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Personalized education using computational thinking and b-learning environment: classroom intervention

Arturo Rojas-López
Division Information and Communication Technologies, Technological University of Puebla
72300 Puebla, México
arturo.rojas@utpuebla.edu.mx

Francisco J. García-Peñalvo
GRIAL Research Group, Research Institute for Educational Sciences, University of Salamanca
37008 Salamanca, Spain
fgarcia@usal.es

ABSTRACT

The percentages of dropout, accreditation and average grade of students that study university courses of Methodology of programming and Programming of first and second semester of career of Information and Communication Technologies in the Technological University of Puebla are not favorable and represent a problem to be solved by academic team, for the above, the main objective of present study is to show results of interventions carried out in front of a group of educational strategies that allowed to have better percentages in comparison with those obtained in the last 8 years. The first intervention involved evaluation of computational thinking through abilities of Generalization, Decomposition, Abstraction, Evaluation and Algorithmic Design, then students were offered 10 learning scenarios for Methodology of programming course. In the second intervention, 4 elements were manipulated to offer options in course of Programming, which were contents, modes of work, rhythms and time, and evaluation. In both interventions, use of Moodle platform allowed to expose learning contents and to have an appropriate context chosen by students. The main result was to generate personalized education as well as a learning experience that contributed to motivation of student in harmony with academic goals of initial programming courses.

CCS CONCEPTS

• **Social and professional topics** → **Computing education** → **Computational thinking**

KEYWORDS

Computational thinking, Computer programming course, Educational programming, Engineering course, Engineering education, Higher education, Learning programming, Programming, Programming teaching, Students, Teaching.

1 INTRODUCTION

From concept of personalized education as an educational conception unrelated to a way of understanding education framed in some specific philosophical, psychological or pedagogical current, but open to all reasonable currents of thought [1]; interventions made sought to attend to what students have in common, and what they have of their own within academic context of courses mentioned, through platform Moodle and offer of options was intended to stimulate each student to be improved freely and responsibly ability to direct their own knowledge, change from a traditional education to a personalized one [2, 3] as reported by Tekin et al [4] or Laksitowening and Hasibuan [5].

Computational thinking [6-8] represents an adequate proposal to promote at an early age the learning of skills that benefit students entering areas of Science, Technology, Engineering and Mathematics [9-12], organization of open competitions for children up to 14 years indicates a global trust on part of Educational Institutions [13, 14] and its evaluation is a research topic that has allowed the creation of evidence [15], linkage with learning programming and Bloom's taxonomy [16], and has effectively served to determine learning scenarios [17].

The median dropout rate at the end of first quarter September - December in career Information and Communication Technologies (ICT) at Technological University of Puebla (UTP) from 2009 to 2016 is 31.13. The median percentage of student credit in Methodology of Programming course in previous period is 70.77. The median grade in same course and period of students who credit is 6.68. The median dropout rate at the end of the second quarter January - April 2010 to 2017 is 30.43. The median percentage of student credit for course Program in previous period is 71.89. The median grade in same course and period of students who credit is 7.03. Therefore, educational strategies were proposed during quarter periods of September-December 2016

and January-April 2017 for Methodology of programming and Programming courses respectively, with the aim of improving indicators of students accredited in mentioned courses, average grade of group and reduce the dropout rates. The interventions described in this article are based on evaluation of computational thinking (CP) to new students, particularly skills of Generalization, Decomposition, Abstraction, Algorithmic Design and Evaluation; to offer learning scenarios based on results of evaluation of PC, use of Moodle platform as a tool for a b-learning environment and four elements (Contents, Working modes, Rhythms and Timing, and Evaluation) that allowed to offer a personalized education.

The content of article is integrated as follows. In Context section we describe characteristics of experimental groups where strategies and control groups were used to compare results obtained from courses Methodology of programming and Programming in the last 8 years. Description section explains the intervention process and educational strategies that were proposed. In Results section, data obtained at the end of quarter periods and their comparison with data of previous years, as well as qualitative results of surveys is commented on. Finally, Conclusions section discusses impact of work done and future work of proposal.

2 CONTEXT

Control groups are characterized by being classroom classes in classroom or laboratory, do not use Moodle platform and perform evaluations in two times indicated by academy. The Methodology of programming course is given to new students during first quarter corresponding to period September - December, for present work data were obtained from 2009 to 2016 giving a total of 3659 students. The Programming course is given to students of second quarter corresponding to period January - April, for present work data were obtained from 2010 to 2017 giving a total of 2633 students.

The experimental groups corresponded to courses where they assigned me as a teacher. For Methodology of programming course, the proposal was applied in 1° C and 1° D with 33 students in each group. For Programming course the proposal was only applied at 2° C with 25 students. For both interventions, material was developed and it was used in Moodle platform. Description of content is as follows: Name and objective of course, thematic units, with their respective objective and organized by readings, audios, videos, activities and evaluation.

