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Opening Students' Creativity and Innovation through CAD Learning in Collaboration with Small and Medium-Sized Enterprises

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Abstract : Currently, student product design work is based on product design examples that the lecturer has determined. This can provide the scope of creativity and innovation of student product designs to be limited to old textbook-based designs and not real problems in the world of work. The research method uses an experiment with a One-Group Double Posttest-Only Design. Respondents are students who take CAD courses. The research scenario was the first week without treatment and the second until the fifth week of treatment with the CAD learning method in Small and Medium-sized Enterprises (SMEs). There are three SMEs as the research location. The research was divided into eight student groups. The data analysis technique uses descriptive statistics to represent the qualities of creativity and innovation. Combined and partial difference tests were carried out by analyzing variance from the experiment's class. Learning CAD in SMEs requires preparation in planning, implementation, and evaluation. Conservatively, there is an increase in student creativity and innovation from time to time when they are in SMEs. Students give a good impression of improving their CAD skills with growing confidence and solving industrial product design problems. In addition, the inferential results show differences in student creativity and innovation from time-to-time experiments.

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1. Introduction

The need for skilled CAD workers in Indonesia is very high because it is supported by experience and education level (Salaryexplorer, 2021). The difference in salary received and understanding in applying various kinds of CAD software. CAD designers in Indonesia can fill the groups of companies in Indonesia which are divided into four namely micro (1-4 workers), small (5-9 workers), medium (20-99 workers), and large enterprise (+100 workers) (Tambunan, 2019). The presence of CAD workers tends to be at medium and large enterprises. Especially for the medium level, the National Team for the Acceleration of Poverty Reduction states that owners and workers in SMEs tend not to have formal education and higher levels of education as found in large industries (Burger et al., 2015). The observations of several local SMEs confirm this in Yogyakarta that the number of CAD workers ranges from 1-3 workers. This is not in line with the dynamic workload of workers with many demands for fast and complex orders.

SMEs can open up innovation by collaborating with universities and other industries for new product development (Prabowo, Singgih, Karningsih, & Widodo, 2020). The aim is to ensure the down streaming of university research results into product and technology commercialization (Galushko & Sagynbekov, 2014). Fundamental innovation problems such as product design must be resolved immediately through quadruple helix innovative actors, among which university-SMEs actors (Morisson & Pattinson, 2020). Students can utilize the limitations of SMEs product design ideas through CAD learning. Collaboration of CAD, students, and CAD workers is always important in engineering because it involves multi-software (Eves, Salmon, Olsen, & Fagergren, 2018). Product design software is increasingly competitive in offering advanced modeling, assembly, animation, structural analysis, presentation, and simulation designs. However, even the slightest assistance in the scope of learning is needed for local SMEs to improve product design quality. At this point, the role of students in building their creativity and innovation through CAD learning in SMEs.

CAD learning is one of the computer-aided mechanical drawing courses used by mechanical engineering vocational students in designing products in both 2-dimensional and 3-dimensional modeling (B. R. Setiadi, Puspito, Sudiyatno, Kurniawan, & Kartowagiran, 2020). CAD is a communication medium between designers (students) and design readers (SMEs). Students can use various software such as Autodesk Inventor, AutoCAD, CATIA, Solid work, Ansys, and other vendors. Combining multi-CAD software means that students can think in hybrid creativity, which combines artistic and technological creativity (Dare-Abel, Uwakonye, & Opoko, 2016). Although students have heterogeneous CAD skills, lecturers need to direct students v. CAD learning is the foundation for mechanical engineering vocational students to equip product design, prototyping, and manufacturing processes. Therefore, students who acquire CAD skills are trained to enrich creativity and innovation in design quality (Veisz, Namouz, Joshi, & Summers, 2012).

Creativity and innovation are two soft skills related to product development in CAD learning (Poh Kiat Ng, Kian Siong Jee, & Nurul Izah Anuar, 2012). Innovation and creativity become employability skills for graduates to compete with others (Suarta, Suwintana, Fajar Pranadi Sudana, & Dessy Hariyanti, 2018). Creativity is an individual's ability to create an imaginative picture in ideas and logical perspectives (Winn & Banks, 2012). Creativity in CAD is needed, especially in selecting tools, enhanced visualization, communication, premature fixation, circumscribed thinking, and bounded ideation (Robertson, Walther, & Radcliffe, 2007). Creativity in CAD learning has several inherent indicators: generating ideas, critical originality, thinking enjoyment, aesthetics, and risk-tasking (Vandeleur, 2001).

