sensory modeling scale to know how close the scores of the temperate type discrimination sample were. As shown in the table below: -

Table (4) Descriptive Characteristics of Sensory Modeling

	Descriptive Properties	**Degree**
-1	Arithmetic Mean	44,313
-2	Mean	43
-3	Variance	35,740
-4	deviation, ,	5,978
-5	Skewness	284
	Kurtosis	839
-6	Range	23
-7	Higher score.	57
-8	Lowest score	34

Final application: -

After the researcher finished preparing the research tools and after verifying their sincerity and reliability , he applied the two tools to the research sample of (378) male and female students from the University of Babylon for the academic year 202 2 – 20 23 in the period between (30/12 - 28/2), that is, by two months

Statistical means

The researcher provided the following statistical means: -

1- K-square test for good conformity to know the statistical significance of the opinions of the arbitrators in the validity of theitems . (Allam , 2010 , p. 188)
2- Pearson correlation coefficient
3- Equation of discrimination to calculate the distinction of items .
4- Equation of the difficulty of the item (Al-Zubaie,et al.,1980,p. 74)
5- Pointe-Bicerial Equation for Calculating Internal Consistency
6- Test (t-test) for two independent samples
7- Test (t-test) for one sample to test the differences between the arithmetic mean and the hypothetical average of the scores of the individuals of the research sample on the research measures.(Al-Turaihi, Hammadi , 2013,117).

8- Analysis of monovariance for repeated measurements to identify sensory modeling . (Al-Kilani , Al-Sharifin , 2005 , pp.331-347)

Chapter IV

Presentation and interpretation of findings, conclusions, recommendations and proposals

In this chapter, we will present our findings in accordance with the objectives of the research and their interpretation according to the theoretical framework and previous studies, conclusions, recommendations and proposals.

First : Presenting the results: In order to achieve the current research, the research tools were applied to the specified sample (378) male and female students , and then the researcher collected the data obtained from the sample and entered it into the statistical bag (SPSS) and the results showed the following :

The first objective : to identify the computer thinking of the students of the University of Babylon.

For the purpose of identifying the computational thinking of the students of the University of Babylon, the arithmetic mean of the grades of the members of the basic research sample, which are(378) students and students for the computer thinking test, the results showed that the average of their grades on the scale amounted to (22,462) degrees and a standard deviation of (8,039) degrees , and when balancing this average with the hypothetical average of the scale of (17) degrees , and using the T-test for one sample, it was found that the difference is statistically significant and in favor of the arithmetic average, as the calculated T-value of (13,225) was higher than the table T-value of (1.96) as in the table below:

Table (5) The T-test of the difference between the sample average and the hypothetical average of the computational thinking test

Sample size	Arithmetic Mean	Standard deviation	Hypothetical mean (Maths.)	A calculated	Table value	Significance
378	22,462	8,039	17	13,225	1.96	significant

It appears from the table that the calculated value of T (13,225) is greater than the table value of T (1.96) , at a level of significance (0.05) and a degree of freedom (377). This means that the value is a statistical function, that is, the sample enjoys computer thinking, and this is due to scientific progress and rapid change that requires the individual to keep up with what is happening around him. In addition, there is almost no home without a computer that has greatly affected our lives, and this result is consistent with the results of the study (The Sarhan , 2020)

Second Objective/ Recognize sensory modeling among university students

For the purpose of identifying the sensory modeling among the students of the University of Babylon, the arithmetic mean of the scores of the members of the basic research sample, numbering(378) students of the sensory modeling scale, the results showed that the arithmetic mean amounted to (23,276) degrees and a standard deviation of (8,039) degrees , and when balancing this average with the hypothetical average of the scale of (17) degrees , and using the T-test for one sample, it was found that the difference is statistically significant and in favor of the arithmetic average, as the calculated T-value of (15,196) was higher than the table T-value of (1.96) as in the table below:

Table (6) The T-test of the difference between the sample average and the hypothetical average of the computational thinking test

Sample size	Arithmetic Mean	Standard deviation	Hypothetical mean (Maths.)	A calculated	Table value	Significance
378	23,276	8,039	17	15,196	1.96	significance

The table shows that the calculated T value of (15,196) is greater than the tabular T value of (1.96), at the level of significance (0.05) and the degree of freedom (377). This means that the value is a statistical function, that is, the sample enjoys sensory modeling. This result can be attributed to the fact that the use of sensory modeling led to a decrease in the percentage of errors and hesitation associated with performance that achieved the element of safety and increased self-confidence, determination and desire to learn .

Objective 3 /Sensory Modeling Computational Thinking

To achieve this objective , he sensed the arithmetic mean on the scale of sensory modeling, which appeared to be equal to (43,709) degrees and a variance of (11,956), while the arithmetic mean of computational thinking reached (22.4630) and a variance of (16,078) .

In order to identify the level of computational thinking according to the sensory modeling of students, the test (T) was used for two independent samples and it appeared that the calculated value of (T) reached (41.229), which is greater than the value of (T) table of (2,074) at the level of significance (0.05) and the degree of freedom (376) .The table below illustrates this .

Table (7) Calculated and tabular T-value of differences between the computational means achieved for both sensory modeling and computational thinking

Variables	SAMPLE	Average Achieved	Variance	Calculated t value	Table T-value
Sensory modeling	378	43,709	11,956	41.229	2,074
Computational thinking		22.4630	16,078		

The above table shows that there are statistically significant differences between sensory modelling and computational thinking. This means that computational thinking is significantly affected by sensory modelling by comparing the computational media between the two variables. It was found that the computational mean of sensory modelling is higher than the computational mean of computational thinking. When comparing the calculated value (T) with the tabular value, it was found that the calculated value (T) of (41,229) is higher than the tabular value (T) of (2,074) at the level of significance (0.05) and the degree of freedom (376). That is, sensory modelling has an impact on computational thinking. This is due to the fact that sensory modelling contributes to improving the learning of computational thinking when the students of the research sample, which had a positive impact on their learning .

The fourth objective /statistically significant differences of computational thinking according to sensory modeling

For the purpose of verifying this objective, a one-variance analysis of the responses of the research sample on the sensory modeling scale was used. The results showed statistically significant differences in the level of computational thinking according to sensory modeling and the table below shows this.

Table (8) Results of the analysis of single variance of differences in the level of computational thinking according to sensory modeling among university students

	Source of variance	Sum of squares	Degree of freedom	Mean squares	Calculated F Value	Level of Significance
Sensory modeling	Between Groups	429.10	2	214.55	4.788	.000
	Intracellular	8918.0	376	44.814		.000

The above table shows that the calculated value of (F), which is (4,788) is higher than the table value of (3.841), and the degrees of freedom (2,376) and the level of significance (0.05). This means that there are statistically significant differences due to the fact that there is an impact of computer thinking on sensory modeling, which enhances the students' abilities to solve problems in any discipline they practice .

Conclusions : In light of the findings of the research, the following can be concluded: -

1-A good level of computational thinking among the students of the research sample

2-A good level of sensory modeling among the students of the research sample

There is a correlation between computational thinking and sensory modeling.

Recommendations : In light of the results of the research, the researcher puts forward several recommendations, including : -

1-The Ministry of Higher Education and Scientific Research adopts the development of programs to develop computer thinking

2- The need to deal seriously with the issue of preference for sensory modeling in the delivery of information to students .

Proposals : To complement the results of the current research, the researcher proposes several proposals, including : -

1- Conducting a study on computational thinking and its relationship to a person's cognitive units

2- Conducting a similar study to the current study on other categories.

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