Journal of Education, Teaching, and Learning
Volume 5 Number 1 March 2020. Page 193-198
p-ISSN: 2477-5924 e-ISSN: 2477-4878

Journal of Education, Teaching, and Learning is licensed under
A Creative Commons Attribution-NonCommercial 4.0 International License.

THE EFFECT OF BLENDED LEARNING APPROACH AND VISUAL-SPATIAL ABILITY ON LEARNING OUTCOMES

Bambang Setiyo HP[1)], Hartati Mochtar[1)], Atwi Suparman[2)]

[1)]*Universitas Negeri Jakarta, Indonesia*

[2)]*Universitas Terbuka, Indonesia*

E-mail: bambang_shp@uny.ac.id

Abstract. The purpose of this study was to conduct an empirical study to find out the aspects that influence the basic CNC learning outcomes, in this case regarding the application of the approach blended learning, and the abilities visual-spatial possessed by students who take the course. Based on the types of research variables that exist, then this experimental research is appropriate to be carried out using the experimental Treatment by Level design. Data analysis in this experimental study used 2-way ANOVA with one treatment variable and one attribute variable. This research was carried out using experimental research methods. This research was conducted at the CNC/CADCAM Laboratory, Department of Mechanical Education, Faculty of Engineering, Yogyakarta State University. Research Results 1) Basic CNC learning outcomes of students who take part in learning using the approach Blended Learning higher than students who take learning using the Conventional Approach; 2) Basic CNC learning outcomes of students with ability spatial-visual high, higher than students with abilities spatial-visual low who jointly follow Basic CNC learning; 3) There is an influence of the interaction between learning approaches and spatial visual abilities on basic CNC learning outcomes; 4) Basic CNC learning outcomes of students capable of high spatial visuals who take part in learning with approach blended learning, higher than students with high spatial-visual abilities who follow learning with conventional approaches; 5) Basic CNC learning outcomes of students with low spatial-visual abilities who take part in learning with approach blended learning, lower than students with low spatial-visual abilities who follow learning with conventional approaches. The conclusion of this research is the basic CNC learning outcomes of students who take part in learning using the Approach *Blended Learning* higher than students who take learning using the Conventional Approach.

Keywords**:** Blended Learning; Visual Spacial; Learning Outcomes; CNC

I. INTRODUCTION

The purpose of this study was to conduct an empirical study to find out the aspects that influence basic CNC learning outcomes, in this case concerning the application of the approach blended learning, and the abilities visual-spatial possessed by students who take the course. Many advancements have been made in the development of Indonesian education until 2014. However, some important problems have also arisen, including those that are being faced are the relevance and accountability of educational outcomes. The relevance of education, both external and internal relevance has become a very important issue today. The issue of external relevance arises triggered by the phenomenon of educated unemployed workers, whose aggregate trend has continued to increase in recent years. While the issue of internal relevance is indicated by the low value of the National Examination (UN).

Analysis of the high number of educated unemployed is one reason for this because of the incompatibility between the qualifications possessed by world education graduates and the qualifications required by the business/industry (du). While the achievement of relatively low UN scores is caused by the quality of learning in Indonesia which is still not well measured from the learning process or student learning outcomes. Related to learning, various studies reveal that the learning process in the classroom, in general, does not run interactively so that it cannot foster creativity, critical power, and students' analytical skills. Competence as a result of learning that is very important to be measured and possessed by students is less attention.

The issue of the relevance of education arises amid major changes in the way people store and access information. The changes that were mainly triggered by the massive development of computers and digital technology, spread to all areas of life, including education. Computers and digital

Journal of Education, Teaching, and Learning
Volume 5 Number 1 March 2020. Page 193-198
p-ISSN: 2477-5924 e-ISSN: 2477-4878

technology are the basis of internet technology, which at present and in the future has the potential to greatly change the various aspects of education. The internet can connect students with various sources that were previously not available, and will be the main medium for delivering information that will substantially change the forms of dissemination of information both text and visual.

