Analyzing the Motivation of the Students in the Art Faculty for Learning Programming

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Abstract

In order to analyze the factors that raise the motivation of students in the art design faculty and digital design faculty to learn programming, a programming course using Processing programming environment was offered to the students at two universities. The teaching materials used were designed in accordance with the ARCS motivation model, and the SIEM assessment standard was used to evaluate students' motivation levels.

It has been found that in order to maintain or raise students' motivation it is more important to allow students to enjoy seeing the final results (artwork) of the programming than to make them strive to create more beautiful artwork.

1. Introduction

Programming has become important for the students in the area of art and digital design. However, it is not easy to motivate those students to learn programming because programming is not a primary interest of those students.

The main purpose of this study is to analyze the factors that maintain or raise the motivation of the students in the area of art and digital design to learn programming when the result of programming is artwork.

In this study, we used Processing [1] as our programming environment. The teaching materials were designed in accordance with the ARCS motivation model [2] as much as possible so that the students would be adequately motivated. The programming courses with Processing were offered in two universities (university A in Japan and university B in Taiwan). The motivation levels of the students were evaluated using the SIEM assessment standard introduced by S. Dohi, O. Miyakawa, and N. Konno [3].

2. The programming courses

In university A, six among the 14 classes of the "Introduction to Information Technology" course were used to teach programming. The class met once a week, and the duration of each class was 90 minutes. Therefore, nine hours in total was used for teaching programming. There were 84 second-year students in the class and all of them were from the art design faculty (character design). In university B, programming was taught in the "Computational Figures and Animation Processing" course. This was an intensive lecture and it took four days: three hours on the first day, three hours on the second day, six hours on the third day, and six hours on the fourth day. Therefore, 18 hours in total was used for the course. The duration of one class was 50 minutes. There were 53 students in the class, and they were all from the digital design department. There were all year levels of students, from first-year to graduate school, mixed in the class.

The title of common syllabus for the two courses is shown in Table 1. As shown in the table, the course contained 14 topics (not in the same duration).

Table 1 Syllabus of the programming courses

Order	Title	Order	Title	Order	Title
1	Computers and	6	Creation of 2D Figures	11	Bezier Curves
2	How to Use Processing	7	3D Figures	12	Fractal Figures
3	Variables	8	Displaying Images	13	Creation of Animations
4	Repetition	9	Algorithms of	14	Conclutions
5	Conditional Branch	10	Mouse Input		

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Table 2 SIEM assessment standard with added evaluation

Factor 1: Class construction	Factor 2: Spontaneity factor	Factor 3: Interaction factor
(1) Success opportunity	(8) Usefulness future	(12) Communication
(2) Familiarity	(9) Improvement effort	(13) Positive consequence
(3) Pleasure	(10) Self control	(14) Equity
(4) Comprehension	(11) Self goal	
(5) Perceptual arousal		
(6) Significance		
(7) Curiosity arousal		
Factor 4: Attendance factor	**MV evaluation items**	**Evaluation items about Processing**
(15)Attendance enthusiasm	(17) Importance	(20) Perceptual arousal
(16) Activation Scale	(18) State recognition	(21) Improvement effort
	(19) Expectation	

3. Evaluation method of motivation

For measuring students' motivation levels, the SIEM assessment standard [3] was used, which is a metric that can be used to objectively measure students' motivation levels to learn programming. It uses the ARCS motivation model [2] as the background theory.

There are in total nineteen evaluation items in the standard, and each item is presented using a five-point Likert Scale. In this study, we added two more evaluation items which are related to the artwork generated by Processing. The evaluation items of the SIEM assessment standard are shown in Table 2.

In Table 2, the added items are item (20) and item (21). Item (20) is similar to item (5), but its question is more specific and related to the results of Processing programming instead of general programming. Item (21) is similar to (9), but its question is more specific to Processing. For the analysis in the next section, item (20) is included in Factor 1, and item (21) in Factor 2.

