A GROUP OF STUDENTS' RESPONSE AND PERFORMANCE IN LEARNING LINEAR FUNCTIONS AND GRAPHS

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Abstract
The main purpose of the present paper is to provide a partial evaluation of an ongoing project at the Middle East Technical University, Ankara involving the use of graphics calculators in in-service education and training (INSET), and the implementation of the technology in schools. In this paper, we will concentrate on the students' performance in solving a set of problems related to linear function and graphs with the support of graphics calculators.

1. Introduction

Graphics and computer algebra system (G/CAS) calculators have the potential to facilitate improvement in the teaching and learning of mathematics. The effects of calculators on students' performance are to be questioned, and effective ways of implementation should be investigated in both affective and cognitive domains. To improve the current situation of both teaching and learning of mathematics, we have worked to gradually incorporate G/CAS calculators into an undergraduate course, *ScE 445 Mathematics Teaching II* at Middle East Technical University (METU), Ankara, and some private schools in Turkey. The main purpose of the present paper is to provide a partial evaluation of an ongoing project at METU involving the use of G/CAS calculators in the implementation of the technology in various schools. In the case of our project, we have experienced the fact that we see not only chance for teaching of mathematics, but also a new chance of the practical instructional effectiveness of methods and the new cognitive tools.

As emphasised in well-reputed reports (e.g. Cockcroft, 1982; NCTM, 1989) the necessity of using calculators in teaching is out of question.

However, there are various issues and constraints for the integration of calculators into the current curriculum at each grade level and/or teaching of mathematics topics. Therefore, appropriate approaches and strategies for the introduction and implementation of calculators have been continually investigated by researchers all over the world (e.g. Jaworski, 1993; Gomes & Waits, 1996 etc). It is one of the experienced fact that there are various differences in them due to social and cultural factors and lack of experience of teachers, curriculum designers etc when we compare the developed and developing countries (Ersoy, 1999). In this paper, we will report responses and performance of a group of 9^{th} grade students.

2. Method and Instruments

Main Goal: The present study was designed to investigate students' responses on using CAS calculators and learning mathematics, in particular the concept of function in multiple representations, and their performance in understanding the language of function and graphs properly.

Subjects of the Study: The subject for the study was a group 9^{th} grade students from UAA who were trained for one semester in the mathematics course during the fall semester of 1999-00 school year. In the researcher's class there are 26 students, 13 boys and 13 girls.

Instruments: Two instruments were used in the implementation of G/CAS calculators in UAA, and the general evaluation of the course, i.e. teaching, students' perceptions and performance etc. The instruments are called Perception Scale of Calculators and Mathematics and Performance Tests on Linear Graphs. They were developed by the researchers, and administrated under the same conditions at the end of the first semester.

3. Analysis of Data and Results

Data collected by means of Likert-type scale can be handled in various ways. In the present paper, the each item of the questionnaire was scored

using a relative-weighted scale +(-) 2, +(-)1 if the response was SA(D), A(D) respectively and 0 if the response was U. Reliability coefficient 26 items was Standardised item alpha = 0.75, and Guttman split-half = 0.79.

3.1. Responses to Statements and Interpretations

To be able to see their intentions in a way that we can more easily interpret, SA multiplied by two and added to A and resulting number is divided by the sum then a relative score A*, i.e. a value indicating positive attitude, is obtained. Similar procedure is followed for SD and D answers with a slight difference only the obtained number is multiplied by –1 to get D* values. After we recomputed the analysed data associated with the students' responses on assignment and examination, we can display the results as shown in Fig 1.

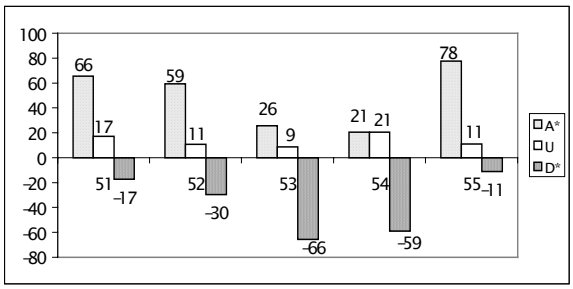

Fig 1. Students' Response on Assignment and Examination

51: It was a good idea to be able to use the calculators in the test.

52: I think that we should be allowed to use graphics calculators in the final examination.

53: Some assignment questions should require the use of graphics calcula-tors.

54: A graphics calculator is a cheating device and it should not be allowed to use in the examination.

55: Graphics calculators assist in many ways especially to provide quick and easy checks on your working.

3.2. Students' Performance in Linear Function Tests

Table 1a. Statistics

Statistics/ **Questions**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**
Mean	3,42	3,42	3,15	2,12	2,88	2,54	1,69	,92
Median	4,00	4,00	4,00	2,00	4,00	2,50	1,00	1,00

Mode	4,00	4,00	4,00	1,00	4,00	4,00	1,00	1,00
Std. Error of Mean	*,17*	*,17*	*,23*	*,27*	*,26*	*,28*	*,28*	*,17*
Std. Deviation	*,86*	*,86*	*1,19*	*1,40*	*1,34*	*1,42*	*1,44*	*,89*

Table 1b.

Level/ Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
L0: Incorrect answer and limited understanding	-	-	-	8	4	4	19	31
L1: Incorrect answer and little understanding	-	-	15	35	15	31	39	54
L2: Some understanding and incomplete work.	23	23	15	27	23	15	19	11
L3: Correct answer but explanation is vague.	12	12	8	-	4	8	-	-
L4: Correct answer, complete understanding and explanation	55	65	62	30	54	42	23	4

4. Concluding Remarks

Like all human being the students were afraid of changes, especially since there are only a few schools using the hand held technology in math classes and the reality of university entrance exam. They discovered that just memorising the certain algorithms and carrying out computations was not enough to get good grades any more. At the beginning of the school year, class discussions were not more than participation of one or two students, but when the end of the year came almost each student was expressing his/her ideas and opinions. Such an innovation takes a lot of efforts and time to succeed in implementing the graphics calculators in teaching mathematics. We will continue to search for the obstacles in students' understanding topics, identify the issues on teaching and learning, and find out more effective ways of using technology in math classes.

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*This study is the part of project AFP-2000.05.01.01 developed under the grant from the METU Research Fund.