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Role of E-Learning Readiness on Workload: Perspective Engineering and Non-Engineering Students

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ABSTRACT

Changes in learning methods from face-to-face to online learning due to pandemic covid-19 have an impact on student readiness in learning and the mental workload felt by students, that can determine the achievement of the learning process. There are differences in the characteristics of learning demands in engineering and non-engineering majors. Therefore, this study aims to evaluate the level of readiness and mental workload of students during the implementing full online learning based on the characteristics of the education department. Data collected by distributing online questionnaires to 180 students (90 students majoring in engineering and 90 students in non-engineering). Self-directed learning (SDL), technical readiness (TC), and comfort with non-face to face communication (CFT) used to measure e-learning readiness, meanwhile NASA TLX used to measure mental workload. Results showed differences between engineering and non-engineering students, especially in the Self-Directed Learning ($p < 0,05$). Non-engineering students perceived that they are more prepared to manage their learning process independently during online learning. Related to mental workload students perceive higher demands from online learning activities, the engineering group had higher level of time-related demands. According to correlation testing there was a negative and significant correlation between the self-directed learning dimension scores of E-Learning Readiness and the NASA TLX scores ($p < 0,05$). These results indicated the role of student's e-learning readiness, especially self-directed learning readiness can reduce perceptions related to the mental workload experienced by engineering students in online learning. This condition was not applied on non-engineering students. Future study needed to explore the characteristics of study programs that relate to both variables and if the condition applied on other learning conditions such as hybrid learning.

Keywords:
Online learning; E-learning readiness; Workload; Engineering and Non-engineering; Self-Directed Learning

1. INTRODUCTION

The Covid-19 pandemic that has occurred, for almost a year has made significant changes in various sectors of human life, including in education sector. In the past, education was generally carried out face-to-face in class, the pandemic conditions 'forced' almost the entire educational process to be carried out online. Referring to the Circular of the Minister of Education and Culture of the Republic of Indonesia Number 36962/MPK.A/HK/2020, learning is carried out online to prevent the spread of Covid-19. The online learning policy is also carried out until the even semester of the 2020/2021 academic year, as in Circular Letter Number 6 of 2020 issued by the Ministry of Education and Culture. Online learning encourages the need for the application of digitalization in the world of education, including in the Higher Education.

The impact of this policy is that many universities implement online learning systems. In online learning, one of the actors who have a major role in supporting the successful implementation of learning is students [1]. There are differences in learning in the classroom with online learning. Online learning has several advantages over classroom learning, in this case the flexibility of learning time and location. Students are required to play an active, independent, and collaborative role in participating in online learning [2].

To be able to encourage the successful implementation of online learning, it is necessary to measure the level of readiness. The level of readiness reflects a person's ability physically and mentally in dealing with a technology. According to Suwarsono [1,31], one of the strategies that can increase the likelihood of participants' success in implementing online learning is by conducting self-assessment of students to take part in the e-learning learning process. Students who were not ready with online learning situation would face negative learning experience and had more prejudice toward online learning activities [3]. E-readiness or e-learning readiness itself is the degree of readiness that individuals have regarding personal attributes, skills and knowledge that contribute to success in online learning [4]. According to previous study, E-learning readiness can predict student's performance in online course [5] and student's interaction and structure [6]. E-learning readiness also influenced student's motivation toward online learning, and then affect to their interaction and perception online activities, such as tasks, online meeting. The evaluation on e-learning readiness should be considered, especially in pandemic COVID-19 situation that forced students to face online learning immediately.

The concept of E-Readiness or E-Learning Readiness has been widely studied that influence student learning readiness in the context of online learning for both individuals and organizations [16,4]. The definition of E Learning Readiness can be viewed from an organizational point of view, namely as the readiness of an institution or organization to a number of aspects of e learning technology that is implemented for certain purposes [17]. However, there are also those who relate it to aspects of individual mental readiness, as stated by Hung et al. [18]. E-Learning Readiness in this paper defined as students' competence and confidence in using electronic devices for e-communication, students' preferences in using computer-based technology and also abilities in self-directed learning [19].

