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## **Exploring Two Student's Group Perception of BIM course in an Indonesia Vocational Higher Institution**

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### **ABSTRACT**

Building information modelling (BIM) utilization in architecture construction and engineering (ACE) companies in Indonesia is growing. BIM has been seen to have benefit in reducing cost and shortening building construction time. However, lack of BIM skilled workforce hamper BIM adoption in AEC companies in Indonesia. Therefore, questionnaire has been developed and distributed to student to measure perception about BIM course. Nineteen five-likert scale questions were developed to measure student perception about student computer skill background, benefit of BIM knowledge for future career, material quality, time allocated, and benefit of exam and assignment. The questionnaires were distributed to two group of students that are student worker and regular student. The data were analyzed using descriptive statistics and Welch's t-test to compare the perceptions of the two groups. The study found no significant difference in perceptions between student workers and regular students. These insights can help refine the BIM curriculum to better align with industry requirements. The groups were selected whether the student workers had different perception about the course compare to regular student.

**Keywords:** BIM, Student's perception, Student workers, Vocational Higher institution;

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### **INTRODUCTION**

Building information modelling (BIM) has been increasingly adopted in Architecture Engineering and Construction (ACE) industries in Indonesia. BIM adoption in Indonesia becomes evident, due to Indonesian government has made BIM mandatory for any state building projects that have more than 2 stories and size over than 2000 m<sup>2</sup> in 2024 (Menteri Pekerjaan Umum dan Perumahan Rakyat 2024). Therefore, companies must have BIM capability in order to secure contract from government. However, study find that BIM maturity level in Indonesia is still relatively low. Josefine identify the obstacles of BIM Implementation by seven challenge variables. The variables are BIM technical readiness, organizational paradigm changes regarding BIM, work environment awareness of BIM, compliance on BIM rules, increased competency and skills, consistent application of effective leadership, maturity of BIM utilization(Latupeirissa, Arrang, and Wong 2024). Indonesian AEC companies, particularly small and medium companies are still in pre-BIM stage. The companies still use 2D drawing for construction activities. Inadequate of BIM skilled workforce in Indonesia is among barriers that delay BIM

implementation in Indonesia. Therefore, education to create BIM skill graduates in Indonesia is in dearth. However, incorporating specific BIM course into AEC higher education is still rare, particularly in vocational higher education. Dense curriculum and high cost hinder BIM adoption in higher institution. With creating BIM skilled graduate in mind, Astra Polytechnic as a vocational higher institution have developed curriculum that specifically address BIM course in associate degree program.

Because vocational institution is a job-focused education, the curriculum differs than university. Vocational education must have at least 60% of their courses are practice courses. The course is a practice course means that the course was conducted in laboratory. The student learned BIM by practicing BIM software. The BIM software used in the course is Revit Architecture. The student follows BIM module to practice the software during the course. The course were 16 weeks long including 1 week mid-term exam and week final project presentation. Measurement of student perception of BIM course at the end of semester is beneficial. Therefore, in this paper, study of student perception of BIM course was conducted. Contribution of BIM course student perception in vocational institution study are two-folds Firstly, to gain feedback to make improvement for the course. Secondly, the study provides knowledge to reader about BIM course student perception in vocational higher institution. Therefore, the reader can use the study as reference to develop BIM course.

Nowadays, the BIM becomes integrated in AEC industry as companies gain benefit from cost reduction and faster construction time. AEC professionals can detect clash faster using BIM than 2D drawing. Moreover, AEC professionals can understand project comprehensively because they can accurately model building and process construction(Farid et al. 2023). As demand for BIM skilled professional growing, higher education must incorporate BIM course into their curriculum. Many countries have been successfully integrating BIM course into higher education curriculum, including Malaysian universities (Tanko and Mbugua 2021). However, educators still find challenges to integrate BIM courses into curriculum. Therefore, evaluation is needed to improve courses material to meet industry standard and students need.

