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Do the Informatics Freshmen Satisfied with Information Technology-assisted Learning? A Study During the Pandemic Era

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***Abstract*—Over three years after Patient 0 was identified, COVID-19 is still a scourge for the world. It has taken its toll in various aspects, including altering day-to-day human routines. Its impact on education forces classes to be held online in a synchronous virtual meeting or through asynchronous learning that utilizes a Learning Management System (LMS). Despite the benefit it offers, this practice brings forth another concern in regard to the student's acceptance. In this study, we addressed the satisfaction issue of freshmen, who just entered college and must be facing online learning through an LMS. 647 freshmen students of Informatics from batch 2021 and 2022 were surveyed, with 565 valid answers returned. The satisfaction questionnaire itself is based on previous works at the same institution. Descriptive and inference statistical techniques were applied for data analysis. In the end, although there are two opposing views, the analysis of the questionnaire results shows that this learning model is well-received by the students, yet with some aspects that should be concerned for future improvement.**

***Keywords*—blended learning, flipped classroom, covid-19 pandemic, college freshmen, online learning acceptance**

I. Introduction

After identified for the first time nearing the end of 2019, the novel Corona Virus which later officially known as SARS-COV-2 became a global pandemic since March 2020 [1], [2]. Due to its nature of transmissions between humans [3], [4], most governance took action such as social distancing to prevent its wider spread [5].

To achieve social distancing, various day-to-day activities have been altered so they can be done online, including higher education [6], [7]. These situation brings new challenges either to students, lectures, and the institutions [8] as well. Therefore, numerous solutions already tried by lecturers to provide learning contents and assessments that could help students achieve the expected learning outcomes even without onsite face-to-face meetings. For instance, in [9], online platforms such as Google Colab and JupyterHub have been utilized to deliver lecture contents on statistical scripting languages to students. The development itself was undertaken in a program of a university that has about a decade track in technology-assisted learning. Before 2021, the already have studies in designing and evaluating online learning activities [10], [11], content delivery [12], and preferences [13]–[19]. However, those studies were done before the pandemic era.

As mentioned earlier, during the pandemic era, students are faced with various challenges [8]. Basically, people are not ready to fully adopt online learning situations. There is event a report about students dissatisfaction with the shift to digital settings, which leads to a significant learning loss [20]. That explains why, in another study, students prefer the offline setup [21]. Despite the negative impacts reported, certain well-established learning platforms such as Google Classroom and MOODLE bring satisfaction when it is used for grading, assessment, training, tech support, etc [22].

In this study we revisited the previously assessed students satisfaction with online technology-assisted learning in [10], [11], with the implementation during pandemic era [9]. The rest of this article is organized as follow: in Section II the methodology used in this study is presented, and the results are discussed in Section III. Finally, in Section IV we conclude this article, as well as presenting some ideas for future works.

II. Methods

This study focused on the first year Informatics students who got into college during the pandemic. The course in concern is Probability and Statistics that must be taken at the first semester. The reason behind the selection of this particular course is its readiness for such an online learning environment since 2020 [9]. For two years, 2021 and 2022, each student who took the course is surveyed. Those years were selected since they share a common similarity in learning plan, compared to what was developed first for the 2020 class. The course was held through the MOODLE Learning Management System (LMS) [23]. Therefore, the survey was done by using the Feedback Activity module that available by default in MOODLE. It is already declared in the beginning of the questionnaire that whatever they answer, it will not affect the grading. Since this study concerns the freshmen, therefore only answers from the first-time takers that will be used in analysis.

