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The Effect of an Al Andalus Fused Curriculum Model on the Learning Outcomes of Elementary School Students

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***Abstract*—**The study was carried out in the Elementary Classes of Andalus Private Schools, girls section using control and experimental groups formed by Random Assignment Strategy. The study aimed at investigating the effect of Al-Andalus Fused Curriculum (AFC) model of learning and the effect of separate subjects' approach on the development of students' conceptual learning and skills acquiring. The society of the study composed of Al-Andalus Private Schools, elementary school students, Girls Section (N=240), while the sample of the study composed of two randomly assigned groups (N=28) with one experimental group and one control group. The study followed the quantitative and qualitative approaches in collecting and analyzing data to investigate the study hypotheses. Results of the study revealed that there were significant statistical differences between students' conceptual learning and skills acquiring for the favor of the experimental group. The study recommended applying this model on different educational variables and on other age groups to generate more data leading to more educational results for the favor of students' learning outcomes.

***Keywords*—**AFC, Lego Education, mechatronics, STEAM, Al-Andalus Fused Curriculum.

I. Introduction

AS educators, we are permanently looking for new ways help students make sense of the multiplicity of life experiences and the bits or the separate pieces of knowledge they gain from a traditionally departmentalized curriculum (i.e. the separate subjects approach). In the separate subjects approach, students continue to move from one discipline to another with disconnected information that is not connected to real life situations (i.e. not authentic). To connect this fragmentation, learners and educators experience, holistic, integrated and fused curricula that are proposed and adopted by many schools. A major driving force behind integrated curricula is the belief that when concepts, understandings, and projects are combined students begin to see meaningful connections between the learning disciplines. Materials then serve as a vehicle for learning but not separate pieces of information. In addition to this, repetition of material from one discipline to another is eliminated [1]. Now the question is "is it fused or integrated?" The answer is that we fuse the intended curricula to achieve the authentic integration as the theme target from the AFC is to get the students to comprehensively grow in all aspects of their personality to adapt for real life "learning for life".

To estimate the Return of Product Development Expense (RoPDE) for AFC, we considered:

- The expected growth margin (GM) (i.e. the fiscal save) for one year from the fusion of the computer skills with the Mechatronics' STEAM.
- RoPDE = (GM - PDE) / PDE = 332.2, which is really big [2].

AFC is a model of learning suggested by Al-Andalus Private Schools, Educational Development Administration, Studies and Research Department, Saudi Arabia [3]. **A** is the abbreviation for Al-Andalus**, F** is the abbreviation for Fused, and **C** is the abbreviation for Curriculum. **AFC** targets the fusion of the STEAM curriculum (Science, Technology, Engineering, Art, and Mathematics) with Computer Science curriculum to meet the needs of learners to acquire the 21st century skills.

II. The Purpose of the Study

This study is undertaken to test the following null (H0) and alternative hypotheses;

H0: The average growth of students who experience the AFC will be the same as the average growth of students that experience the separate subjects' approach.

HA: The average growth of conceptual learning and skills for students who experience the AFC model is different from the average growth of students that experience the separate subjects' approach.

III. How AFC Works/Methodology

To explain how the AFC model of learning works, the model was divided into steps, as show below:

Step 1. Flipped learning: this part is achieved using a learning management system (LMS) to send students a discussion board that includes a 1.5 minute/grade video (i.e., for grade 4 the video segment should not exceed 1.5 × 4 = 6 minutes) followed by a few questions on the video content at the remember and understand levels [3]. According to Lego Education, this phase is called the connect phase.

Step 2. When students are back to class they work an activity where:

- Students are divided into groups of four,
- Each group is subdivided into two pairs A and B,
- Project booklets are distributed to the groups,
- Groups work on project hands-on,

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- Time is assigned by the instructor for the project construction.

NB: A PDF hands-on file is uploaded to the learning management system (i.e., Classera LMS) to demonstrate the steps of the activities.