Creativity is a crucial element in design innovation and product development (Williams, Ostwald, & Askland, 2010). Innovation is a step to commercialize creativity, so a good fit for users (Kumar, 2009). Regarding CAD learning, innovation will grow if students have a design project that stimulates their competence (Goncher, Chan, & Schunn, 2017). CAD learning that has been observed tends to be monotonous and challenging to provide innovation space for students. An indication of the success of CAD learning innovation is to demonstrate creating new products, creating processes, product development, process improvements, and adding a creative touch by duplicating and integrating production factors and new methods (Wankel & Stoner, 2008).

This research focuses on developing learning methods for CAD courses in collaboration with local SMEs. The encouragement of collaboration will trigger students' creativity and innovation in engineering industrial products. As a comparison, the research was directed in a CAD class experimentation at Universitas Negeri Yogyakarta, Indonesia.

This research aims to develop the creativity and innovation of CAD students in solving product design problems in SMEs. Students will indirectly optimize their CAD skills in providing SMEs with several design ideas and product designs. In Yogyakarta, SMEs have limited innovation due to CAD human resources with high school education level, out-of-date software, and minimal skills. For this reason, the presence of students in SMEs will provide product design innovation and access to skills from universities.

2. Research Method

A. Research Setting

The research setting uses a quantitative process approach. Proof of the CAD learning method collaborates with SMEs using experimental research with a one-group pretest-posttest design. The choice of multiple posttests aims to cover the weaknesses of the first pretest and post-test internal validity (Salkind, 2010). The double posttest was used to observe changes in students' creativity and innovation during their stay in SMEs. The experimental design is listed in table 1 below.

Table 1 : Research Experimental Design

Weeks				
1	2	3	4	5
Traditional CAD Learning (Pretest)	Treatment with CAD Learning Method in SMEs	Posttest I	Treatment with CAD Learning Method in SMEs	Posttest II

Table 1 explains that the first-week students were given a worksheet-based CAD learning. Before students are assigned to SMEs, traditional CAD learning is still given to assess creativity and innovation through a pretest as initial data. Students develop creativity and product design innovation in SMEs from the second to the fifth week. Every two weeks, continually evaluate with a posttest regarding the quality of student creativity and innovation.

The experiment used one CAD practicum class in the Department of Mechanical Engineering Education, Universitas Negeri Yogyakarta. This study uses 5th-semester students who take 3D CAD courses for the 2021/2022 academic year. Respondents are students who take 3D CAD courses with a total student of 20 people. A lecturer was involved in this research as a collaborator with SMEs. The target of competency material is 3d modeling, simulation, and detail drawing. The research was conducted in the product design laboratory at universities and SMEs. The collecting data was five weeks with a week on campus and four weeks in SMEs.

B. Collecting Data

The data collection technique used the questionnaire. The questionnaire instrument consists of two instruments, including self-assessment on creativity and innovation. For indicators of creativity, refer to Azuma (Vandeleur, 2001), which consists of generating ideas, critical originality, thinking enjoyment, aesthetics, and risk-tasking. At the same time, innovation refers to the innovation theory summarized by Stoner et al., which suggests that innovation consists of creating new products, creating processes, product development, process improvements, and adding a creative touch by duplicating and integrating production factors and new methods (Wankel & Stoner, 2008).

The instrument used the Likert scale through a score of 1 to 5 with the gradation of answers adjusting the self-assessment rubric. Respondents can self-assessment their creativity and innovation abilities according to the conditions and facts. The development of the instrument went through a coherent phase, starting with determining the indicators of creativity and innovation, determining the instrument grid, expert judgment, testing the questionnaire in a limited class, analyzing the validity and reliability, and revising the instrument.

To ensure the research formulation is ready to be researched, it is necessary to experimental prerequisite testing. The test of prerequisite is the normality test with Kolmogorov-Smirnov and homogeneity test. Data analysis techniques are used to solve research problems using one-way analysis of variance. In addition, measuring the difference between each treatment was carried out to ensure significant differences in each test performed. The quality of each test and descriptive statistics are also needed, both in tables and in percentages.

