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Designing An Educational Program in mathematics Based on STEAM and its Impact on Multiple Intelligences of Fifth Grade Students

Abstract

This study aims to designing an educational program in mathematics based on STEAM, and determining its impact on multiple intelligences of fifth grade students (Linguistic, Logical- Mathematical, Spatial, Bodily- kinesthetic, Musical, Interpersonal, Intrapersonal, Natural).

The educational program designed by four steps (Analysis, Design, Implementation, Evaluation)

Multiple Intelligences scale prepared according to Gardner theory, contained of (40) item applied on both of group's sample (experimental and control) that shows the result:

An educational program based on STEAM has positive Affected on the intelligences of experimental group students that (Spatial, Bodily- kinesthetic, Interpersonal, Logical- Mathematical, Natural) without different in sex (males and females), that depends on program activities

Keywords

STEAM, Multiple intelligences

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The STEAM is an example of changing philosophies in education acknowledges that new approaches to pedagogy must include interdisciplinary study based on inquiry, design thinking, and real-world problem-solving. (Hardiman 2016)

In (2015) The European Parliament proposes the need for countries to review and develop their educational programs to match the 21 century skills and global developments in all fields by integrating different disciplines with real life into educational programs because the multidisciplinary approach supports targeted education and seeks to increase the human It will contribute to the development of societies and increase their competitiveness. (Bati et al, 2018)

The different among people in their attitudes and interests that mean they differ in their intelligences, that requires to development educational fields to invest and nurture mental abilities and prepare students for live outside the school to be a source of benefit to the community. (Gardner 1999)

We are required today to teach a generation that thinks and Innovates with necessary knowledge and skills to live, so we must not neglect the abilities of students during education in order for the educational system to achieve its objectives, so the students need high quality of mathematical programs leads to creating challenge to each of them and helps them to choose their future careers.(ministry of Iraqi education, 2013)

In the foregoing, the problem of research appears in attempt to answer the following question ' is the mathematics educational program that design- based on STEAM will impact on multiple intelligences of fifth grade students?.

What distinguishes the educational constructive content is that it is based on the learners' knowledge and they educational needs then presented on the principle of (multiple senses and multiple intelligences), it's based on realistic problems that require learners try to solve in different ways, the constructive encourage the use of various teaching methods such as projects, inquiry and active tasks if designed It gives the learner the opportunity to build his knowledge based on his previous knowledge, and these practices contribute to the work of the hands and minds of learners with complete consensus. (Zeitoun, 2008)

The multiple intelligences theory concerned with describing and identifying the interests of each person and working to refine them in the right direction to understand the world around them and to solve the problems and future challenges, as it fits many learning theories and linking them to other learning models is attractive because learners expand their base Cognitive linking their previous knowledge with the new through the means of learning that suits them most, There is an emphasis on understanding human intelligence as a multi-species to establish the idea of difference between human beings in their abilities and preparations, this gives a special need for the educational aspect to take into account the diversity of all educational activities in the school curriculum or restructuring it to be flexible and focus on various skills With real-life problems to develop strengths and develop weaknesses. (Armstrong, 2009)

The study aims to:

1. Designing an educational program in Mathematics based on STEAM for fifth grade students.
2. Determining the impact of the educational program on multiple intelligences of fifth grade students.

Theoretical Framework

Mathematics education based on STEAM:

Principles and standards of school mathematics call for interdependence with other areas and the real world because separation leads to education far from reality It is necessary to integrate mathematics with other fields and real multifaceted problems during their education to clarify their relationship and convergence with other fields and to ensure that they are realistically employed to learners by identifying mathematics Interconnection of mathematical topics with other areas and real life of learners and their problems and organization in a way that overlaps the elements of STEAM to suit the learners and the stage. (Kim et al ,2012)

Multiple intelligences:

In (1983) Howard Gardner introduced the theory of multiple intelligences in his book (Frames of Mind), suggesting that each person possessed at least seven basic intelligences and then added eighth (natural) intelligence and discussed the possibility of adding ninth (existential) intelligence in his theory, he sought to expand human potential beyond the limits of intelligence. He described intelligence as the ability to solve problems and deliver real products to society. Everyone has the same set of intelligence as others, but it varies by force

and performing any task requires an interaction between intelligences, (Linguistic, Logical-Mathematical, Spatial, Bodily- kinesthetic, Musical, Interpersonal, Intrapersonal, Natural). (Armstrong, 2009)

Multiple Intelligences Theory provides a variety of guiding frameworks in the educational aspect that serve the educational content, activities, tasks of the teacher and the learner and the evaluation process to be properly employed in the educational process to suit the specific differences of learners, their characteristics, interests and abilities. And guide them towards the appropriate path in the future, it shows us the importance of the educational environment and how to restore and enrich it with the necessary to activate a generation of thinkers and creative able to solve problems and provide real products to humanity, The educational situation provided by STEAM includes diverse educational fields integrated with each other and with reality problems and is presented through a variety of contexts within the activities of knowledge and applied strategies in flexible teaching methods and appropriate learning centered around students and appropriate to their characteristics and diverse abilities, These teaching practices are, according to the theory of multiple intelligences, educational entry points to target students' intelligences, which leads us to a clear theoretical relationship between multiple intelligence and STEAM, but we are in the process of knowing the procedural effect.