The development of computer and digital technology has encouraged efforts to renew educational practices. Some of the things that have been done are the utilization of the development of computer technology for learning processes such as Computer Assisted Instruction (CAI), for presentations of presentation of teaching materials, and information in the form of images, text, graphics, simulations, animations, exercises with direct feedback, and learning that is both individual and group. Computer technology has also helped organize the teacher-centered learning process into learner-centered learning.

In the world of education, efforts to improve praxis and quality of education have always been carried out, both through improving various policies in the field of education and with a series of educational and learning research. The goal, so that the world of education is still able to carry out its role as an institution that prepares qualified Human Resources (HR), which can compete in the era of globalization, and the era of development of Science, Technology, and Arts that continues to occur.

Efforts to improve the quality of education, especially learning, and learning outcomes cannot be separated from the factors that influence it. It was stated by Smaldino, Lowther, and Russell (2012: 16), that teachers and learning strategies are factors that have a significant effect on students. The theory and results of research on learning show that the learning strategies chosen by the teacher greatly influence the learning outcomes of students. The strategy and approach chosen by the teacher as a learning guide for students will be very helpful to improve and encourage learning to be effective so that students can achieve the expected learning outcomes.

Observations on the learning outcomes of the Basic CNC course are conducted to determine the external efficiency, namely the relationship between the qualifications of expertise in NC programming needed by the industry and the qualifications of NC programming skills achieved by students in Basic CNC learning. Besides, observations are also intended to determine internal efficiency, namely the quality of Basic CNC learning seen from the test scores of learning outcomes achieved by students compared to the standard values that must be achieved, and the number of students who achieve standard competencies in the NC programming field.

Observations are intended as preliminary research, and after some problems are identified, (1) Basic CNC competencies achieved by students/students both in the field of programming and operation of CNC machines are not optimal; (2) the limited number of CNC machines as NC practice learning facilities, so that the number of CNC machines and the number of students to be served is of an unbalanced proportion, (3) the learning approach that has been used so far, that is face-to-face learning with ineffective group practices. not providing individual activities to obtain the learning experience needed to achieve basic CNC basic competencies.

The problems that arise in CNC learning with such group practices are the decrease in attention and concentration of learning experienced by most students when other students are operating CNC machines. In each group, when one student in his group is actively operating a CNC machine, other students should be around the machine, watching, interacting, and concentrating on the machine. However, what often happens is the opposite, students who are not actively operating the machine do other things that are not related to learning material and play. They lose their learning concentration when other friends in the group are full of concentration.

From the results of the tests conducted at the end of the lecture program, it is known that one or several students who are active and have a dominant role in the group can achieve the specified CNC programming competency standard. Some of the other students, namely around 3 to 4 people in each group, who were from the beginningless active, were on average unable to reach the specified CNC programming competency standard.

Looking at the results of the research and teaching experience presented above, it is clear that there are still gaps between expected learning objectives and CNC programming skills that have not been achieved optimally, therefore there needs to be an effort to be able to improve these abilities, especially for students of Engineering Education Study Program Machine. One effort to improve quality that can be done is by reengineering the learning process by applying a variety of learning approaches that are in line with the development of science and technology by paying attention to differences in the ability of students individually in learning.

II. Methodology

Based on the types of research variables that exist, then this experimental research is appropriate to be carried out using the experimental *Treatment by Level design.* Data analysis in this experimental study used 2-way ANOVA with one treatment variable and one attribute variable. This research was conducted at the CNC/CADCAM Laboratory, Department of Mechanical Education, Faculty of Engineering, Yogyakarta State University. The research was conducted in the odd semester of the 2015-2016 academic year, between August and December 2015. The study adjusted the class schedules in the laboratory. The sampling is based on multi-stage random sampling with probability sampling techniques. One sampling technique with probability sampling is simple random sampling. It is said to be simple because it is done randomly regardless of the strata that exist in the population. The study took place in 9 meetings. The duration of each meeting is 1 x 50 + (2 x 100) minutes = 250 minutes (1 theory credits and 2 laboratory practice credits). Sampling in this study was conducted using random techniques (random sample). All members of the study population had the same opportunity to be selected as research samples (Wiersma, 1986: 263-265).