Though all of the items are used for evaluating students' motivation levels, there are two particular items, (17) and (19), which are used to calculate the motivation index (abbreviated as "MV" in this paper). MV is calculated as equation (1).

$$MV = (17)\ \text{Importance} \times (19)\ \text{Expectation} \quad (1)$$

In a prior study, it has been found that there was a correlation between the added items about Processing, (20) and (21), and the items to calculate the motivation index, (17) and (19) [4]. In other words, there was a correlation between the aesthetic satisfaction and the motivation levels to learn programming.

In both universities, the time series evaluation of motivation using the questionnaires with SIEM assessment standard was conducted three times in all: early in the course, halfway through, and late in the course.

Table 3 MV of the students in the two universities

	Institute	university A			university B		
	Period	Early	Middle	Latter	First	Second	Latter
Total	Mean	17.1	13.9	12.7	17.0	17.7	18.9
	Maximum	25	25	25	25	25	25
	Minimum	6	1	1	8	8	9
	Variance	25.0	37.0	31.7	18.4	23.2	23.5
	Total	484	391	357	611	638	679
High group	Ratio	37.9%	10.3%	10.3%	38.9%	47.2%	50.0%
20 <= MV	MV mean	21.8	25.0	23.3	21.4	22.1	23.1
Medium group	Ratio	51.7%	62.1%	48.3%	52.8%	50.0%	47.2%
10 <= MV < 20	MV mean	14.7	15.1	14.2	14.4	14.2	15.0
Low group	Ratio	10.3%	27.6%	41.4%	8.3%	2.8%	2.8%
MV < 10	MV mean	8.0	5.6	7.3	8.0	8.0	9.0

4. Experimental results

Using the questionnaires mentioned in section 3, we evaluated the students' motivation to learn programming. Table 3 shows the values of MV measured in different times at the two universities.

Although MV taken early in the course at university A (17.1) was slightly higher than that of university B (17.0), MV became much higher at university B when it was taken late in the course. At university A, the time series evaluation of MV shows a decreasing tendency, while at university B, it shows an increasing tendency. A similar decreasing tendency of MV was reported in [3]. Since the teaching materials of programming become more difficult as time progresses, it is understandable to have decreasing tendency of MV. It is rather surprising to see the increasing tendency of MV at university B.

In order to analyze the change in motivation of the students further, the mean value of each factor in SIEM standard was calculated. Fig. 1 shows the transition of the mean values. These values were processed with logarithm in order to minimize the influence of the differences of the teaching environment at the two universities discussed in section 2. This figure suggests that there was a significant decreasing tendency in Factor 1 and Factor 2 for university A, and increasing tendency in Factor 1, Factor 2, and Factor 3 for university B.

To confirm this conjecture, t-test between the same

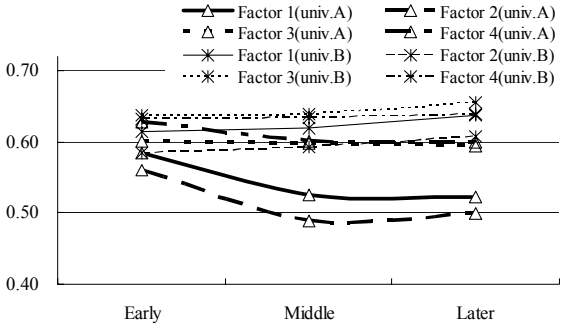

Fig. 1 Transition of the mean value (converted into logarithm) of each factor

evaluation items at different times were conducted. It can be noticed that there are many p-values that are less than or equal to 0.05 in the row of (Univ. = A) and (Between = Early and Middle) for Factor 1 and Factor 2. Therefore, there is a statistical significance between the same evaluation items taken early in the course and of those taken in the middle of the course for many items in Factor 1 and Factor 2, of a significant level of 5%. This fact proved that Factor 1 and Factor 2 for university A had actually dropped. Also, some p-values less than 0.05 can be found in the rows of (Univ. = B) for items (2), (6), (7), (11), and (12). In this case, the mean values of those evaluation items actually increased.