3. Results and Discussion

Study programs in collaborative research routinely carry out cooperation with SMEs. Final project courses and industrial internships are the mainstays of the collaboration. This research broadens the scope of partnership implementation of CAD learning on campus and SMEs.

A. Development of CAD Learning Methods in SMEs

CAD learning methods in SMEs require planning, implementation, and evaluation support. Planning based on CAD competencies includes the curriculum structure, revitalizing material content adapted to SMEs' development, and applied lesson plan with CAD evaluation tools. Planning is the basis for successfully implementing experiments in CAD practicum classes. In the implementation, the needs are prepared, especially the willingness of students and SMEs, the Implementation of Arrangements (Cooperation Contract), and the schedule in SMEs. Students will fully implement their CAD skills to get various SMEs' product designs downstream and commercialize collaboration with partners. Capable computer equipment is an obstacle but can be optimized with supporting facilities for CAD learning in SMEs. In this section, students are also required to increase their creativity and innovation to contribute to the development of local SMEs. The evaluation stage requires an evaluation tool to measure student creativity and innovation in SMEs, measured at third and fifth weeks.

The implementation of CAD learning in SMEs is a sustainable collaboration between technical and vocational universities and SMEs. This micro elaboration is a dual system concept that benefits both as implemented and successfully in Germany (Herr & Nettekoven, 2017). The advantage obtained by the university is the development of competencies and experiences that impact student creativity and innovation (Hoffman & Schwartz, 2015), and SMEs benefit by solving industrial problems in the scope of product design, line mass production, and product innovation (Prabowo et al., 2020). This encourages the activeness of both parties to carry out design evolution. An overview of the CAD learning method that combines both parties is summarized in Figure 1.