Journal of Education, Teaching, and Learning
Volume 5 Number 1 March 2020. Page 193-198
p-ISSN: 2477-5924 e-ISSN: 2477-4878

III. Results and Discussion

A. *Results*

Data collected in this experimental study is the dependent variable (Y) data, namely the value of the student's basic CNC learning outcomes test which is the subject of the study. The description of the research data concerning the basic CNC learning outcomes test value mainly concerns the highest value (Y_H), the lowest value (Y_L), the average value ($\bar{Y}$), and the value or price of the standard deviation (s^2).

Descriptions were carried out on four groups of CNC Basic learning outcomes test data values, respectively; (1) Basic CNC student learning outcomes test data based on the treatment group, in this case the value of the Basic CNC learning outcomes test group of students who take part in learning using the approach *blended learning* (A_1), and the basic CNC student learning outcomes test group learning uses a conventional approach (A_2); (2) the value of the basic CNC learning outcomes of students based on the level of spatial visual ability, in this case is the value of the Basic CNC learning outcomes test group of students who have high ability *visual spatial* (B_1), and the basic CNC learning outcomes test group of students who have orability *spatial visual* low(B_2); (3) the value of the learning outcomes test according to level 1 (ability *spatial visual* high) and treatment, in this case is the value of the Basic CNC learning outcomes test group of students with abilities *spatial visual* high who follow Basic CNC learning using the approach *blended learning* (A_1B_1), and the most basic CNC student learning outcomes test scores with abilities *spatial visual* high, follow Basic CNC learning using a conventional approach (A_2B_1), (4) learning outcomes test scores according to level-2 (ability *visual spatial* low) and treatment, in this case the value of Basic CNC learning outcomes test groups of students with abilities *spatial visual* low who follow Basic CNC learning using the approach *blended learning* (A_1B_2), and the value of the Basic CNC learning outcomes group of students with abilities *visual spatial* low follow basic CNC learning using a conventional approach (A_2B_2). Basic CNC learning outcome score data for each group are summarized in Table I (See Annex 5.1, pp. 601-604).

1) *Student Learning Outcomes Test Values on Basic CNC Learning Using the Approach Blended Learning (A_1)*

The learning outcomes test scores of groups of students participating in Basic CNC learning use the approach *Blended Learning* (experimental class), obtained from 13 research subjects. The highest value of the group of students taking Basic CNC learning with the approach *blended learning* is 86.00, while the lowest value is 60.20, the average value ($\bar{Y}$) is 74.60; the range between the highest and lowest values is 26.00. Description of the value of Basic CNC learning outcomes tests statistically from 13 students of the Basic CNC learning group using the approach of *blended learning*.

TABLE I
VALUE OF BASIC CNC LEARNING OUTCOMES TEST BASED ON STATISTICAL MEASURES

Spatial Visual Ability (B)		**Learning Approach (A)**		**ΣB**
		***Blended Learning* (A1)**	**Conventional (A2)**	
The ability of Visual-Spatial High (B1)	n	7	7	14
	Y_H	86.00	76.00	-
	Y_L	76.00	70.00	-
	$\bar{Y}$	82.00	72.00	77.00
	s^2	12.67	9:41	-
	ΣY	574.00	504.00	1078.00
	$ΣY^2$	47 144	36310.64	83454.64
the ability of Visual-Spatial Low (B2)	n	6	8	14
	Y_H	72.60	76.00	-
	Y_L	60.20	60.10	-
	$\bar{Y}$	65.96	67.26	66.70
	s^2	23:13	46.25	-
	ΣY	538.10 933.84		395.74
	$ΣY^2$	26217.36	36508.33	62725.69
ΣA	n	13	15	28
	Y_H	86.00	76.00	-
	Y_L	60.20	61.10	-
	$\bar{Y}$	77.00	69.47	71.85
	s^2	85.27	39.27	-
	ΣY	1042.10 2011.84		1078.00
	$ΣY^2$	83454.64	72818.97	146180.33

2) *Student Learning Outcomes Test Results on Basic CNC Learning Using a Conventional Approach (A_2)*

The learning outcomes test scores of groups of students participating in the Basic CNC study using the conventional approach (control class), were obtained from 15 research subjects. The highest value of the group of students taking Basic CNC learning with the conventional approach is 76.00, while the lowest value is 61.20, the average value ($\bar{Y}$) 69.47; the range between the highest and lowest values is 16.00. The description of the value of Basic CNC learning outcomes tests statistically from 15 students of the Basic CNC learning group using a conventional approach.