In order to investigate what made this rise in motivation of the students at university B, the correlation coefficients between the two evaluation items about Processing, (20) and (21), and other evaluation items were calculated. Those coefficients for university B are shown in Table 4. It can be found in this table that many items in Factor 1, Factor 3, and Factor 4 correlate to item (20) but not to item (21), though the items in Factor 2 correlate to both item (20) and item (21). This fact implies that in order to maintain or raise students' motivation it is more important to allow students to enjoy seeing the final results (artwork) of the programming than to make them *strive* to create more beautiful artwork, since the question for item (20) is "Do you think it's fun to see the results of Processing programming?" and the one for item (21) is "Do you think you want to strive to create more beautiful artwork with Processing?".

At university A, the grade of the course was determined by only one final assignment. Therefore it could be that the students at university A had to strive to create beautiful artwork. At university B, on the other hand, the grade was determined by two exams, two assignments, two quizzes, and class attendance. Therefore, it could be that the students at university B enjoyed creating artwork with Processing more than the students at university A, and hence their motivation was maintained.

5. Conclusions

A programming course was offered to the students in the art design faculty and digital design faculty at two universities (A and B), and the factors that raise the motivation of students to learn programming were analyzed. In the time series analysis of motivation, it was found that the students' motivation increased at university B, while it dropped at university A. The correlation between the evaluation items about Processing and other items for university B reveals that in order to maintain or raise students' motivation it is more important to allow students to enjoy seeing the final results (artwork) of the programming than to make them *strive* to create more beautiful artwork.

Table 4 Correlation between the evaluation items about Processing and other items for univ. B

Item	Period	Factor 1								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)		
(20)	Early	0.52	0.56	0.61	0.17	0.68	0.21	0.51		
	Middle	0.63	0.31	0.60	0.49	0.87	0.55	0.62		
	Latter	0.50	0.71	0.59	0.47	0.48	0.49	0.64		
(21)	Early	0.30	0.42	0.37	0.09	0.30	0.33	0.23		
	Middle	0.38	0.40	0.42	0.42	0.44	0.40	0.35		
	Latter	0.42	0.48	0.34	0.42	0.21	0.63	0.58		
Item	Period	Factor 2				Factor 3			Factor 4	
		(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(20)	Early	0.53	0.55	0.53	0.43	0.00	0.27	0.45	0.71	0.30
	Middle	0.49	0.49	0.41	0.40	0.39	0.63	0.59	0.57	0.57
	Latter	0.44	0.48	0.40	0.47	0.34	0.37	0.55	0.75	0.46
(21)	Early	0.38	0.64	0.58	0.27	-0.06	0.22	0.44	0.39	0.33
	Middle	0.43	0.52	0.54	0.33	0.23	0.30	0.29	0.27	0.33
	Latter	0.51	0.33	0.51	0.37	0.34	0.35	0.45	0.48	0.42

We could also quantitatively analyze the learning tendency of the students in the art departments when learning programming. We think that we will be able to use the knowledge obtained from the analysis to effectively improve the programming education in the art departments, which has been relying on teachers' experience.

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References

[1] Processing 1.0 (BETA), http://processing.org/

[2] J. M. Keller and K. Suzuki, "Use of the ARCS motivation model in courseware design (Chapter 16)," In D. H. Jonnasen (Ed.), Instructional designs for microcomputer courseware, Lawrence Erlbaum Associates, USA, 1987.

[3] S. Dohi, O. Miyakawa, and N. Konno, "Analysis of the Introduction To the Computer Programming Education by the SIEM Assessment Standard," Proceedings of the 6th International Conference of Information Technology Based Higher Education and Training , 2005, Session F4A, pp. 8-13.

[4] Y. Takemura and H. Nagumo, "Analysis of the Relationship between Motivation for Learning Computer Programming and Computational Figures," Poster Paper Notes of the 14th International Conference on Computers in Education (ICCE2006), 2006, pp. 49-52.