Self-directed learning presented in several studies is one of the factors that most influence students' readiness to learn in e-learning [14]; affect acceptance and also the academic progress of students in higher education [20,21]; can predict student performance and learning satisfaction regardless of level (undergraduate or post graduate) or type of learning format (hybrid or online). A number of studies attempt to show other factors that influence students' e-learning readiness, researched by Hung et al [18], proposing 5 dimensions in e-learning readiness, namely self-directed learning readiness, online communication self-efficacy, learner control, computer self-efficacy and motivation for learning. Smith [22] and Blankenship and Atkinson [23] proposed the comfort factor with non-face to face communication in the context of online learning as dimension on e Learning readiness rather than online communication self-efficacy. Another factor is Technical Readiness, which in Hung et al [18] is explained by the dimensions of computer self-efficacy, but also the need for internet self-efficacy [19,24].

The application of online learning also has an impact on the workload felt by students. The use of technology in the learning process contributes to the mental workload experienced [2]. Associated with the use of technology in online learning has an impact on the high need for information processing which increases the mental workload. Mental workload is defined as the interaction between job demands and human cognitive abilities. Workload analysis can provide information on task management by considering the limitations of humans, so that the optimal process is obtained [7]. The level of workload experienced by students is a major factor in the emergence of academic stress [8]. To minimize the risk of academic stress and dropout rates, an appropriate learning model is needed by considering the role of each key stakeholder. Identification of relevant workload issues can be used to maximize the potential for achieving good learning outcomes [9]. Since online learning could have effect to student's academic workload perception, the lower score on e-learning readiness would increase the higher perceived academic workload, student's stress condition and academic performance.

Mental workload is defined as the effort required by a person to do a job. Mental workload is usually used, one of which is the basis for the design of job descriptions and also in determining the number of human resources needed to complete a job. Several subsequent studies looked at the workload in an academic context, called the academic workload. A number of studies explain how the perception of academic workload affects students' stress levels and performance [9,25]; student's perception on appropriate workload affected to student's performance [26]. Readiness both on students and

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lecturers (institution) will improve quality of student's learning experience and student's awareness on academic workload. There are not many studies on academic workloads that associated with e learning readiness; one of which has been done by [2]. The results show that students perceive that online learning requires a higher mental workload than face-to-face learning. Another study [27] found that students with low self-directed learning will perceive heavy workloads in online learning. It was mentioned earlier that self-directed learning is an important component in determining online learning readiness.

Several perspectives can be used to measure academic workload such as credit hours according to the degree and perceived subjective measurement. Related to subjective measurement, there were several methods that can be used namely NASA TLX, Workload Profile and SWAT [8]. However, many studies use the NASA TLX method because it has used a multidimensional approach to evaluate mental workload. NASA TLX is a subjective workload measurement method developed by [28]. This method is in the form of a questionnaire that was developed based on the demand for subjective measurements that are easier and more sensitive. To minimize the subjectivity issue, more than one data is needed for each object of observation. In addition, in data processing, validation of the data obtained is also required, so it will not interfere with the measurement results. There are six workload aspects that will be measured to assess a workload, namely mental demand, physical demand, temporal demand, performance, effort, and frustration level.

The research object of a private university, since 2009 has developed and implemented e-learning. Initially e-learning will be implemented to complement the existing traditional learning system, but in the future, it will not only complement but become one of the leading methods in the teaching and learning process. There are two scientific clusters, namely engineering clumps and non-engineering clumps. According to [10] there are different profiles between engineering and non-engineering students, related to innovation and risk taking. Engineering students have a higher level of innovation than non-engineering students. This is possible because the learning process is required to produce innovation. In addition, according to [11], engineering students are required to have the ability to solve problems and deal with uncertainty better. In the application of online learning, they are often faced with situations with high uncertainty and require active participation from students in carrying out the learning innovation process. Based on this, it is possible that there are differences in the level of readiness and workload between engineering and non-engineering students.

Various previous studies have analyzed the level of mental workload among college students [12,8,13,9,7], and the correlation with e learning readiness [2]. Several studies use quasi-experimental methods to analyze differences in mental workload levels between online learning and face-to-face learning [12,2]. Meanwhile, in other studies using mental workload measurement through questionnaires involving large samples [8,13,9]. In previous studies, mental workload measurements were still carried out for profiles of students with similar educational backgrounds [8,13]. Research that discusses the measurement of the level of readiness and mental workload was carried out by [2], but the research was conducted in an experimental context. Previous research [31] examined the level of readiness for the application of online learning in a university using five dimensions, namely policy, technology, financial, human resources, and infrastructure. The readiness evaluation was reviewed from the point of view of lecturers and students. There is a research gap to examines the level of readiness and mental workload in students with full online learning situations. In addition, there is no research that examines the differences in the profiles of engineering and non-engineering students.