Step 3. This phase is called the **Construct** phase: A transition to the third phase where students draw a table on a word document to fill out during the activity, as shown in Table I.

TABLE I
THE CONTEMPLATE CHART

I tried this	My prediction	What happened?
1a		
2a		
3a		

The students reflect on the experiment using

- The same,
- Slower,
- Faster,
- Worse, or
- Better.

Challenges and reflections are included in this investigation-based module, where the teacher sends a chart to the student groups to fill in with the direct observations, data analysis and deductions the learners obtain from the trials and empirical experiments.

- First, the pairs of students separately note down their predictions.
- Second, the pairs perform the experiments and get the results.
- Third, each pair compares the predictions with the outcomes (what happened).
- Fourth, each pair compares the responses with the others in the same group.
- Eventually, time is assigned to the students to make their specific modifications and deductions.
- Sharing is applied between the groups by randomly selecting a group and a group member to present their group's response.

This step is considered as the Contemplate phase.

Step 4. A transition to the fourth phase where the instructor challenges the learners' creativity through a new task that is based on the task that has been already done and keeps the learners' in a "state of flow". The flow state is an optimal state of intrinsic motivation where the learner is immersed as much as possible in what he or she is doing. The learners are now trying to overcome the challenge by implementing skills like problem solving (i.e., creative and critical thinking).

In order to overcome the challenge, the learner is directed to draw an imaginary design that requires either art skills alone (i.e., lines, circles, etc.,) or computerized art skills (i.e., how to use programs like paint brush).

In this phase, the learners are involved in a Team Project, described as the following:

1. Assigning the Project goal: Teams must transform a box that has pieces of colorful interlocking plastic bricks accompanying an array of gears, figurines called minifigures, and various other parts. Lego pieces can be assembled and connected in many ways to construct objects into something creative.
2. The students are assigned the following cooperative learning roles:

- Recorder: who draws the team's vision for what their project will be, and names the things the team needs for the project accomplishment.
- Materials Monitor: who is responsible for collecting, distributing, and putting away all materials that the team needs for the project. He/she has to be sure that the team cleans up when they complete their project.
- Designer: who suggests how each part of the project done by each individual member will match the other parts in the team, "Not a Box" project.
- Attacher: who suggests how to attach the project parts together once the designer suggests how it will look like. The attacher determines if he/she needs to use glue, a glue stick, tape, staples, etc. to join all pieces of the project [4].

3. Students work in teams to create their "Not a Box" projects. This step is the continue phase.

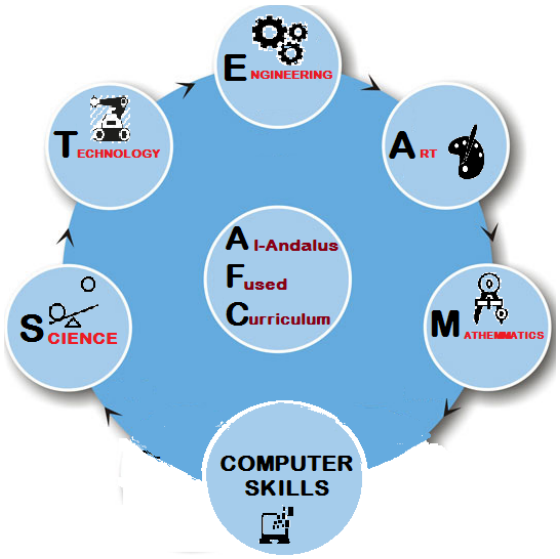

Fig. 1 AFC Model Diagram

IV. STUDY DESIGN

A pretest-posttest two-randomised samples experimental and control groups design was used in this study [5].

In notational form, the design is described as:

R O1 X O2

R O1 O2

where R = the groups were randomly assigned, O = the two measures (i.e., STEAM rubric and the concept based standardized test), and X = fused curriculum.