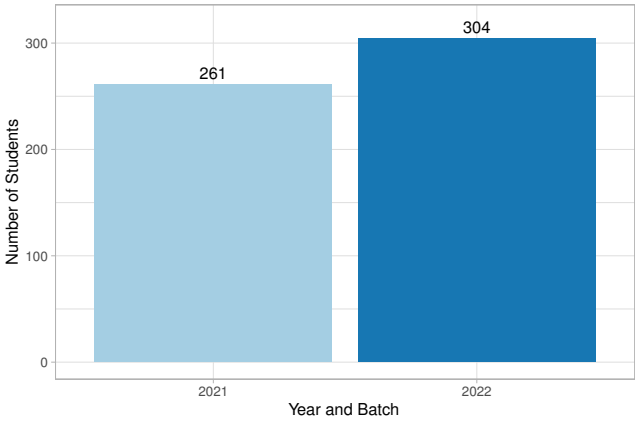


Figure 1: Number of students in each batch.

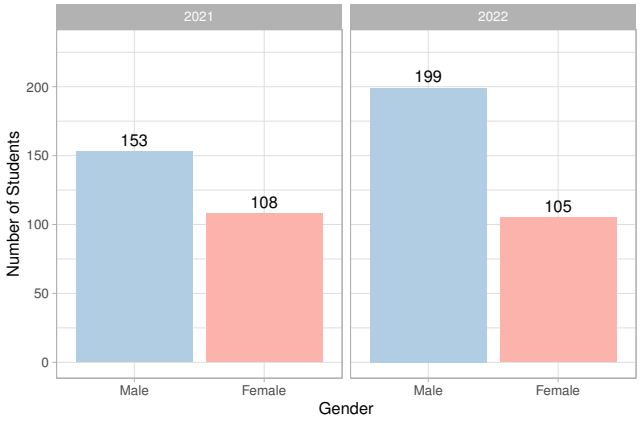


Figure 2: Students' gender in each batch.

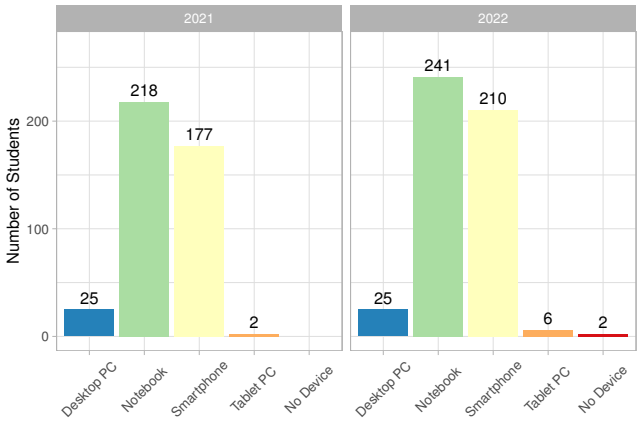


Figure 3: Device used

The questionnaire is based on the previous works [10], [11] with some minor modifications:

1) The Likert scale expanded to six points instead of five to reduce the tendency of being abstain/choosing no side.
2) Instead of using ordinal scale, we asked the students to give their ratings, between 1 to 6, for each survey item.
3) The device selection is expanded to accommodate student that has more than a single device that one used to access the learning content.
4) The options for connectivity covers various possible scenarios.

Since the questionnaire was modified, then the inference statistics method also changed. In this study we use the whole distribution, not only the positive feedback. The 1 to 6 scale was linearly aggregated into 0 to 10. Therefore, positive feedback in the previous studies [10], [11] were employed as a numeric boundary of the satisfaction, where neutral option was in the middle of the scale in the previous studies, then we translate it to be numerically equal to five in the current study.

Inference statistical test is used to determine the significance of the results. For each item, a one-tail test is used with alternate hypothesis that the mean (or median) of the item is significantly greater that five. In this study, we use 95% confidence level ($\alpha = 0.05$)

III. Results and Discussions

There were 295 and 352 students who actively participated in the course in 2021 and 2022, respectively (n=647). Out of this number, some are retakers who belong to the previous batches. By taking only the freshmen in each year, as well as complete questionnaires, there are 565 (87.33%) valid answers in total.

A. Demography

The 565 valid answers are consist of 261 and 304 freshmen from batch 2021 and 2022, respectively (Figure 1). In both years, male students dominated the number, as shown in Figure 2.