BIM is seen as advanced technology in AEC industry. Furthermore, teaching BIM is not merely changing teaching material from 2D software to 3D software, but, changing paradigm. BIM is not about teaching visualization but to teach student to understand construction project comprehensively (Papuraj, Izadyar, and Vrcelj 2025). Therefore, understanding student perception about BIM course is important. Many researchers have studied student's perception about BIM course. Bruno (2022) study Malaysia's student perception of BIM education. The study finds 5 research gaps to be included in BIM course in higher institution. Information management, curriculum are among the 5 key areas. Narmin (2024) studied student's sentiment towards BIM usage in construction management project in United Arab Emirates. The study

found that the students have positive learning experience. However, both studies require rigorous data collection and analysis. Bruno (2022) executed quantitative research about student perception of BIM in classroom is more suitable to obtain quick feedback from targeted group of students. Therefore, the study follows research to obtain students perception.

There are two kind of student classes that register to BIM class, the first class is working students class and the second one is regular class. The working student class are student who are working in construction industry, therefore has exposed to BIM before, while the regular students are the students who never know BIM before.

Therefore, questionnaires were distributed to measure whether there is significant differences between regular student and working student’s perception about BIM course. The perception is important for syllabus improvement.

## **METHOD**

Questionnaires were distributed to student at the end of semester after they studied BIM course. The approach methods that are used to conduct the research are the inductive approach. This approach is the most appropriate methods with small qualitative data. Data are collected and a theory developed as a result of the data analysis. The class consist of 15 students. All 15 students answered the questionnaires through google form. The questionnaires have 19 questions 5-likert scale, with 1 means “very disagree” and 5 means “total agreement”. The questionnaires use Indonesian language. There are 2 sections in the questionnaire. The first section consist of 6 questions were addressed to obtain student general information about BIM courses. The second section consist of 13 questions were addressed to obtain perception about software usage. The data obtained are as shown in Table 1.

Table 1. Questionnaires Data

Data Type	Description	Values
1. Groups	Two student groups compared in the analysis	- Regular Students - Student Workers
2. Total respondents	Number of participated students	15 students from the first year of Building Construction Technology Class
3. Questionnaire structure	Likert-scale questions divided into two sections	19 total questions - 6 General Information Questions - 13 Software/Practical Usage Questions
4. Likert scale	Response options for the questionnaire	- 1: Very Disagree - 2: Disagree - 3: Neutral - 4: Agree - 5: Strongly Agree

Further, the results were analysed using descriptive statistic. Means, mode, and median were calculated to provide distribution analysis. Secondly Welch-t test was employed to study differences between regular student and working student. Because those two groups have

different sample size then Welch-t test are employed. The algorithm of the data analysis is as explained in Table 2.

Table 2. Data Analysis Algorithm

Procedure	Details	Tools
1. Data collection	Collect questionnaire responses from both regular and student workers using Google Forms. The data consists of 19 Likert-scale questions.	Survey via Google Forms
2. Categorize responses	Group the data into two categories: (1) Regular Students (2) Student Workers.	Manual categorization based on academical data
3. Data cleaning	Check for incomplete responses.	Removal or imputation missing values
4. Calculate data statistics	Compute the mean, median, and mode for each question for both groups. Further, determine the variance for each group to assess the variability of responses.	Statistics calculation formula
5. Apply Welch's t-test	Use Welch's t-test to compare the two groups to see the statistically significant difference in their perceptions. Use the result to calcute the value of the degree of freedom.	Welch t-statistic formula
6. Compare t-statistic with critical value	Compare the calculated t-statistic with the critical t-value at the calculated degrees of freedom to determine statistical significance.	Obtained from the t-distribution table
7. Interpret results	Determine the null hypothesis to validate the significant difference between two groups.	If p-value are higher than 0.05, accept the null hypothesis (no significant difference)

The results are processed using descriptive statistics method. Statistics provide valuable insights for decision-making by transforming raw data into useful information. Descriptive statistics are applied to large sets of disorganized data, making it an effective method for organizing, summarizing, and presenting data in a clear and meaningful manner. In a set of data, determining the central tendency is important for calculations. Values used for this analysis include the mean, median, and mode (Lind, Marchal, and Wathen 2024). Once the mean is determined, the variance is calculated to assess the average amount by which the data points differ from the mean. The formulas for sample variance are applied in this analysis (Lind et al. 2024).