3) *Values of Basic CNC Learning Outcomes Test for Students with Spatial Visual Ability High on Learning using the Approach Blended Learning (A_1B_1)*

Data sources (research subjects) groups of students who have high spatial-visual abilities in the experimental class (Basic CNC learning using the approach *Blended Learning*) are 7 students. The highest value of the group of students with high spatial-visual abilities who follow Basic CNC learning using the approach *blended learning* is 86.00, while the lowest value

Journal of Education, Teaching, and Learning
Volume 5 Number 1 March 2020. Page 193-198
p-ISSN: 2477-5924 e-ISSN: 2477-4878

is 76.00, the average value ($\bar{Y}$) is 82.00; the range between the highest and lowest values is 10.00. Statistically, the basic CNC learning outcome test scores of 7 students have the high spatial-visual ability in the Basic CNC learning group with approach *blended learning.*

4) *Value of Basic CNC Learning Outcomes Test for Students with Spatial Visual Ability Low Learning using the Approach Blended Learning ($A_1(B_2)$*

Data sources (research subjects) groups of students who have low spatial-visual abilities in the experimental class (Basic CNC learning using the approach *Blended Learning*) are 6 students. The test scores of the basic CNC learning outcomes of students in the ability group *Visual-Spatial* low who take part in learning with the approach are *blended learning* described as follows. The highest score obtained by students of this group is 72.60; the lowest value 60.20; the average value ($\bar{Y}$) 65.96; and the range between the highest and lowest values is 12. Statistically, the value of the Basic CNC learning outcomes test from as many as 6 students has a low spatial-visual ability in the Basic CNC learning group with approach *blended learning.*

5) *Values of Basic CNC Learning Outcomes Test for Students with Spatial Visual Ability High on Learning by Using a Conventional Approach (A_2B_1)*

The group of students with high ability *visual-spatial* who follow basic CNC learning using the conventional approach (A_2B_1) is 7 people. The value of the CNC learning outcomes test The highest basis that this group can achieve is 76.00; while the lowest value is 70.00; the average value of 72.00; and the range between the highest and lowest values is 6.0. Statistically, the complete Basic CNC learning achievement test scores of students with ability *Visual-Spatial* High who follow learning using the Conventional approach.

6) *Learning Outcomes Test Results of Students with Spatial Visual Ability Low in Basic CNC Learning Using Conventional Approaches (A_2B_2)*

Groups of students with ability *Visual-Spatial* Low who follow Basic CNC learning using the Conventional approach (A_2B_2) are 8 people. The value of the CNC learning outcomes test The highest basis that this group can achieve is 76.00; while the lowest value is 60.10; the average value of 67.26; and the range between the highest and lowest values is 16.0. Descriptions of the statistics of Basic CNC learning outcomes test scores of students in ability groups *Visual-Spatial* Low who follow Basic CNC learning using the Conventional approach.

B. *Discussion*

Results of the analysis (calculation) of empirical data are the results of the Basic CNC learning outcomes test of two groups of students, namely groups that follow CNC Basic learning with using approach *blended learning* (experimental class), and groups that follow Basic CNC learning using the conventional approach (control group), indicate differences. Basic CNC learning outcomes in groups of students who take part in learning using the approach *blended learning* are higher than the basic CNC learning outcomes of groups of students who follow learning using conventional approaches. This is indicated by two things.