This research that will be conducted is primarily aimed to analyze the student workload that associated with student learning readiness in online learning situation and examine the differences among engineering and non-engineering students. The results of this research will be used to improve the online learning system, especially to improve learning activities and assessments for both engineering and non-engineering students. This paper include several section, namely introduction, methodology, results and discussion, conclusion.

2. METHOD

This study uses quantitative methods to analyze the relationship between e-learning readiness and perceptions of workload among students. Data collection was carried out through the distribution of online questionnaires to a sample of students who had participated in full online learning during the pandemic. Data processing will be carried out using descriptive statistics, Spearman correlation test and Mann Whitney-U difference test. The research was conducted in the context of engineering and non-engineering students at a large private university. The variables of this study was based on previous research (2,1, 32) that online learning increased perceived workload on students, and can workload can be decreased by student preparation on online learning readiness, or e-learning readiness. E-learning based on Hung et al (18) can be measured by its dimensions. There were three dimensions adapted from Hung et al. by Suwarsono (1) : self-directed learning readiness, technical readiness and Comfort with Non Face to Face Communication (Comfortness), as shown in Figure 1. The implementation of online learning has an impact on the perceived mental workload for users. To reduce the perception of mental burden during online learning is to increase student readiness for online learning [2]. To support self-directed learning, it is necessary to have a conducive learning situation with an appropriate workload [36]. Workload demands can affect student acceptance of online learning [37]. Based on this, the hypothesis that will be proven in this study:

H1 : There is a correlation between e-learning readiness and perceived workload

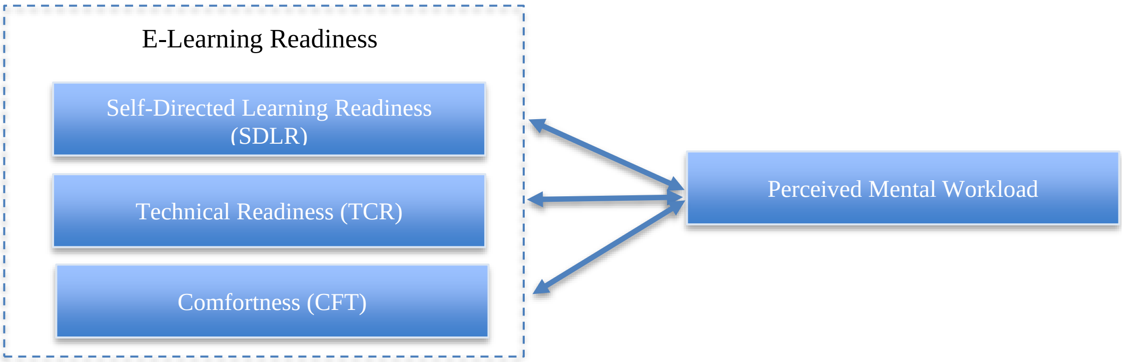

Figure 1 - Conceptual Framework

The research was carried out in three stages, namely the preparation stage, the data collection stage, and the data processing and analysis stage, as shown in Figure 2. At the preparation stage, the characteristics of the sample of respondents who will be involved in the research are identified and the preparation of the questionnaire instrument to be used. The second stage is collecting data by distributing online questionnaires. Meanwhile, in the third stage, namely data processing and analysis, descriptive statistical processing, Mann Whitney-U difference test, and correlation test will be carried out to achieve the research objectives. A detailed explanation of the participants, instruments and data processing processes can be seen as follows.