The students did make use of various devices to access the LMS. In 2021, there were 422 and in 2022, 482 devices used by students. In total, there are 904 devices used, make it into a ratio of 1:1.6 devices per student. Figure 3 shows the devices used in each batch. As can be seen, portable devices such as Notebook and Tablet PC are the main choices by students. These figures is still consistent with ones in [11], except now we see an increasing number of mobile phones.

The fixed line with occasional use of cellular data is the preferred choice of Internet connectivity as shown in Figure 4. The use of cellular data as the only option comes second. The use of Internet connectivity available at campus is very few due to the restriction during the pandemic. This finding implies that most students have steady access to the Internet due to the nature of the fixed line.

In regards to how they made use the Internet, access to the LMS sits as the most frequent use in both batches, as shown in Figure 5. The majority spent about one to three hours every day accessing the LMS. The number surged in batch 2022, leaving the other options far behind. In terms of using the Internet for studying (e.g. looking for references and tutorials from other sources), the figures peaked between three to five hours and five to ten hours. There is no meaningful difference in either batch in this aspect. The use of Internet for general needs has similar patterns with the previous category with lower duration, where the accesses are between one to three hours and three to five hours long. Compared to [10], the students have higher tendencies to use the Internet for accessing the contents and assessment materials on the LMS.

Due to the pandemic situation, hence conventional face-to-face meetings are avoided. Therefore, there is no need for students to physically attend at the city where the campus is located. Students that participated in this study were spread in 45 cities/regencies across the nation, with major concentration in the North Sulawesi province. This situation can be seen from Figure 6 where despite the national reach,