Method

The experimental method was followed appropriately the objectives and procedures of the study to reach the results, the sample consisted of (36) students distributed in two experimental groups (7) male and (10) females and control group (8) male and (11) female, Parity was made in (age , previous achievement, intelligence and previous mathematical knowledge).

The Educational program based on STEAM designed by four steps:

Analysis:

- Defining the educational content (mathematical concepts)
- identifying the theoretical and practical relations between the textbooks, identifying the real problems in the fifth grade textbooks (science, social, reading)
- identifying educational needs
- determining the general objectives of the educational program

Design:

- Determining Procedural Objectives
- Set up an educational content in accordance with the objectives of mathematics, educational needs, STEM principles and quality elements in the Global STEM Alliance (GSA 2016)
- determining the steps of project completion (selection , planning, implementation, evaluation)
- arranging and preparing a special class for mathematics that includes tools and devices for use during education
- Set up cooperative groups

Implementation:

The process of applying The Educational program on the experimental group students

Evaluation:

Determine the extent to which the objectives of the educational program have been achieved,

Feedback: Is the developmental Processing during all previous steps

Instrument: A multiple intelligences scale based on Gardner has been prepared consisting of (40) item distributed in (8) **fields (Linguistic, Logical- Mathematical, Spatial, Bodily-kinesthetic, Musical, Interpersonal, Intrapersonal, Natural)** for each field (5) item, there is three choices for each item (Agree=3, Slightly Agree =2, Disagree =1) It was presented to experts in psychology Then applied to an external sample (100) students before it was applied to the main sample to analysis the items:

Validity:

- The correlation (r) of each item with instrument (min 0.473 –max 0.688)
- The correlation (r) of each item with its field (min 0.549 –max 0.748)
- The correlation (r) of each field with instrument

field	r value	field	r value
Linguistic	0.939	**Musical**	0.916
Logical	0.919	**Interpersonal**	0.936
Spatial	0.928	**Intrapersonal**	0.927
Bodily	0.921	**Natural**	0.889

*Cal- value > - value (0.196), df (98) , sig. level (0.05)

Reliability: used (Alpha) formula

All items (instrument)	0.953
Linguistic	0.892
Logical	0.870
Spatial	0.790
Bodily	0.821
Musical	0.800
Interpersonal	0.835
Intrapersonal	0.792
Natural	0.815

Statistics: (SPSS20) was used to process the data by:

- (one way anova): to Parity (Males and females) of sample in variables (age , previous achievement, intelligence and previous mathematical knowledge)
- (Pearson correlation): to find relationship of items and fields
- (Alpha Cronbach): to find Reliability of instrument (scale)
- (Mann-Whitney): To test the significance of the difference between the scores of the experimental and control groups in the total scale and each of its fields and the significance of the difference between the male and female experimental group in the areas that were positively affected

Results

- There is a positive impact of the educational program on the student's intelligences of the experimental group (Spatial, Bodily, Interpersonal, Logical, and Natural), but The intelligences (Linguistic, musical and Intrapersonal) were little influenced and were not significant.

Result table of two groups in multiple intelligences scale

Field	Group	NO.	Mean of Ranks	Sum of Ranks	U value		Sig. level (0.05)
					Cal.	**Table**	
All	Exp.	17	25.85	439.5	**36.5**	99	**Sig.**
	Cont.	19	11.92	226.5			
Linguistic	Exp.	17	19.67	336	140	99	Non Sig.
	Cont.	19	17.37	330			
Logical	Exp.	17	24.21	411.5	64	99	**Sig.**
	Cont.	19	13.39	254.5			
Spatial	Exp.	17	26.21	445.5	30.5	99	**Sig.**
	Cont.	19	11.61	220.5			
Bodily	Exp.	17	25.56	434.5	41.5	99	**Sig.**
	Cont.	19	12.18	231.5			
Musical	Exp.	17	17.18	292	139	99	Non Sig.
	Cont.	19	19.68	374			
Interpersonal	Exp.	17	24.71	420	56	99	**Sig.**
	Cont.	19	12.95	246			
Intrapersonal	Exp.	17	21.38	363.5	112	99	Non Sig.
	Cont.	19	15.92	302.5			
natural	Exp.	17	23.56	400.5	75.5	99	**Sig.**
	Cont.	19	13.97	265.5			

- There is not different of the Educational program impact between experimental (Males and Females) group in affected intelligences.

The Different between Males and Females of experimental group in significant intelligences

Field	**Sex**	NO.	Mean of Ranks	Sum of Ranks	U value		Sig. level (0.05)
					Cal.	**Table**	
Spatial	M	7	10.7	70.5	27.5	14	Non Sig.
	F	10	8.25	82.5			
Bodily	M	7	11.7	82	16	14	Non Sig.
	F	10	7.1	71			
Interpersonal	M	7	10.36	72.5	25	14	Non Sig.
	F	10	8.05	80.5			
Logical	M	7	10.5	73.5	24.5	14	Non Sig.
	F	10	7.9	79.5			
natural	M	7	9.71	68	30	14	Non Sig.
	F	10	8.5	58			

Preference

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