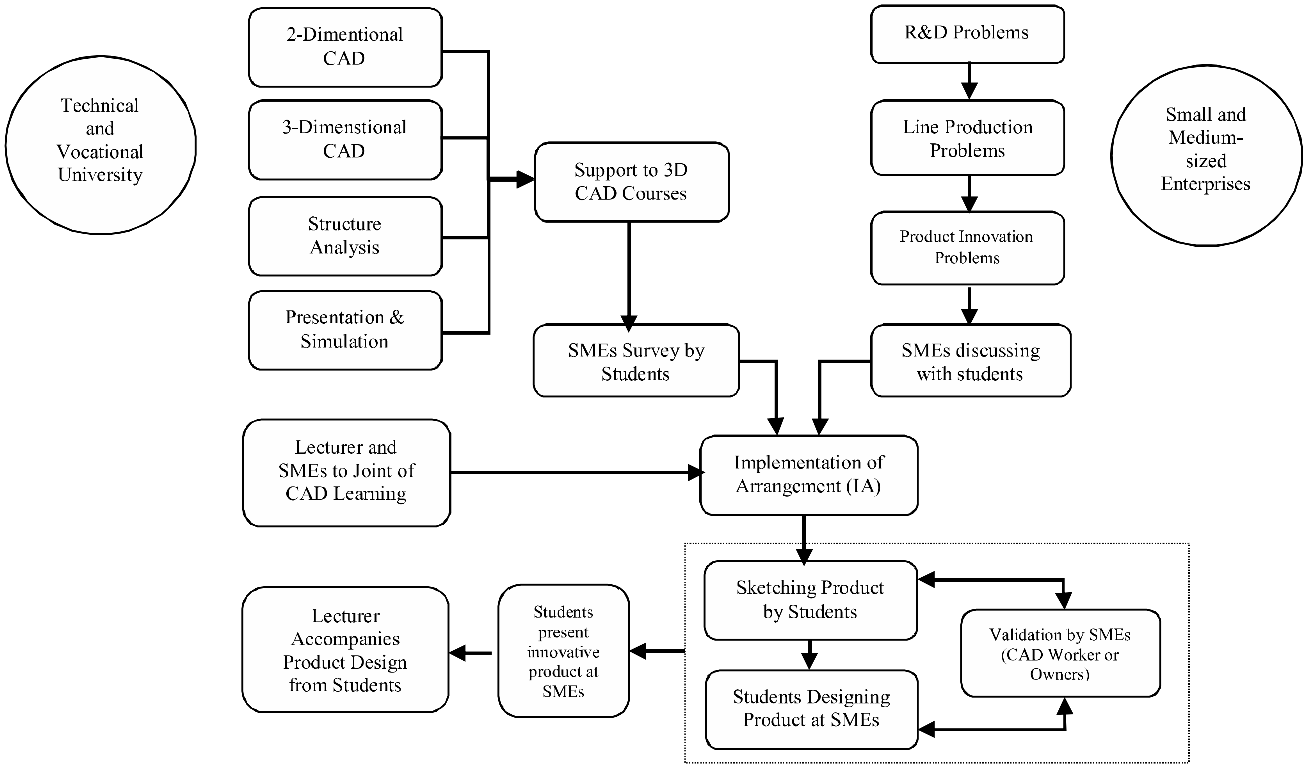

Fig. 1 : CAD learning methods in SMEs

The CAD learning method in SMEs (see Figure 1) shows a mature readiness of students with the provision of mastered software. The software includes AutoCAD for sketching, Autodesk Inventor for making parts, assembly, and presentations, and Ansys for computing structural analysis. The combination of multi-CAD software is a capital that needs to be considered to support the success of CAD learning in SMEs, affecting student hybrid creativity-innovation (Dare-Abel et al., 2016).

The CAD learning method has several advantages and disadvantages. The benefits of using SMEs collaborative CAD learning methods are (1) the quantity and quality of collaboration with SMEs are getting stronger, (2) industrial product design problems are solved by collaborative CAD learning, (3) student product design creativity and innovation are growing fast, (4) experience students' reality of the complexity of SMEs product design problems, and (5) synchronization of CAD learning materials on campus with empirical conditions in SMEs. However, on the other hand, there are several drawbacks to this method, including (1) the need for an integrated curriculum structure to support CAD courses, (2) determining SMEs that are appropriate to the field of mechanical engineering, and (3) for ordinary SMEs, the lack of openness about design issues. Industrial products.

Students will directly select a variety of problems in SMEs ranging from simple to complex and comprehensive difficulties. Students can convey the results of their product design innovations to SMEs. The application of the CAD learning method involves 3 SMEs were students in grouping each SME located in Yogyakarta, Indonesia. The product design jobs were carried out by 20 students divided into eight groups with the distribution described in Table 2 below.

Group	SMEs	Product Design	Sum of Students
1	ED Aluminium	Car Velg	3
2		Tap and Back Pad Wheelchair	3
3		The frame of the Electric Bike	3
4	WL Aluminium	Mold and Dies	2
5		Electric Panel Box	2
6		Wheel Drum	2
7	PT. Hari Mukti Teknik	Laundry Rotary Shaft	2
8		The frame of CNC Cutting Laser	3

Table 2 : Student Employment in Smes

The presence of students in SMEs provides significant changes to existing product designs. For example, by utilizing multi-CAD software, students can recommend evaluating SMEs modeling products in models, materials, and product weights (see figure 2). SMEs need this simple thing significantly to increase productivity, reduce production costs, streamline production, and increase company turnover .

B. The quality of student creativity and innovation

The quality of student creativity and innovation in CAD learning in SMEs refers to research indicators. Students are fully respondents in filling out the self-assessment questionnaire. They independently measure the extent to which the creativity received can be felt in every face-to-face in SMEs. Based on student self-assessment (Figure 3), both creativity and innovation instruments from the first week, third week, and fifth week showed a significant increase.

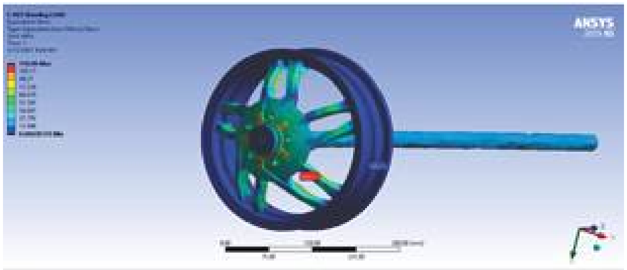

Fig. 2 : Creativity and innovation of student product design at SMEs. a) structure analysis of car velg;

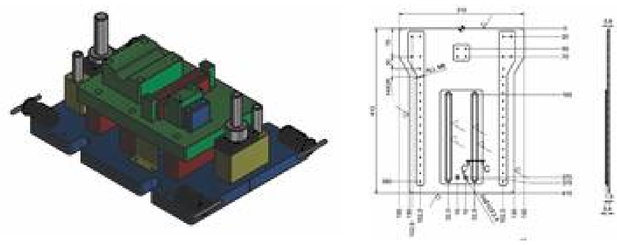

Fig. 2 : b) 3d-modeling of mold and dies, and c) mechanical drawing of tap and back pad wheelchair.