Descriptive statistics play a crucial role in summarizing, organizing, and analyzing data to make it more comprehensible. In this study, descriptive statistics were used to provide an overview of students' perceptions of a Building Information Modeling (BIM) course at a vocational higher education institution. This analysis offered insights into the central tendencies and distribution of students' responses, serving as a foundation for further statistical comparisons between regular students and student workers. By interpreting the descriptive statistics, the study was able to identify general trends, pinpoint areas where students expressed satisfaction or dissatisfaction, and lay the groundwork for more detailed analyses like the Welch's t-test.

Descriptive statistics involve summarizing data in a manner that highlights patterns and key features. This approach is especially useful when dealing with survey data, where multiple respondents provide ratings on a scale, such as the five-point Likert scale used in this study. The main measures used in descriptive statistics are explained in Table 3(Prasad 2023).

Table 3. Descriptive Statistics Main Measurement

Main Measures	Details	Purpose
1. Central Tendency	Include the mean, media, and mode	Shows typical values in a set of data
2. Dispersion	Include range, variance, and standard deviation	Reveal how spread out the responses are around the mean
3. Frequency Distribution	Include the number of selected options	Show how frequently each response option was selected by the respondents

Using these methods, the study provided a clear overview of how students viewed various parts of the BIM course, including how easy they found the software to learn, the quality of the course materials, and the potential career advantages of gaining BIM skills.

The Welch t-test is a modification of the student's t-test designed for comparing two samples that may have unequal variances. Unlike the Student's t-test, it does not combine variances from different sources. Instead, it adjusts the denominator to account for the possibility that the samples come from populations with unequal variances. As a result, this method is also referred to as the unequal variance t-test or non-pooled variance t-test. The t-statistic in Welch's t-test is calculated using a formula that reflects these adjustments (Curtis 2024)

The commonly used formula was introduced by Welch. The degrees of freedom related to this variance estimate are approximated from the sample data using the Welch-Satterthwaite equation.

The calculated t-statistic should be compared to the critical value. If the absolute value of the t-statistic exceeds the critical value, the result is deemed statistically significant, leading to the rejection of the null hypothesis. If the t-statistic is less than or equal to the critical value, the null hypothesis cannot be rejected, suggesting no statistically significant difference between the groups.

When comparing groups with different professional backgrounds, such as regular students and working students, Welch's t-test is often chosen because it is more robust in cases where the groups may have unequal variances. This method is particularly useful when the assumption of equal variances required by the standard Student's t-test is not met, which is common when the groups have different levels of experience or familiarity with a subject. As the Derrick B suggests, in practical situations involving the comparison of two means from normal populations, it is recommended to use Welch's t-test when there is uncertainty. This is because Welch's t-test maintains robustness against Type I errors in normally distributed data, particularly in cases where the independent samples t-test may fail to do so (Curtis 2024). Students who have

experience working in the construction industry often have a better understanding of Building Information Modeling (BIM) concepts due to their practical use of the technology. This familiarity allows them to approach the material with more confidence, resulting in more consistent survey answers. On the other hand, students without work experience typically encounter these concepts for the first time in an academic setting, leading to greater variation in their responses as they adapt to new information. This difference in experience can result in varying levels of understanding between the two groups (Phan and Thuy T 2024)

Welch's t-test is an ideal method to address these variations, as it adjusts for differences in variances between groups, such as the ones seen between experienced and inexperienced students. Unlike traditional t-tests, which assume equal variances, Welch's t-test calculates a statistic that takes into account each group's unique variance, allowing for a more accurate comparison of their average perceptions. This makes it particularly useful when sample sizes are not equal, ensuring that comparisons between the groups remain fair even if one group is larger than the other.