The control group did not implement the fused curriculum, whereas the experimental group implemented the fused

curriculum. All participants of the two samples were measured using pretest and using the three months posttest.

The study used a mixed approach (i.e. quantitative and qualitative).

V. Data Analysis and Interpretation

We marked the tests, the rubrics to evaluate the effectiveness index (growth) of each of the two approaches: the AFC Model approach and separate subjects' approach. The results of the pre-assessment and the post-assessment were analyzed in percentages. The data were analyzed for testing the hypotheses and deducing the conclusion and recommendations.

The study used the two-sample t-test, p-value and correlation coefficient to test the hypotheses and deduce the conclusion and recommendations.

Table II shows that the p-value (the significance) is less than 0.05. This means that there is significant difference in the skills (i.e., determining the problem, Analysis, Problem solving, Creative thinking, connecting, building and transforming, and computer skills) growth between the students who experienced instruction based on the AFC Model, and students who experienced separate subjects' instruction.

TABLE II
AFC Effect on "Targeted Skills"

calculations	Groups	
	Experimental	Control
N	4	4
Growth Mean	1.271	0.3855
Std. Deviation	0.594	0.116
*t	2.926205649	
Sig. (1- tailed p-value)	0.007905159	
Sig. (2- tailed p-value)	0.015810317	
Conclusion	Sig.	

* **t** is the value of the t- statistic at (5.380813123) degree of freedom.

We would reject the null hypothesis in favor of the alternative hypothesis.

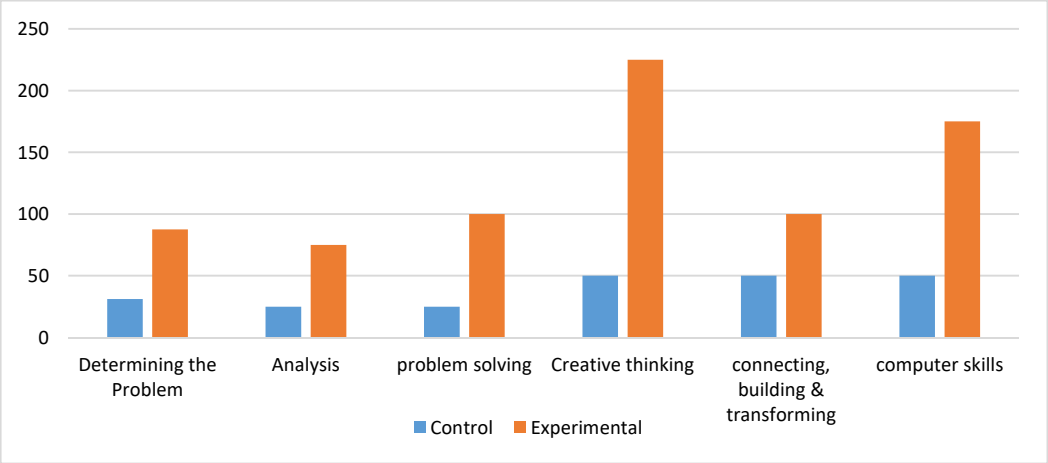

Fig. 2 Comparing the Effect of AFC and the Separate Subjects' Approach on Skills' Acquisition