First, the average value of the Basic CNC learning outcomes test was obtained by each student group. The mean value of the Basic CNC learning outcomes test group of students participating in learning using the approach *blended learning* ($\bar{Y}_{A1}$) = 74.60 is higher than the average test scores of students' learning outcomes using the conventional approach ($\bar{Y}_{A2}$) = 70.21. Second, analysis of variance to the learning outcomes of the basic CNC the two groups obtained the price of the F-count = 5.64 which was much larger than the F-table 4.26, so$_{H0}$ be rejected, and accept $H_{1,}$ which means there the difference in Basic CNC learning outcomes between students who take Basic CNC learning uses the approach *blended learning* and students who take the lesson using a conventional approach. To test one side of the price F-count is converted to price t, so that the price of t-count is 2.38 and t-table is 1.71. It can be seen that the price of the calculated conversion from F-count is greater than the t-table, so that empirically the mean of basic CNC learning outcomes of students who take the learning using the approach *blended learning* is higher than the students who take learning using conventional approaches, proven the truth. This empirical evidence has answered the research hypothesis that the basic CNC learning outcomes of students who follow learning using the approach *blended learning* are higher than students who take learning using the conventional approach.

ANAVA Calculation as shown in Table I, the source of the interaction variance A x B shows the value of F_{ount} = 4.67> $F_{table\ (\alpha\ =\ 0.05)\ (1\ ,\ 24)}$ = 4.26, therefore $H_{o\ is}$ rejected and $H_{1\ is}$ accepted, which means that there is an interaction between the learning approach (A) and the ability *visual-spatial* (B) on the learning outcomes of Basic CNC. The interaction of this influence, the influence of the learning approach to basic CNC learning outcomes, depends on the abilities of *visual-spatial* students'. Likewise, the influence abilities *of spatial visual* on student basic CNC learning outcomes also depend on the learning approach used. The effect of the interaction between the learning approach and the ability of *spatial visual* on student CNC learning outcomes can be explained further based on the following empirical data.

Two-way ANAVA calculation data and hypothesis testing empirically show the effect of the interaction between the learning approach and the *visual-spatial* students' ability on the learning outcomes of the basic CNC. Groups of students with abilities *spatial-visual* high who follow Basic CNC learning use different learning approaches, obtaining different learning outcomes. The same thing also happened to groups of students with abilities *spatial-visual* low, those who took Basic CNC learning used a different learning approach, apparently also obtained different learning outcomes. With the interaction of these influences, the basic CNC learning outcomes of students are largely determined by the learning approach used, and the abilities of *spatial-visual* students.

The Dunnet t-test calculation as in Table I shows that the value of $_{count\ (A1B1;\ A2B1)}$ = 5.47> $_{table\ (\alpha\ =\ 0.05),\ (9.23)}$ = 1.71 so that $H_{o\ is}$ rejected and H_1 accepted. Thus it can be concluded that there are differences in Basic CNC learning outcomes between groups of students with high spatial-visual abilities who follow Basic CNC learning using the approach *blended learning* (A1B1), and groups of students with ability *visual-spatial* high who follow Basic CNC learning using conventional approaches (A2B1).

The difference in learning outcomes is indicated by the average value of the basic CNC learning outcomes test. It can be seen that the average value of the Basic CNC learning outcomes test of the group of students with ability *spatial-visual* high who took part in learning using the approach *blended learning* was 82.00, while the average value of the Basic CNC learning outcomes test group of students with ability *visual-spatial* high followed the conventional approach 72.29. The average value of the student's basic CNC learning outcomes test shows that the basic CNC learning outcomes of students with abilities *spatial-visual* high who follow basic CNC learning with approach *blended learning* are higher than students with abilities *spatial-visual* high who follow Basic CNC learning using a conventional approach.

The Dunnet t-test calculation as seen in Table 4.11 shows that the value of $t_{count\ (A1B2;\ A2B2)} = 0.36 < t_{table\ (\alpha = 0.05),\ (9:\ 3)} = 1.71$, meaning that H_o rejected and H_1 accepted. Thus it can be concluded that there are differences in basic CNC learning outcomes of students with low spatial-visual abilities who follow basic CNC learning with approach *blended learning* (A_1B_2) with students with low spatial-visual abilities who follow Basic CNC learning with conventional approaches (A_2B2).

Based on the calculation, the average value of the students' basic CNC learning outcomes test with the low spatial-visual ability that follows Basic CNC learning with the approach *blended learning* is 65.96. The mean value of the learning outcomes test was lower than the average value of the Basic CNC learning outcomes test of students with low spatial-visual abilities who followed Basic CNC learning using a conventional approach of = 67.14.