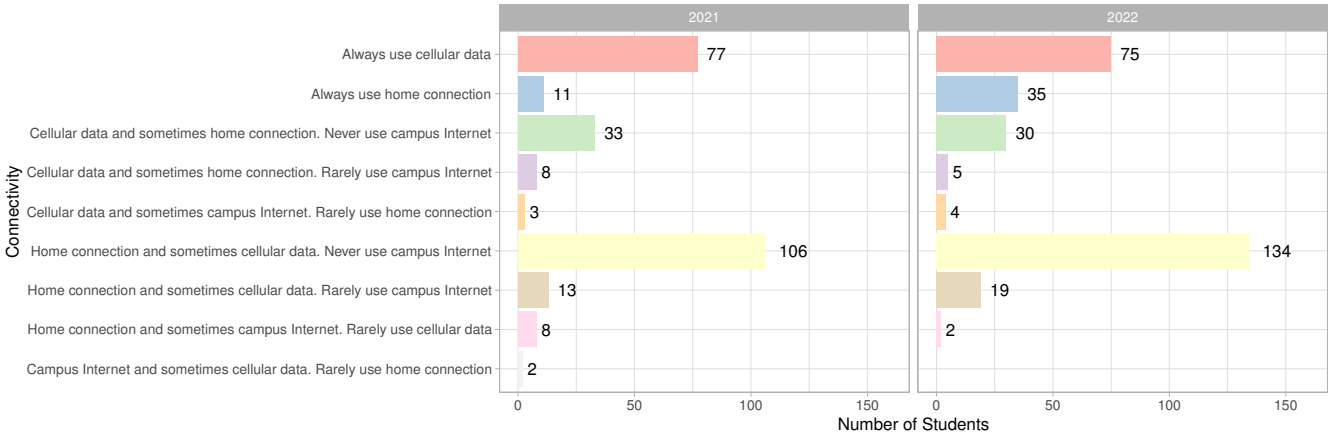


Figure 4: Connectivity options

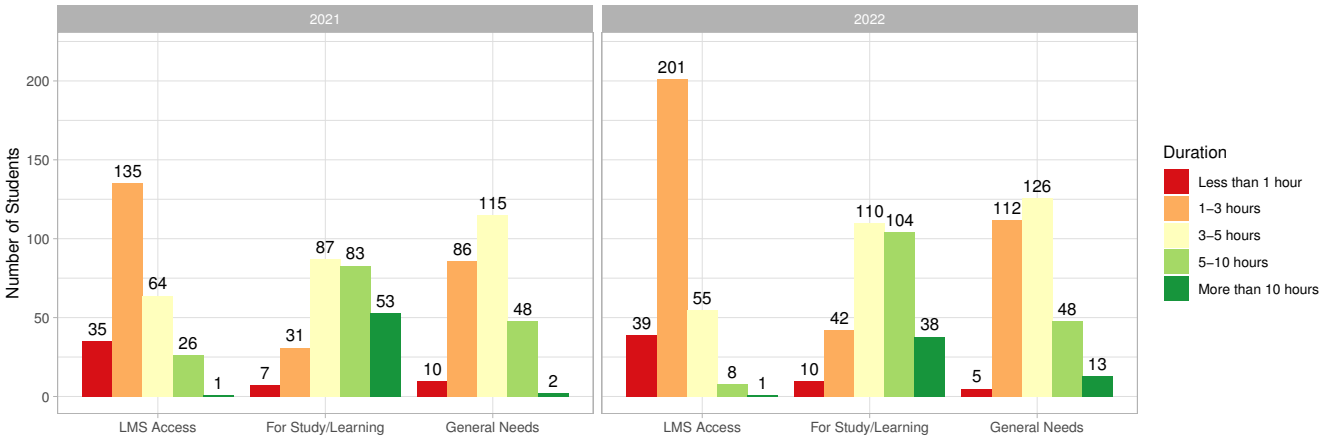


Figure 5: Daily Internet Usages

the number is still low compared to those in Figures 7a and 7a. It is clearly shown in Figure 7a that most of the students are actually located within the vicinity of the campus, depicting the preference to be near their hometown.

B. *Satisfaction Factors*

There are three variables that discussed in this part. The first one is the preference that derived from [10]. This variable is actually to compare the conventional and blended learning models, to seek which is more preferred by students. In this study, the same variable is reused to see whether the preference is above the threshold or not. Figure 8 shows the distribution of each item in the preference variable that already linearly aggregated, as mentioned in Section II. As can be seen, most of the items are distributed above the threshold. According to this boxplot, there are some issues with convenience, enjoyment, motivation and the skills acquired by the students. On the other hand, this learning model strong points are helping the content delivery so students can get knowledge with their own pace. It is also helpful for students to evaluate themselves, to find ones weaknesses. With this learning model, the grading also found to be fairer for students.

An inference statistics test is needed to see whether the issue is significant or not. According to the distribution normality test of the Preference items in Table I, all items are not normally distributed, hence further analysis must use the non-parametric method.

The Wilcoxon Signed Rank test was used as the inference method, and the result is presented on Table II. As can

TABLE I: Results of Shapiro-Wilk distribution normality test of Preference items.

Item	p-value
Acquire knowledge	396.8×10^{-21}
Decide pace of learning	146.4×10^{-21}
Acquire skills	101.1×10^{-18}
Control enhancement	2.114×10^{-18}
Increase motivation	846.0×10^{-18}
Increase flexibility	358.5×10^{-21}
Increase enjoyment	1.302×10^{-15}
More convenient	176.1×10^{-18}
Identify weakness	5.677×10^{-21}
Found mark given fair	2.451×10^{-21}

be seen, the p-values of all items are far lower than α. Therefore, for all Preference items, the scores are significantly greater than expected, hence it can be concluded that this finding is aligned with the previous study [10], where blended learning is a preferred learning model. As can be seen in Table II, there are only two values of median, six or eight. Therefore, the items with the lower median should become concerns for future studies.

1) System Quality: The System Quality evaluates the interaction of the students with the LMS. As shown in Figure 9, in this study there are five items of System Quality that were assessed. The boxplot shows that in all items this learning model excels, except for some outliers within the lower region in features and ease of handling.