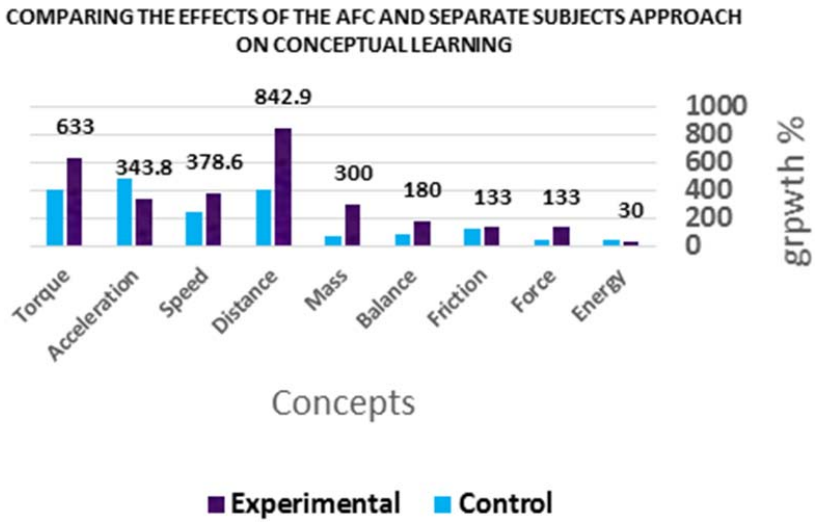

Fig. 3 Comparing the Effect of AFC and the Separate Subjects' Approach on conceptual learning

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TABLE III
AFC EFFECT ON "CONCEPTUAL LEARNING"

calculations	Groups	
	Experimental	Control
N	14	14
Growth Mean	3.026	1.9
Std. Deviation	0.25	0.3
*t	2.304251787	
Sig. (1- tailed p-value)	0.015290506	
Sig. (2- tailed p-value)	0.030581011	
Conclusion	Sig.	

* t is the value of the t- statistic at (23.73863647) degree of freedom.

Table III shows that the p-value (the significance) is less than 0.05. This means that there is significant difference in the Concepts acquisition growth between the students who experienced instruction based on the AFC Model and students who experienced separate subjects' instruction.

We would reject the null hypothesis in favor of the alternative hypothesis.

VI. CONCLUSION

Based on the findings of this study, the conclusion can be made that:

- There is a strong correlation between the two learning outcomes (LO) skills perfection and concepts' acquisition; hence, the correlation quotient is 0.9, which is considered as a strong positive correlation. That meets the research of Bichukale and Bhor [6].
- There are significant positive effects of both the AFC Model and the separate subjects' approach on the learning outcomes (i.e., concepts and skills).
- There is a significant statistical difference in the conceptual learning and skills acquiring growth between students who experienced the separate subjects' approach and those who experienced the AFC model of learning for the favor of the AFC.

VII. RECOMMENDATIONS

Based on the above-mentioned conclusions, we recommend the following:

A: Applying models or approaches of learning that have large RoPDE and models and approaches which enable students' conceptual learning and the skills' acquisition in their context, such as AFC model.

B: Doing a longitudinal study to assure the effectiveness of this model on learning and other related variables.

VIII. ADDENDUM

A: ***Curriculum:*** the term curriculum, in general usage, means a program of study (i.e. the knowledge and skills students are expected to learn), which includes a set of courses and their content and related activities of study. In a shared understanding of the term, we are likely to agree that it encompasses:

- A set of activities that someone in authority deems required to lead to some assumed or stated objectives;
- The content or the syllabus, on which activities deemed to foster learning are focused;
- Projected outcomes or hoped for results, either implicit or explicit; and
- A context which influences, shapes and constrains the curriculum and its implementation [7].

B: ***STEAM***: is an educational approach to learning that focuses on Science, Technology, Engineering, Arts + design, and Mathematics. The STEAM approach is a STEM infused with the Arts and Design principals. The STEAM Project brings these components together as students deal with real-world challenges to serve their community. This promotes student inquiry, dialogue, and thinking. The STEAM approach aims at developing long life learners, who take thoughtful risks, engage in experiential learning, persist in problem-solving, embrace collaboration, and work through the creative process. These are the inventors, instructors, and leadersof the future [8].

C: ***Concepts:*** are mental categories of facts, skills, and ideas that have common characteristics across situations and contexts [9].

D: ***Conceptual learning***: is a pedagogical approach that focuses on big-picture ideas and learning how to arrange and relate information [9].

Fig. 4 Conceptual learning Diagram, adopted from [9]

E. ***Skill*:** is the ability to carry out a task with pre-determined results often within a given amount of time, energy, or both [10].

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