Based on the assessment of each quality (see Figure 3), visually, the graph shows a significant contribution after implementing CAD learning in SMEs. The highest aspect that dominates the histogram is how students express ideas to SMEs. In addition, students are also encouraged to provide critical and original concepts based on their experience, lectures, and other learning resources. The quality average of student creativity in the pretest position was 53.62%, after the third weeks' implementation of CAD learning method in SMEs was 71, 31%, and after the fifth week of treatment increased to 81.54%. This shows an increase in students' creativity from week to week after applying CAD skills in SMEs.

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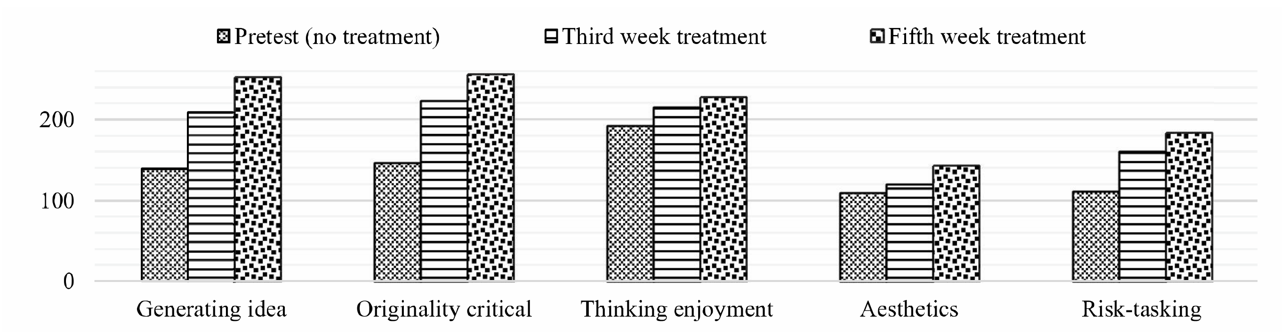

Fig. 3 : The quality of student creativity in CAD learning

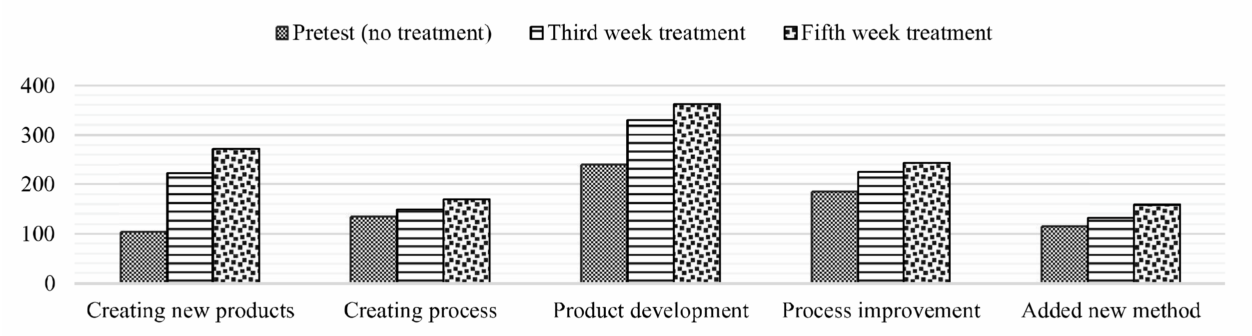

Fig. 4 : The quality of student innovation in CAD learning

The quality of innovation seen in Figure 4 increases after being given the CAD learning method in SMEs. The graph of a sharp increase can be seen in how students can create a new product and develop a product in SMEs. Students' skills in using several CAD software make it easier for them to innovate product designs to create new designs or reverse engineering existing designs (Kostic, Radakovic, Cvetkovic, Trajkovic, & Jevremovic, 2012). The results of the overall relative quality show that the first week with a percentage score of 55.71%. After the third week, the application of CAD learning methods in SMEs increased to 75.71%. In the fifth week, the quality of student innovation became 86.21%. This improvement in the quality of innovation is supported by students' motivation and interest in learning to make several innovative breakthroughs beneficial for SMEs.

