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Preparing engineering students for entrepreneurial creative industries

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ABSTRACT: Entrepreneurship-learning in technical vocational schools has not proved optimal in providing graduates skilled in creative, innovative and marketable products. But, the new curriculum in Indonesia includes productive and creative course subjects, in which the creative industry is viewed as economically strategic. Hence, technical school graduates should become entrepreneurs in creative industry sub-sectors. The study showed that engineering students' creativity could be improved through entrepreneurial-based creative industries (EBCI) learning. The research method was based on a quasi-experimental non-equivalent control group design. The study had 32 mechanical engineering students, and two groups were formed: experimental and control. The control group learned entrepreneurship the existing way, and the experimental group students were taught with the EBCI method. Data collection was by questionnaire and observation. The results showed EBCI significantly improved students' creativity as compared with the control group. After EBCI, the highest score was for creative ideas, at 87.06 percent for the ideational indicator.

Keywords: Creativity of engineering students, entrepreneurial-based creative industries, learning entrepreneurship

INTRODUCTION

The current vocational school curriculum in Indonesia features the terms *prakarya* and *creative products* in an effort to highlight the need to produce creative, productive and marketable engineering graduates. The government of Indonesia's policy is to concentrate on entrepreneurship in the creative industries [1][2].

There are 18 sub-sectors of creative industries. These include animation, architecture, design, photography, music, crafts, culinary, fashion, research and development, publishing, film, advertising, interactive games, performing arts, visual arts, information technology, television, radio and video. Learning in Indonesia should be designed in accordance with the need to produce creative industry-based entrepreneurs. Problems with curricula affect the relevance of graduates, causing the unemployment rate of engineering graduates to increase as the labour absorption rate is reduced. An important point in directing engineering graduates to the creative industries is to include creativity in the appropriate curricula [3].

Creativity is a characteristic required by an engineering student both during education and after graduation [4]. Creativity in engineering students results both from innate qualities and the efforts of the students [5]. Learning methods can encourage students to think creatively, innovatively, productively and at a high level [6]. The existence of creative thinking demands insight, ideas and methods for completing tasks more effectively and efficiently [7].

Guilford opines that creativity is built on fluency, originality, flexibility and elaboration [8]. Fluency means the ability to give birth to ideas that express the many ways to do something; flexibility means the ability to use various approaches in overcoming problems; originality means the ability to generate ideas and elaboration means the ability to enrich or develop an idea [9]. These four variables determine the preparation required for vocational school graduates to become entrepreneurs in the creative industries.

Adopted for this study was the entrepreneurial-based creative industries (EBCI) learning model for entrepreneurial learning at technical vocational schools. Entrepreneurial learning is about how to develop an entrepreneurial business, but not about creative products. Student work often contains innovative ideas. Entrepreneurial learning in the engineering department needs to ensure a new atmosphere to motivate students, while developing creativity and encouraging product innovation. This EBCI learning model has a sequence of steps:

- Identify creative industry sub-sectors of interest to engineering students.
- Establish groups according to sub-sectors.
- Plan creative products that are innovative and marketable.
- Create the products.
- Present the students' creative products.
- Evaluate the feasibility of products in the marketplace.
- Promote students' creative products.

It is hypothesised that this learning model can increase student creativity as compared with entrepreneurial learning in general. The aim of this study was to look at changes in student creativity when taught with the EBCI model, as compared with students taught in the conventional way.