Shapiro-Wilk test of distribution normality (Table III) shows that the response of the students were not normally

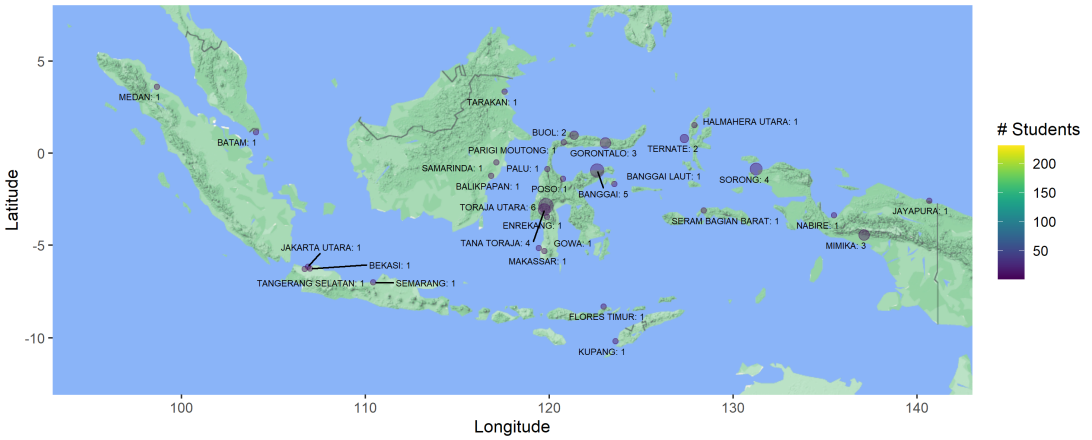
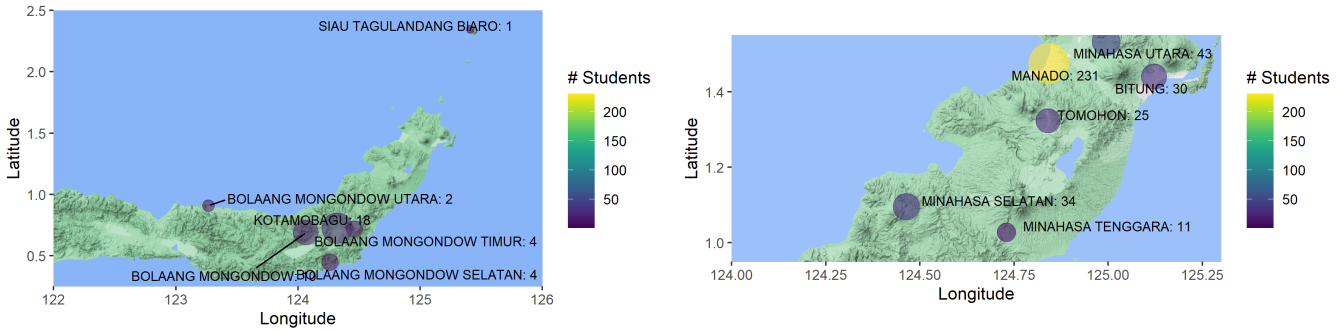


Figure 6: Students locations while following the course, except those in North Sulawesi



(a) Except those in Minahasa and Manado area

(b) In Minahasa and Manado area

Figure 7: Locations of the students in North Sulawesi while following the course.

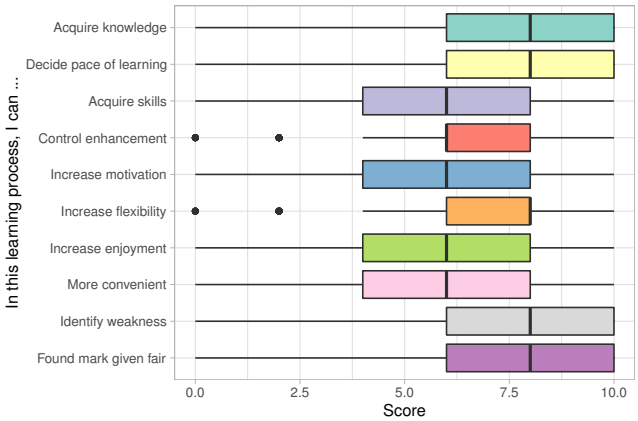


Figure 8: Learning model preferences

TABLE II: Results of Wilcoxon Signed Rank test of the Preference items.