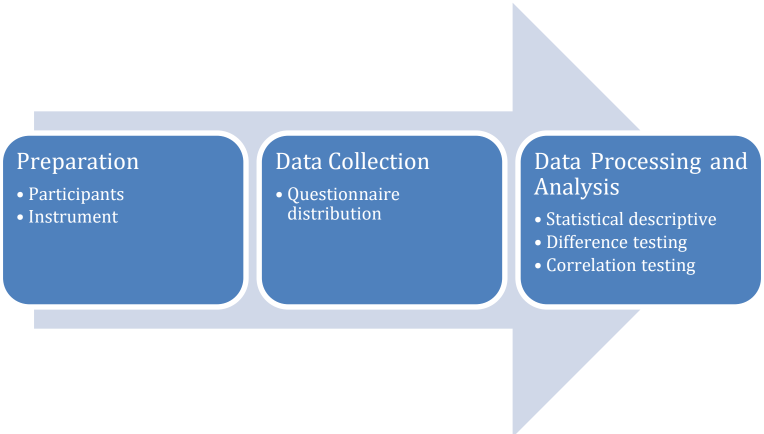

Figure 2 - Research stages

2.1 Participants

Data collection was carried out through the distribution of online questionnaires due to the pandemic situation which required all academic activities to be online. Participants were second-year student and had been full online learning experience in that semester. Other characteristics of participants samples was chosen, like major of study (engineering and non-engineering), gender and GPA. Previous studies had shown there were difference characteristics between engineering and non-engineering students [10,11] in perceiving online learning [33,34]. A total of 188 data was gathered, but there were 8 data that could not be processed further due to incompleteness in filling out the questionnaire, so there were only 180 data that were used further for this study. The participants of the study were 180 undergraduate students from the engineering departments (90 students; male = 64.4%; female = 35.6%) and non-engineering departments (90 students; male = 35.6%; female = 64.4%) at a large private university. Participants were. Table 1 shows the distribution of participant demographic.

2.2 Instruments

The survey questionnaire was consisted of the 3 sections. First section was devised to collect demographic data (such as major, GPA, gender); the second section of the questionnaire was e-learning readiness self-assessment; and the third section related to workload. E-learning readiness measures student's perception readiness based on three dimensions namely self-directed learning readiness, technical readiness, and comfort with non-face to face communication. The questionnaire used was developed by [1], that was adapted from [18] and already aligned with Indonesia context. The questionnaire includes 63 items related to the three dimensions of e-learning readiness and use 4-point Likert scale to measure the items. To represent the e-learning readiness, the average value of each item in the dimensions was calculated. Next the overall e-learning readiness was calculated based on average value on all dimensions. The measurement of perceived workload by the student NASA-TLX (Task Load Index) questionnaire was used, similar with previous study [2, 7, 8]. NASA TLX was a multidimensional rating procedure consist of six aspect that will be measured, namely physical demand, mental demand, temporal demand, performance, effort, and frustration [28].

2.3 Data Processing

Data processing includes descriptive statistical processing, NASA TLX score calculation, Mann Whitney U difference test, and correlation test. Descriptive statistical processing is carried out on each measurement dimension of e-learning readiness. For the calculation of the NASA TLX score, it is done by calculating the multiplication between the weights and the rating for each aspect. The results of the score calculation will then be classified into four workload categories, namely low, medium, high, and very high referring to [29]. Furthermore, the Mann Whitney U difference test was conducted to determine whether there was a significant difference between the engineering and non-engineering groups. Different tests were carried out for the e-learning readiness variable and the perception of the workload. The last part is to test the correlation between e-learning readiness and workload to find out the possible relationship between student readiness in participating in full online learning and the perception of the workload experienced by students.

3. RESULT AND DISCUSSION

According to the respondent profile that can be seen in Table 1, most respondents in the engineering group were male students (64.4%), while the non-engineering group were female students (64.4%). In addition, the distribution of the characteristics of the GPA achievement in the previous semester, most respondents in the engineering group had a GPA in the range of 3.01 to 3.50 (33.3%), while the non-engineering group had a GPA of more than 3.75 (43.3 %).

Table 1 - Demographic Features of Participants

	Engineering	%	Non-Engineering	%
Gender				
Male	58	64,4%	32	35,6%
Female	32	35,6%	58	64,4%
Previous semester GPA				
< 2,50	6	6,7%	0	0,0%
2,50 - 2,75	5	5,6%	1	1,1%
2,75 - 3,00	18	20,0%	1	1,1%
3,01 - 3,50	30	33,3%	16	17,8%
3,51 - 3,75	21	23,3%	32	35,6%
> 3,75	10	11,1%	39	43,3%

3.1 Variable e-Learning Readiness

Regarding e-learning Readiness, three dimensions were measured, namely self-directed learning (SDL), technical readiness (TC), and comfortness (CFT). The results of data processing regarding e-learning readiness scores from respondents can be seen as follows in Table 2. Next a test was conducted using Mann-Whitney U to investigate whether there is a significant difference between the two groups of respondents, namely engineering and non-engineering department.