METHOD

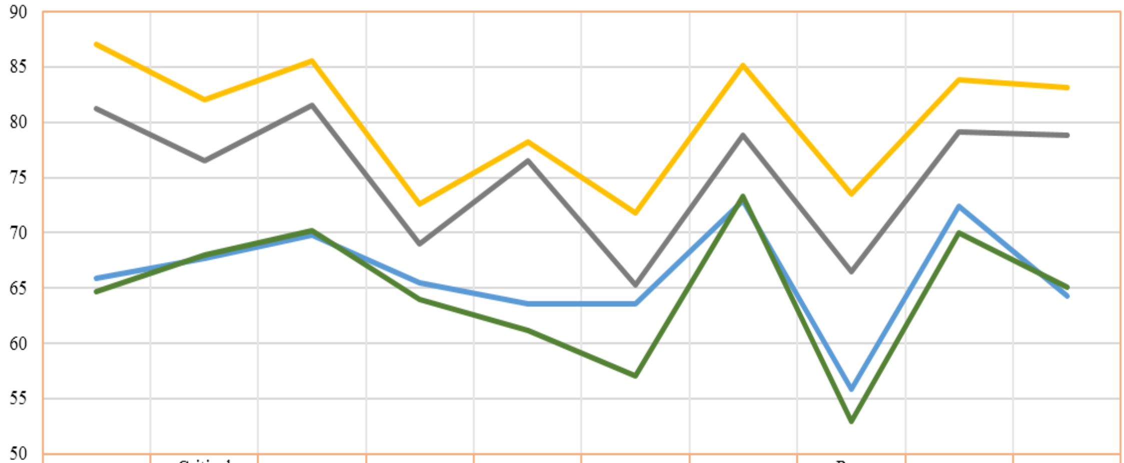
This research was quantitative based on experiment. The research used a quasi-experimental non-equivalent group design with two engineering student classes, viz. a control class and experimental class [10]. The selection into a class was based on a student's registration number, i.e. odd numbers were placed in the control class and even into the experimental class. The research was conducted at a vocational school of mechanical engineering in Yogyakarta city, Indonesia. The research subjects were 32 students of machine engineering class XI. Sixteen students were assigned to the control class and 16 to the experimental class. As per the experiment design, the control class was not taught using the EBCI model, but about entrepreneurship in general. The experimental class was taught creative-based entrepreneurship using the EBCI model.

Data collection instruments were questionnaire and observation. The Vendeleur model was used to provide direct and indirect indicators of students' engineering creativity [11]. Direct indicators include ideational mobility, critical thinking, originality, risk-taking, enjoyment and aesthetics. Indirect indicators include group interaction, pre-knowledge, motivation and self-esteem.

Questionnaires were used to measure the students' creativity by the direct indicators using a five point Likert scale. Validity was verified by construct validity using expert opinion and instrument reliability testing. Testing was limited to 30 students. Valid and reliable instrument items were used for data collection by questionnaire. In addition, observations were made of the activity of students during the learning activities.

Data analysis used quantitative descriptive statistics. A *t*-test was used to compare the creativity of engineering students taught using EBCI with students not taught using EBCI, as described above. The study was conducted across three sessions to achieve consistency in measuring the creativity of students. Data analysis was for the direct and indirect indicators of creativity, as described above.

RESULTS



	Ideational	Critical thinking	Originality	Risk-taking	Enjoyment	Aesthetic	Interaction	Pre-knowledge	Motivation	Self-esteem
Odd group pretest	65.88	67.65	69.8	65.49	63.53	63.53	72.94	55.88	72.35	64.31
Even group pretest	64.71	67.94	70.2	63.92	61.18	57.06	73.33	52.94	70	65.1
Odd group posttest	81.18	76.47	81.57	69.02	76.47	65.29	78.82	66.47	79.12	78.82
Even group posttest	87.06	82.06	85.49	72.55	78.24	71.76	85.1	73.53	83.82	83.14

Figure 1: The creativity of engineering students in entrepreneurial learning.

The study revealed that creativity plays an important role in engineering students' learning entrepreneurship. The pre-test determined the initial condition of the two groups, while post-test determined the effect of normal entrepreneurship learning for the control group and learning using the EBCI method for the experimental group. In practice, the EBCI method provides the widest opportunity for engineering students to explore their hobbies and passions as part of creative entrepreneurial learning. Results of the creative measurement of engineering students can be seen in Figure 1.