C. Experimental prerequisite testing

The data analysis can be continued in-depth, so it needs testing of experimental prerequisites. Prerequisite tests include normality test with Kolmogorov-Smirnov and homogeneity test. The normality test was carried out on three variables: no treatment, after treatment at the third week, and after treatment at the fifth week. The normality and homogeneity tests are distributed in Table 3 and 4.

Table3:Data Normality Test With Kolmogorov-smirnov

Variables	Treatment Time	Statistic	df	Sig.
Creativity	The first week (pretest)	0.106	20	0.200*
	After the third week (posttest)	0.189	20	0.059
	After the fifth week (posttest)	0.133	20	0.200*
Innovation	The first week (pretest)	0.150	20	0.200*
	After the third week (posttest)	0.137	20	0.200*
	After the fifth week (posttest)	0.130	20	0.200*

Table 4: Homogeneity Test

Based on Mean	Levene Statistic	df1	df2	Sig.
Creativity Score	1.056	2	57	0.354
Innovation Score	0.338	2	57	0.715

Based on the analysis of the normality test (Table 3) and the homogeneity test (Table 4), which refers to the significance value, the data is normal and homogeneous. The value is concluded based on a significant value above 0.05. Because the prerequisite test is fulfilled, the inferential analysis can be breakdown comprehensively.

D. Testing the differences of experimental times

The test was carried out in three experiments—the first experiment without special treatment or using learning methods with practicum job sheet. The second experiment was carried out using the CAD learning method, where students were in SMEs until the third week and continued with a posttest assessment. The third experiment was that students continued their learning activities in SMEs until the fifth week, and in the last session, a posttest assessment was carried out.

From the results of the prerequisite test, it has been concluded that the data between variables is homogeneous and normal. This becomes a trigger to determine whether the three experiments have significant differences. The analysis uses one-way ANOVA through multiple comparisons from Bonferroni between experimental times, both creativity and innovation variables

Table 5 : Testing The Difference in Experimental Time Together

Variables	Analysis of Groups	Sum of Squares	df	Mean Square	F	Sig.
Creativity Score	Between Groups	3372.633	2	1686.317	119.985	0.000
	Within Groups	801.100	57	14.054		
	Total	4173.733	59			
Innovation Score	Between Groups	4705.633	2	2352.817	204.890	0.000
	Within Groups	654.550	57	11.483		
	Total	5360.183	59			

Table 5 shows that testing CAD learning methods in SMEs together significantly affects student creativity and innovation. The significance value of 0.000 indicates that the experimentally observed show differences, and there is no visible similarity in the data. To ensure the difference between each experiment of the two variables, a post hoc test of comparison multiple was carried out with the results as presented in Table 6 and Table 7.

Table 6 : Bonferroni's Multiple Comparisons on Aspects of Student Creativity

(I) Creativity of CAD Learning	(J) The creativity of CAD Learning	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No Treatment	After the 3rd week	-11.500*	1.186	0.000	-14.42	-8.58
	After the 5th week	-18.150*	1.186	0.000	-21.07	-15.23
After the 3rd week	No treatment	11.500*	1.186	0.000	8.58	14.42
	After the 5th week	-6.650*	1.186	0.000	-9.57	-3.73
After the 5th week	No treatment	18.150*	1.186	0.000	15.23	21.07
	After the 3rd week	6.650*	1.186	0.000	3.73	9.57

Table 7 : Bonferroni's Multiple Comparisons on Aspects of Student Innovation

(I) Innovation of CAD Learning	(J) Innovation of CAD Learning	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No Treatment	After the 3rd week	-14.000*	1.072	0.000	-16.64	-11.36
	After the 5th week	-21.350*	1.072	0.000	-23.99	-18.71
After the 3rd week	No treatment	14.000*	1.072	0.000	11.36	16.64
	After the 5th week	-7.350*	1.072	0.000	-9.99	-4.71
After the 5th week	No treatment	21.350*	1.072	0.000	18.71	23.99
	After the 3rd week	7.350*	1.072	0.000	4.71	9.99

The comparison table shown in table 6 for creativity and table 7 for innovation shows the difference between experiment times. Both creativity and innovation that have used the CAD learning method in SMEs showed a significant difference with a reference value of 0.000. Every time the treatment is given results in a different score, a substantial change in score occurs.