## **RESULTS AND DISCUSSION**

Results of questionnaires are summarized in Table 4 and Table 5 below. Questions in Indonesian and English are provided in the table to provide clear information to the reader.

Table 4. General information

<b>Questions</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Means</b>	<b>Mode</b>	<b>Median</b>
I find it is easy to learn new computer software and applications.	0	0	8	6	1	3.53	3	3
I consider myself to be computer literate.	0	2	5	7	1	3.20	3	3
After attending this building information modeling (BIM) class, I felt that I could discuss the use of BIM in relation to course materials.	0	1	2	9	3	3.47	4	4
I feel that the BIM material gives me a good orientation in civil engineering so that I can reuse this knowledge when I need the material in the workplace.	0	0	3	3	9	3.93	4	4
How valuable do you think the BIM material can help you in advancing your career in your current job after graduation?	0	0	2	3	11	4.40	5	5
How important is knowing the BIM to your success in the construction industry in the future	0	2	6	7	0	4.60	5	5

Table 5. Specific information

Question	1	2	3	4	5	Means	Mode	Median
Practicum instruction in the classroom is adequate.	0	2	6	7	0	3.33	4	3
I had experience using Autodesk Revit Architecture software before I took BIM courses.	1	2	8	2	2	3.13	3	3
The Revit software is intimidating me.	1	5	6	0	1	2.40	3	2
The Revit software is easy to use.	0	0	9	3	3	3.60	3	3
Practicum tutorial is detailed enough to complete class assignments.	0	1	9	3	2	3.40	3	3
The practicum tutorial is too complicated and detailed, causing confusion.	1	6	3	4	1	2.87	2	3
The tutorial is not detailed enough to do what is required in the practicum assignment.	1	6	6	4	0	2.73	2	3
I see more value by studying the BIM.	0	0	5	4	6	4.07	5	4
Practical assignments are time consuming.	3	5	6	1	0	2.33	3	2
There is enough time to do assignments and get help from instructors in class.	0	1	7	6	1	3.47	3	3
Instructions for doing practicum assignments are clear.	0	0	7	2	6	3.93	3	4
UTS and UAS help me understand BIM better.	0	2	2	4	5	3.80	5	4
UTS and UAS questions are adequate.	0	1	6	6	2	3.60	4	3

### Measures of Central Tendency

From the data collected, one important way to measure central tendency is the mean, or average, which is crucial for analyzing survey results. The mean was calculated for each question to understand how students feel about the course overall. For example, a high average score on questions about career relevance suggests that students mostly agree that having skills in Building Information Modeling (BIM) is important for their future jobs. On the other hand, a low average score might show that students are not satisfied with certain parts of the course, like the complexity of the software or not having enough time. In this study, the average scores for

questions about how useful BIM skills are for future careers were usually above 4, which indicates strong agreement that learning BIM would help students in their careers. This finding matches global trends, where being skilled in BIM is seen as a valuable asset in the Architecture, Engineering, and Construction (AEC) industries (Abouelkhier et al., 2024).

The second measure of central tendency is the median. The median is the middle value when all responses are arranged from lowest to highest. It is especially useful for dealing with skewed data because it is less affected by extreme values or outliers. For instance, if most students rated the course positively but a few gave very low ratings, the median would give a clearer picture of the overall student feelings than the mean. In this study, the median scores for most questions ranged from 3 to 4, suggesting that students generally had neutral to positive views about the BIM course. This measure was particularly helpful in pinpointing areas where opinions varied more, such as whether there was enough time to complete assignments.

The third measure of central tendency is the mode. The mode is the most common response in a set of data. In this study, the mode was used to find out which ratings were given most often by students for each survey question. For example, a mode of 5 for a question about the quality of teaching materials would mean that most students thought the materials were very good. Identifying the mode helped to understand which parts of the course received the most praise or criticism.