The results show that that the pre-test student creativity for the control group was 66.94% averaged over the indicators and 65.72% for the experimental group averaged over the indicators. Pre-test, the interaction indicator had the highest score for both groups, while the pre-knowledge indicator had lowest again for both groups.

Post-test, the experimental group taught with EBCI produced the highest value of 87.06% for the ideational indicator and the lowest value of 71.76% for the aesthetic indicator. The corresponding values for the control group were 81.18% and 65.29%, respectively, though note that the control group had a high result post-test of 81.57% for originality; this was still lower than the experimental group post-test on originality, which was 85.49%.

The shift to idea development shows the potential of EBCI in generating creative student engineering ideas as part of building an entrepreneurial spirit. For the experimental group, the greatest improvement was for the ideational indicator and the smallest for the risk-taking indicator. ANOVA (analysis of variance) was used to test for homogeneity, which was satisfied with a value of 0.649. The presentation of data normality, standard deviation (SD), mean gain, etc, are shown in Table 1.

Table 1: Paired sample test.

Group	Normality (Shapiro-Wilk)	No.	SD	Mean	Correlation	*t*-test sig.(2-tailed)
Pre-test odd	0.350 (sig.)	17	8.24	13.29	0.882 (sig.)	6.648 (0.000) sig.
Pretest even	0.568 (sig.)	17				
Post-test odd	0.114 (sig.)	17	9.51	22.24	0.815 (sig.)	9.634 (0.000) sig.
Posttest even	0.712 (sig.)	17				

Table 1 shows that there is a difference between pre-test and post-test for both the control and experimental groups whether without EBCI (control) or with EBCI (experimental). The increase in the mean gain is the difference 22.24 - 13.29 = 8.95. The *t*-test results between the post-test groups indicate a 2-tailed significance of 0.000, standard deviation of 9.51 with correlation 0.815 (sig. 0.000). This indicates that there is a difference in entrepreneurial learning with EBCI compared with not applying the method, with the experimental group using EBCI being the better.

DISCUSSIONS

The results show a significant increase in entrepreneurial learning using EBCI. The improvement is because students start generating creative ideas to develop creative products in accordance with their creative industry sub-sectors and hobbies [12]. Students' creative power grows freely when they are given a wider space in which to be creative [13].

Eighteen creative industry sub-sectors provide a very wide choice in selecting creative products. The implementation of EBCI received a positive response from entrepreneurship teachers. Some of the models are easy to implement, although it is difficult to promote the students' e-commerce creative products. Encouraging e-commerce creative products fosters students' enthusiasm for productive entrepreneurship [14][15].

The shift in learning direction to fulfil the need for creative economy workers must include students in engineering. Following the principles of the educator John Dewey, opportunities should be provided for students to choose work in accordance with their wishes [16][17].

The opportunities for students after graduation are unlimited, but they should not be urged to fulfil technical jobs in which they are not deeply interested. The employment challenge to find experts in creative fields provides an opportunity for creative industrial sub-sector employment needs to be satisfied by engineering graduates.

CONCLUSIONS

The conclusions and findings of the study are as follows:

1. The use of the EBCI method in entrepreneurial learning can improve students' engineering creativity, as assessed by ten assessment indicators, compared to previous entrepreneurial learning.

2. There is a shift in entrepreneurial learning in which creativity is developed based on student ideas of creative and innovative products.

3. Engineering students should exploit their creative hobbies in the creative industries sector to improve future job opportunities.

Based on this study the recommendation is that schools implement the EBCI method and use applicative examples of creative products for creative industry sub-sectors. Policies should focus on preparing technical school graduates for the creative industry sub-sectors.

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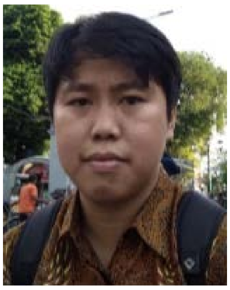
BIOGRAPHIES



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