Collaborative CAD learning with SMEs positively impacts lecturers, students, and partners. The results of confirmatory interviews with CAD lecturers revealed that in implementing product design collaboration with SMEs, lecturers could provide intervention on product design ideas. Lecturers have an in-depth understanding of fundamental issues in SMEs product design. Students gain experience providing product design recommendations to SMEs and increasing creativity and product design innovation. The presence of lecturers and students at SMEs can solve product design problems. SMEs with limited resources can be empowered by maximizing the role of students in collaborative CAD learning. The three parties involved benefit from each and must be disseminated in other CAD learning. In essence, SMEs need the presence of universities in the development of product design innovations to compete with global industries.

The CAD learning method in SMEs provides an increase in both student creativity and innovation. This happens because students are motivated from time to time to do better. After all, they position themselves as workers or teamwork of CAD in a company that emphasizes quality and quantity (Poh Kiat Ng et al., 2012). An engineering student requires creativity and innovation during the CAD courses (Bayu R. Setiadi, Suparmin, & Samidjo, 2018). External encouragement can also be one of the triggers to provide students with increased product design skills. Every design work carried out by students is constantly monitored by industry and course lecturers.

4. Conclusion

CAD learning methods in SMEs provide creativity and innovation of students to increase from time to time. This change occurred because students considered product design courses like a student's future workplace, so they needed to be serious about product design. This can be seen there is a significant difference between the experimental time from the start without treatment to the treatment given until the fifth week. A collaboration between the Technical and Vocational University and SMEs will significantly influence educational institutions to get to know job occupations, and SMEs are assisted by product design engineering.

References

[1] Asperl, A. (2005). How to teach CAD. Computer-Aided Design and Applications, 2(1–4), 459–468. https://doi.org/10.1080/16864360.2005.10738395

[2] Burger, N., Chazali, C., Gaduh, A., Rothenber, A. D., Tjandraningsih, I., & Weilant, S. (2015). Reforming policies for small and medium-sized enterprises in Indonesia. RAND Corporation in collaboration with Tim Nasional Percepatan Penanggulangan Kemiskinan (TNP2K). Retrieved from http://www.tnp2k.go.id/images/uploads/downloads/Reforming SMEs_0529_lowres_2015-1.pdf

[3] Dare-Abel, O., Uwakonye, O., & Opoko, A. (2016). The Effect of CAD on Architecture Students' Creativity and Enthusiasm. INTED2016 Proceedings, 1(March), 8530–8536. https://doi.org/10.21125/inted.2016.0984

[4] Eves, K., Salmon, J., Olsen, J., & Fagergren, F. (2018). A comparative analysis of computer-aided design team performance with collaboration software. Computer-Aided Design and Applications, 15(4), 476–487. https://doi.org/10.1080/16864360.2017.1419649

[5] Galushko, V., & Sagynbekov, K. (2014). Commercialization of University Research in Canada: What Can We Do Better? International Journal of Business Administration, 5(5). https://doi.org/10.5430/ijba.v5n5p1

[6] Goncher, A., Chan, J., & Schunn, C. D. (2017). Measuring design innovation for project-based design assessment: Considerations of robustness and efficiency. Revista Bitácora Urbano Territorial, 27(4), 11–18. https://doi.org/10.15446/bitacora.v27n4Esp.68959

[7] Herr, H., & Nettekoven, Z. M. (2017). The Role of Small and Medium-Sized Enterprises in Development. Nigerian Chapter of Arabian Journal of Business and Management Review. Berlin: Friedrich-Ebert-Stiftung. https://doi.org/10.12816/0040342

[8] Hoffman, N., & Schwartz, R. (2015). Gold Standard: The Swiss Vocational Education and Training System International. Washington, DC: National Center on Education and the Economy.