Thus the results of these calculations are following the hypothesis which states that the basic CNC learning outcomes of students with low spatial-visual ability who follow Basic CNC learning with approach *blended learning* are lower than students with low spatial-visual abilities who follow Basic CNC learning using a conventional approach.

IV. Conclusions

Basic CNC learning outcomes of students who take part in learning using the Approach *Blended Learning* higher than students who take learning using the Conventional Approach. The results of the descriptive analysis show that the average learning outcomes of the Basic CNC students who follow the lesson use the approach of *blended learning*. The basic CNC learning outcomes of students who follow learning using the conventional approach.

Basic CNC learning outcomes of students with abilities *spatial-visual* high are higher than students with abilities *spatial-visual* low who jointly follow Basic CNC learning. There is an influence of the interaction between learning approaches and spatial visual abilities on learning outcomes of basic CNC. For students who have the high visual-spatial ability, students who take part in approach *blended learning* have a Basic CNC learning result higher than students who take a conventional approach to learning, while for students with low spatial-visual ability, students who take approach *blended learning* have Basic CNC learning outcomes are lower than students who follow learning with conventional approaches.

Basic CNC learning outcomes of students capable of high spatial visuals who take part in learning with the approach of *blended learning* are higher than students with high spatial-visual abilities who follow learning with conventional approaches. The results of such data analysis indicate that to improve the basic CNC learning outcomes of students who have high spatial-visual abilities, it is more appropriate if Basic CNC learning is done using approach *blended learning*.

Basic CNC learning outcomes of students with low spatial-visual abilities who follow learning with the approach *blended learning* are lower than students with low spatial-visual abilities who follow learning with conventional approaches. The results of the analysis of empirical data thus show that to improve basic CNC learning outcomes of students who have low spatial-visual abilities, it is more appropriate if Basic CNC learning is done using a conventional approach.

References

Anderson, Lorin W., and David R. Krathwohl. (2001). *A taxonomy for learning, teaching, and assessing a revision of Bloom's taxonomy of education objectives.* Abgridged Edition. New York: Addison Wesley Longman, Inc.

Arends, Richard I. (2007). *Learning to teach Book 1 & 2.* Seventh Edition. New York: McGraw Hill Companies, Inc.

Christensen, Clayton M., Michael B. Horn, and Heather Taker. (2013). *Clayton Christensen Institute.* The Christensen Institute is based in the San Francisco Bay Area in California. http://www.christenseninstitute.org/key-concepts/blended-learning-2/

Illeris, Knud. (2009). *Contemporary theories of learning.* Translated by M. Khozim. London and New York: Routledge, Edisi Bahasa Indonesia oleh Penerbit Nusa Media Bandung.

Gagne, Robert M. (1973). *The condition of learning and theory of instruction.* New York: Holt Rinehart and Winston, Inc.

Gagne, Robert M., Walter W. Wager, Katharine C. Golas, and John M. Keller. (2005). *Principle of instructional design.* Fifth. Belmont, California: Thomson Learning, Inc.

Gardner, Howard. (1993). *Frame of mind the theory of multiple intelligences.* Tenth Anniversary Edition. New York: Basic Books, a Member of the Persues Books Group.

Harriman, Gray. (2004). *http://www. grayharriman.com/blended_learning.htm#top.* 2004. http://www. grayharriman.com.

Mayer, Richard E. (2009). *Multimedia learning prinsip dan aplikasi.* Edited by Baroto Tavip Indrojarwo. Translated by Teguh Wahyu Utomo. Yogyakarta: Pustaka Pelajar.

Smaldino, S.E., Lowther, D.L., and Russell, J.D. (2012). *Instructional technology & media for learning.* 9th. New Jersey: Pearson Educatian Inc.

Snelbecker, Glen E. (1974). *Learning theory, instructional theory ang psyco-educational design.* New York: McGraw Hill Book Company.

Valvo, E. Lo, Licari, R., & Adornetto, A. (2012). CNC milling machine simulation in engineering education. *International Journal of Online Engineering*, *8*(2), 33–38. https://doi.org/10.3991/ijoe.v8i2.2047