### **Measures of Dispersion**

The first measure of dispersion is the range. The range shows the difference between the highest and lowest responses. In this study, the range helped to understand how varied student opinions were on certain topics. For example, a wide range in responses to a question about how complicated the software was might mean that some students found the BIM software easy to learn, while others had a lot of trouble with it.

The second measure of dispersion is variance and standard deviation. These two measures give a clearer picture of how spread out the student's answers were. A low standard deviation means that most responses were close to the average, indicating that students mostly agreed. On the other hand, a high standard deviation means there were many different opinions. In this study, questions about how relevant BIM is for career development had low standard deviations, showing that most students agreed that BIM skills are important. However, questions about how hard the software was to learn had higher standard deviations, which means there was a wider range of experiences among students. For instance, if a question had a mean score of 4.2 and a standard deviation of 0.5, it suggests that most responses were around 4 or 5, indicating strong agreement. In contrast, a standard deviation of 1.2 for a question about software complexity would mean that some students found it very hard, while others didn't have much trouble at all.

### **Frequency Distributions**

Frequency distributions were used to show how often each answer choice was selected for each survey question. By displaying this information in tables or charts, the study could easily spot trends, such as which questions received very mixed responses compared to those with more evenly spread answers. For example, the frequency distributions revealed that most students, around 60%, rated the question about the value of BIM for their careers as a 5, meaning they strongly agreed. The other students selected a 4. This suggests that most students believe learning BIM offers important career benefits, which aligns with larger trends in the Architecture, Engineering, and Construction (AEC) industry, where BIM is becoming an essential skill for professionals (Abouelkhier et al. 2024)

### **Welch's T-Test**

After the initial analysis of the survey data using descriptive statistics, the researchers used Welch's t-test to compare the average responses from two different groups of students: regular students and student workers. To calculate the Welch's t-statistic, they needed to find the difference between the average scores of the two groups for each question in the survey. This calculation also considered the variance and sample size for each group, which helps make the comparison more precise by not assuming that the groups have the same level of variability.

The formula they used accounts for the differences in variability within each group, making it a more reliable method. Additionally, the degrees of freedom for each survey item were determined using the Welch-Satterthwaite equation. This equation helps to adjust for the differences in sample sizes and variances, ensuring that the comparisons made are fair and unbiased.

Using Welch's t-test is particularly useful when the variances of the two groups are not equal. Although there might be a slight decrease in statistical power when using Welch's t-test, depending on the shapes of the data distributions, the rate of errors remains more stable compared to using the traditional Student's t-test. Furthermore, Welch's t-test is less reliant on assumptions that are hard to test, making it a robust choice for this kind of analysis (West 2021). The test is performed in terms of robustness was  $\alpha = 0.05$  level of significance for 13 sample size which is the number of specific questions (Curtis 2024). The results are presented in the following Table 6 below.

Table 6. Welch's t-test results

<b>Statistic</b>	<b>Group 1</b>	<b>Group 2</b>
Sample size (n)	13	13
Mean	3.18	3.17
Variance	1.20	1.16
Standard Deviation (SD)	1.095	1.077
Standard Error of The Difference (SE)	0.426	
T-statistic (t)	0.023	
Degrees of Freedom (df)	23	

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P-value > 0.05

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There is no statistically significant difference between the two groups as the calculated t-value 0.023 is much smaller than the critical value for the given degrees of freedom, resulting in a high p-value. This finding suggests that both groups generally shared similar views about the BIM course, including its usefulness for their careers and the quality of course materials. This alignment between the two groups implies that the course successfully communicated the professional value of BIM to all students, regardless of their prior experience.

### **Discussion**

The questionnaire responses provided a balanced view of both positive and negative perceptions related to the BIM course. While some students expressed challenges or difficulties with aspects of the course, such as the complexity of the software, the pace of lessons, or the adequacy of support during practical sessions, these negative responses were mostly rated below 3 on a Likert scale. A score below 3 typically indicates disagreement, suggesting that students did not strongly feel that these aspects hindered their learning experience significantly.