Item	m	W	p-value
Acquire knowledge	8.000	137.6×10^3	865.2×10^{-54}
Decide pace of learning	8.000	137.6×10^3	1.544×10^{-51}
Acquire skills	6.000	122.9×10^3	8.403×10^{-30}
Control enhancement	6.000	130.5×10^3	343.4×10^{-42}
Increase motivation	6.000	106.2×10^3	2.823×10^{-12}
Increase flexibility	8.000	134.2×10^3	646.7×10^{-48}
Increase enjoyment	6.000	111.4×10^3	62.18×10^{-18}
More convenient	6.000	115.7×10^3	3.398×10^{-21}
Identify weakness	8.000	140.7×10^3	4.338×10^{-57}
Found mark given fair	8.000	135.7×10^3	1.944×10^{-48}

TABLE III: Results of Shapiro-Wilk distribution normality test of the System Quality items.

Item	p-value
Provides high availability	636.4×10^{-27}
Easy to handle	51.32×10^{-21}
User friendly	15.48×10^{-21}
Provides interactive features	1.534×10^{-18}
Attractive features	157.6×10^{-21}

distributed, hence the non-parametric Wilcoxon Signed Rank Test is used. The result of the inference test is shown in Table III. It is clear that despite the presence of some outliers, the System Quality items are significantly above the threshold, with $m = 8$ for all items. This finding implies that the course design that implemented on the LMS is good.

2) Information Content Quality: In Subsubsection III-B1, we can conclude that the course design implemented on the LMS has a good quality. However, to assess the character of the learning materials, the Information Content Quality must also be evaluated. In this study, the Information Content Quality covers the clarity of the learning materials, as well as the compatibility of the difficulty level and students' workload, and the adequacy of the provided information. Figure 10 shows the distribution of the linearly aggregated

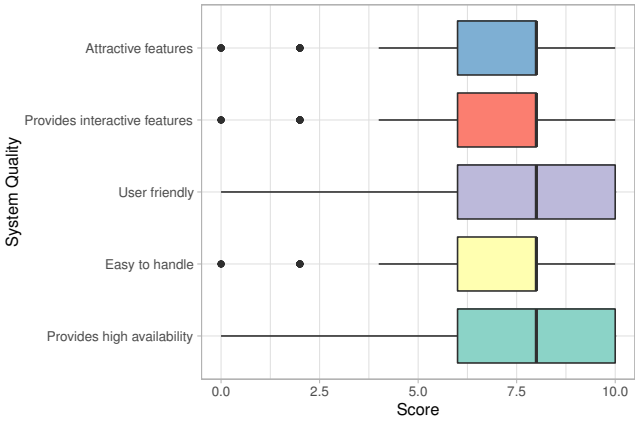


Figure 9: Satisfaction on system quality

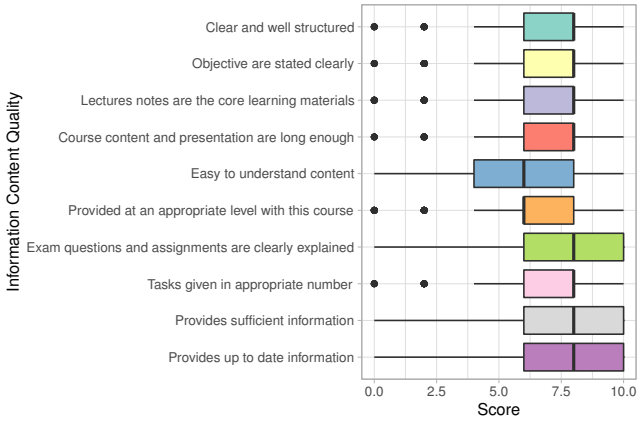


Figure 10: Satisfaction on information content quality

TABLE IV: Results of Wilcoxon Signed Rank test of the System Quality items.