3 DESCRIPTION

An important element that is considered in personalized education is offer options to students. The first intervention was developed with following characteristics. Evaluation of computational thinking through abilities of Decomposition, Generalization, Abstraction, Algorithmic Design and Evaluation; which fit well with subjects of course. Evaluation allowed offer 10 learning scenarios using three types of study: classroom, semi-classroom and online. In classroom mode, classes were carried out in a traditional way, practical and theoretical activities as indicated by course sheet in timetable assigned by career director. In semi-classroom mode, use of Moodle platform was used to adapt knowledge to be learned by student according to correct answers to evaluation of computational thinking, and counseling days were organized. In online mode student could request advice to clarify doubts or to deliver evidence of evaluation. The exercises that were used to evaluate the PC and description of scenarios can be found in [18]. The second intervention was developed with following characteristics. Student had opportunity to choose contents of course, readings, audios or videos; he had opportunity to choose type of learning (classroom, semi-classroom or online), rhythms and times of learning and evaluation, student engaged and determined moments in which he delivered evaluation products and time that dedicated to study of contents; finally, he had opportunity to choose evaluation evidences that he delivered taking as a guide a checklist for each product.

4 RESULTS

For period September-December 2016, dropout rate was 24.24 for 1° C and 27.27 for 1° D, which is lower at 6.89 and 3.86 percent than median of last 8 Years (31.13); percentage of accreditation for Methodology of programming course was 81.82 for 1° C and 72.73 for 1° D, which is greater at 11,14 and 2.05 percentage than median of last 8 years (70.67); average grade of same course in students of 1° C was 7.12 and of 1° D was 6.81, greater by 0.43 and 0.13 percent over median of last 8 years (6.68). Table 1 concentrates information discussed above.

Table 1. Information in the last 8 years first quarter period

Year	Percentages	Average

	First quarter		Grade
	Desertion	Accreditation	
2009	24.32	77.31	6.78
2010	27.81	74.20	6.67
2011	31.13	70.50	6.64
2012	31.14	71.50	6.69
2013	35.20	65.23	6.18
2014	42.24	58.81	6.31
2015	30.30	70.85	6.81
2016	34.00	68.5	6.75
Median	31.13	70.67	6.68
1°C 2016	24.24	81.82	7.12
1°D 2016	27.27	72.73	6.81

For period January-April 2017, dropout rate was 8.0 for 2° C, which is 22.76% lower than median for last 8 years (30.76); accreditation percentage of Programming course was 92.0, which is 20.11 higher than median of last 8 years (71.89); average grade of same course in students of 2° C was 7.09 higher by 0.06 percent over median of last 8 years (7.03). Table 2 summarizes above information.

Voluntary surveys were carried out in both courses to know acceptance of learning strategies carried out in respective interventions, results are presented below. For Methodology of programming course, it was asked whether work modality (classroom, semi-classroom or online) seemed to right student with his expectation of learning, of 66 students 24 answered question and 75% indicated that he agreed; it was also asked if evaluation of computational thinking, through skills of Decomposition, Generalization, Abstraction, Algorithmic Design and Evaluation, at beginning of quarter was a successful activity to determine best learning environment, 73.3% of the 24 students answered Yes. For Programming course, it was asked if content of course contributed to professional training, of 25 students only 22 answered voluntary survey and 100% agreed with content of course.

Table 2. Information in the last 8 years second quarter

Year	Percentages First quarter		Average Grade
	Desertion	Accreditation	
2010	16.48	85.20	7.0
2011	33.69	70.45	6,.29
2012	29.99	73.07	6.92
2013	28.22	73.87	7.07
2014	31.38	71.62	7.24
2015	30.89	71.09	6.94
2016	30.63	72.17	7.05
2017	32.25	69.57	7.09
Median	30.76	71.89	7.03
2°C 2017	8.0	92.0	7.09

5 CONCLUSIONS

The interventions carried out implementing strategies described in article: proposal of a learning scenario based on evaluation of computational thinking, offer options of evaluative evidences, learning pace and delivery time of products determined by students, options in formats of contents and different learning modalities (classroom, semi-classroom and online) to offer a personalized education, allowed to obtain a dropout rate lower than those registered in last 8 years at end of first and second quarter, as well as accreditation percentage major in courses of Methodology of programming and Programming in same period. In spite of having obtained favorable numbers and that students indicated acceptance of proposals made, interventions must still be worked to improve results and to have more participants at moment of answering surveys; future work includes a timely follow-up of

students' online activities, which allows to improve the average grade, since as indicated results was low as median of last 8 years and does not represent a favorable element for ICT career in UTP.

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