On the other hand, positive responses, such as the perceived value of BIM for future career prospects, the effectiveness of the course content, and the clarity of instruction, were dominantly rated between 3 and 4. Scores in this range generally reflect agreement or a positive view of these aspects. This indicates that students found the BIM course beneficial and worthwhile, appreciating its role in preparing them for real-world applications in the construction and engineering industries.

The contrast between the ratings of positive and negative feedback suggests that, overall, students were more inclined to view the BIM course favorably. Although some aspects received criticism, these concerns were relatively minor compared to the overall positive impressions. This trend indicates that the course's benefits, such as enhancing students' skills and understanding of BIM, outweighed the challenges they faced during the learning process. As a result, the data suggests a generally positive reception of the BIM course, with the negative aspects being less impactful on the students' overall perceptions.

The t-test results indicated that the difference in the mean values between the two groups—regular students and student workers—was not statistically significant. This suggests that both groups have comparable views on the course content and their learning experiences. Consequently, the null hypothesis, which posits that there is no significant difference between the groups, cannot be rejected. A potential explanation for this lack of difference could stem from the students' similar backgrounds. Both groups likely share regional and educational similarities, as they are from the same geographic area and have been working through the same course material together. This shared context may contribute to their parallel perceptions of the course.

Question 1 and 2 From general information in shows that students are not afraid to learn new software, they feel easy to learn new software. Further, questions 2 shows that most students think they know how to operate computer easily. The students also feel confident to discuss BIM as shown in question 3. Further, students think that having knowledge of BIM is valuable for their future career as shown from question 4,5, and 6.

From specific questions related specific software usage and practicum. Students think that class has been conducted very well. Response from question 1 and 11 show that student did not have problem to do the task given in the class. While in previous semester they learn how to model building using google sketch up, it seems that 4 students have learned Autodesk Revit. Questions no 3 and 4 address student perception about Autodesk Revit, the responses indicated that the students are convenience with Autodesk Revit. Questions 5, 6, 7, and 11 measured student perception about module usage for practicum in class. Students think that the module instruction is clear enough to be done in class. All tasks in the module can be completed during class. Questions 9 and 10 show that time allowed to finish task in class is adequate. Furthermore, the students also have positive perception of mid-term exams and final project assignment as shown in question 12 and 13. They believe that the exam and final project improve their knowledge about BIM.

These subtle trends, even if they are not statistically significant, provide important feedback for instructors. They highlight areas where changes could be made to better assist students from various backgrounds. For instance, offering additional tutorials or hands-on practice sessions for those who are less familiar with industry-specific software could be beneficial. By addressing these differences, instructors can create a more equitable learning environment, allowing all students, regardless of their previous experience, to engage more fully with the course material.

## **CONCLUSION**

Based on the students' responses from questionnaires after completing a semester-long BIM class, it appears that their perceptions of the course are largely positive. The students view BIM as a valuable lessons for their future careers, indicating that they recognize its relevance in the industry. Additionally, they believe that the course structure, including the content of the modules and the amount of time allocated, is sufficient to support their learning needs.

These findings suggest that the course has been well-received, with students feeling adequately supported in learning the software and in understanding how BIM fits into broader civil engineering practices. The consistent responses from both regular students and student workers indicate a strong sense of satisfaction with the course's design, instructional materials, and the practical applications of BIM. However, it is important to note that while the questions

posed in the survey were simple and straightforward, they may not capture the full complexity of students' perceptions regarding the BIM course. To gain a more comprehensive understanding, further research is necessary. Implementing qualitative interviews can provide deeper insights into student experiences and opinions, complementing the quantitative data gathered from the surveys. Additionally, employing mixed-methods research approaches may enhance future research designs by integrating various perspectives and methodologies, which is supported by educational research literature.

In summary, while the current findings paint a positive picture of the BIM course, further exploration through qualitative methods could offer valuable insights into the nuances of student perceptions, ultimately leading to more effective course enhancements.

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