[9] Kostic, Z., Radakovic, D., Cvetkovic, D., Trajkovic, S., & Jevremovic, A. (2012). Comparative Study of CAD Software, Web3D Technologies, and Existing Solutions to Support Distance-Learning Students of Engineering Profile. International Journal of Computer Science Issues, 9(4), 181–187.

[10] Kumar, V. (2009). A process for practicing design innovation. Journal of Business Strategy, 30(2–3), 91–100. https://doi.org/10.1108/02756660910942517

[11] Morisson, A., & Pattinson, M. (2020). Industry collaboration: a policy brief from the policy learning platform on. Lille.

[12] Poh Kiat Ng, Kian Siong Jee, & Nurul Izah Anuar. (2012). Enhancing Creativity Through

Teamwork, Continuous Improvement And CAD: A Review. 3rd International Conference on Engineering and ICT, (April), 68–73.

[13] Prabowo, R., Singgih, M. L., Karningsih, P. D., & Widodo, E. (2020). New product development from inactive problem perspective in Indonesian SMEs to open innovation. Journal of Open Innovation: Technology, Market, and Complexity, 6(1). https://doi.org/10.3390/JOITMC6010020

[14] Robertson, B. F., Walther, J., & Radcliffe, D. F. (2007). Creativity and CAD tools: Lessons for engineering design education from the industry. Journal of Mechanical Design, Transactions of the ASME, 129(7), 753–760. https://doi.org/10.1115/1.2722329

[15] Salaryexplorer. (2021). CAD Drafter Average Salary in Indonesia 2021. Retrieved from www.salaryexplorer.com/salary-survey.php?loc=101&loctype=1&job=90&job type=3

[16] Salkind, N. J. (2010). Encyclopedia of research design. Dictionary of Statistics & Methodology. Singapore: SAGE Publications Asia-Pacific Pte. Ltd. https://doi.org/10.4135/9781412983907.n439

[17] Setiadi, B. R., Puspito, J., Sudiyatno, Kurniawan, D., & Kartowagiran, B. (2020). Isn't it effective if the transformation of product design tests into 3-dimention modelling? Journal of Physics: Conference Series, 1700(1). https://doi.org/10.1088/1742-6596/1700/1/012004

[18] Setiadi, Bayu R., Suparmin, & Samidjo. (2018). Preparing engineering students for entrepreneurial creative industries. Global Journal of Engineering Education, 20(2), 127–131.

[19] Suarta, I. M., Suwintana, I. K., Fajar Pranadi Sudana, I. G. P., & Dessy Hariyanti, N. K. (2018). Employability skills for entry-level workers: A content analysis of job advertisements in Indonesia. Journal of Technical Education and Training, 10(2), 49–61. https://doi.org/10.30880/jtet.2018.10.02.005

[20] Tambunan, T. (2019). Recent evidence of the development of micro, small and medium enterprises in Indonesia. Journal of Global Entrepreneurship Research, 9(1). https://doi.org/10.1186/s40497-018-0140-4

[21] van Rijn, R. A. C., van Esch, P. M. R., Price, R. A., Oonk, M. M. E. M., & Netten, M. P. (2018). U and I: Insights from a University-Industry Design Collaboration. 21st DMI: Academic Design Management Conference Next Wave, (August), 1–2.

[22] Vandeleur, S. (2001). Indicators of creativity in a technology class: a case study. South African Journal of Education, 21(4), 268–272.

[23] Veisz, D., Namouz, E. Z., Joshi, S., & Summers, J. D. (2012). Computer-aided design versus sketching: An exploratory case study. Artificial Intelligence for Engineering Design, Analysis and Manufacturing: AIEDAM, 26(3), 317–335. https://doi.org/10.1017/S0890060412000170

[24] Wankel, C., & Stoner, J. A. F. (2008). Innovative Approaches to Global Sustainability. New York, NY: Palgrave Macmillan.

[25] Williams, A., Ostwald, M., & Askland, H. H. (2010). Assessing Creativity in the Context of Architectural Design Education. Proceedings of Design Research Society (DRS), (June), 1–9.

[26] Winn, D., & Banks, F. (2012). CAD and Creativity – A New Pedagogy, (2001), 488–495