Item	m	W	p-value
Provides high availability	8.000	152.7×10^3	3.016×10^{-81}
Easy to handle	8.000	143.6×10^3	14.80×10^{-63}
User friendly	8.000	143.5×10^3	35.55×10^{-63}
Provides interactive features	8.000	137.2×10^3	3.723×10^{-51}
Attractive features	8.000	137.5×10^3	1.800×10^{-51}

ratings given by students.

The distribution normality test to the Information Content Quality items, shown in Table V indicates that the ratings given by students are not normally distributed. Then, the Wilcoxon Signed Rank test is used to infer the significance. As can be seen in Table VI, despite the two items with medians lower than the others, all items are significantly above the threshold. However, the low medians in the "Easy to understand content" and "Provided at an appropriate level with this course" should not be neglected, since it is implied that the provided contents are hard to understand and some students might find the learning contents were too hard for them.

IV. CONCLUSION

Despite the pandemic situation, humanity must survive. Therefore, many aspects of human life must be adapted for the sustainability, including higher education. It is very unfortunate where the physical face-to-face meeting has to be substituted with video conference and/or asynchronous online classes. Although e-learning has been around for several decades, in most scenario it is employed as a complement to the conventional face-to-face meetings. In the pandemic era, there are cases where the online classes become the main way of teaching and learning.

In this study, we evaluated the satisfaction of the students who participated in a fully online class. Compared to the previous studies, the implementation of e-learning is received with a positive notion from the students, despite the pandemic situation where they cannot meet the lecture directly. Even better, the access to the LMS is enhanced compared to the previous study. Regardless of the positive findings, there is still room for future improvement, such as in ensuring the student will acquire the related skills, ability to control once enhancement, motivation, enjoyment, and convenience. In terms of learning materials, the ease of understanding and the level of difficulties must become a concern of the lecturer.

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TABLE V: Results of Shapiro-Wilk distribution normality test of the Information Content Quality items.

Item	p-value
Clear and well structured	39.76×10^{-21}
Objective are stated clearly	358.1×10^{-21}
Lectures notes are the core learning materials	439.6×10^{-21}
Course content and presentation are long enough	207.3×10^{-21}
Easy to understand content	855.9×10^{-18}
Provided at an appropriate level with this course	1.240×10^{-18}
Exam questions and assignments are clearly explained	6.704×10^{-21}
Tasks given in appropriate number	307.7×10^{-21}
Provides sufficient information	33.70×10^{-21}
Provides up to date information	863.8×10^{-24}

TABLE VI: Results of Wilcoxon Signed Rank test of the Information Content Quality items.

Item	m	W	p-value
Clear and well structured	8.000	143.6×10^{3}	20.00×10^{-63}
Objective are stated clearly	8.000	138.2×10^{3}	123.9×10^{-54}
Lectures notes are the core learning materials	8.000	135.8×10^{3}	1.008×10^{-48}
Course content and presentation are long enough	8.000	142.6×10^{3}	1.152×10^{-60}
Easy to understand content	6.000	108.7×10^{3}	17.87×10^{-15}
Provided at an appropriate level with this course	6.000	130.0×10^{3}	1.843×10^{-39}
Exam questions and assignments are clearly explained	8.000	142.7×10^{3}	932.9×10^{-63}
Tasks given in appropriate number	8.000	140.0×10^{3}	58.40×10^{-57}
Provides sufficient information	8.000	143.1×10^{3}	136.9×10^{-63}
Provides up to date information	8.000	145.4×10^{3}	5.944×10^{-66}

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