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Table 2 - E-Learning Readiness Score

Dimensions	*Engineering*		*Non-Engineering*		Sig
	Mean	SD	Mean	SD	
Self-Directed Learning (SDL)	2,27	0,49	2,43	0,60	0,047*
Technical Readiness (TC)	1,04	0,30	1,02	0,21	0,562
Comfortness (CFT)	3,98	0,21	3,93	0,36	0,313
E-Readiness Score	2,42	0,33	2,28	0,37	0,005*

*Significant at 0,05

Based on the Table 2, there are two scores that have a significant value to distinguish engineering and non-engineering students, namely the value of E-Readiness (total score from the dimensions of Self-Directed Learning, Technical Readiness and Comfortness), and the dimensions of Self-Directed Learning. These results indicate that the dimension that plays a major role in E-Readiness is Self-Directed Learning.

It can be seen in the table that the self-directed learning dimension scores in both groups are still classified as average. This condition indicates that students are generally still not used to planning, controlling and giving consistent efforts to their work. This is still in line with previous research [1] regarding the SDL level of students who are still on average, or have not been consistently carried out. Based on the average value, respondents from the non-engineering group had higher self-directed learning scores than the engineering group. Referring to the table above, there is a significant difference between the scores of self-directed learning in the engineering and non-engineering groups ($p = 0.047$; $p < 0.05$). These results indicate that the non-engineering group has better self-directed learning readiness than the engineering group in carrying out the online learning process.

In the technical readiness dimension, the scores in both groups are still relatively low, which indicates that the technical understanding of students in using applications that will be useful in the online learning process is still limited. Based on the average value, respondents from the engineering group had a higher technical readiness score than those from the non-engineering group. The results of the significance test showed that the two groups did not have a significant difference in technical readiness scores ($p > 0.05$).

Regarding the comfortness dimension, the scores in both groups showed results that were classified as high, which indicated that generally students were accustomed and felt comfortable in communicating online, both with fellow students and lecturers. Based on the average value, respondents from the engineering group had higher comfortness than those from the non-engineering group. The results of the significance test showed that the two groups did not have a significant difference in comfortness scores ($p > 0.05$).

3.2 Variable Workload

Regarding the measurement of workload variables, this study uses the NASA TLX framework to measure the academic workload felt by students. Online learning activities certainly increase the mental workload experienced by students. Based on the measurement results of the NASA TLX score, it can be seen that the perception of mental workload in the engineering group is higher than that in the non-engineering group (as shown in the Figure 2). Based on the results of statistical testing using the Mann-Whitney U test, there was no significant difference between the workload in the engineering and non-engineering groups ($p > 0.05$).

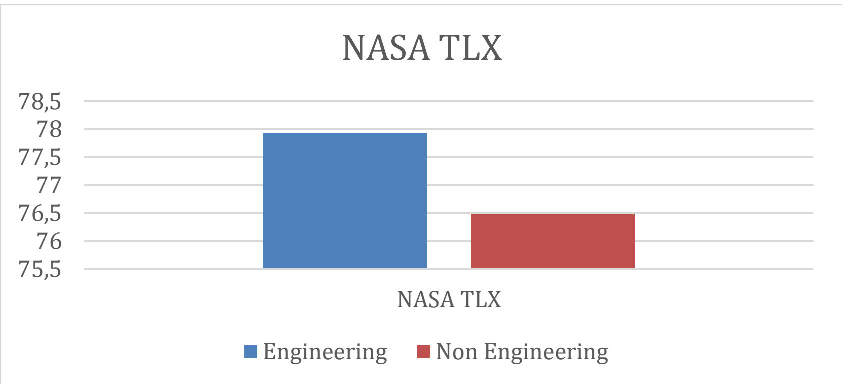

Figure 2 - Comparison NASA TLX between Engineering and Non-Engineering Department

To evaluate the perceived workload profile, then a value mapping was carried out based on each dimension in NASA TLX. The following is attached a graph of the NASA TLX dimension profile from the data collection carried out. From the Figure 3, it can be seen that the contribution of mental demands, temporal demands, and frustration levels in the engineering group is higher than in the non-engineering group. These results reflect that online lecture during the pandemic conducted by students in the engineering group have a higher level of time-related demands, so that the level of frustration experienced by students in this group is relatively high. The engineering group is required to have time management skills in the online learning process to be able to anticipate various obstacles and levels of frustration faced. Related to the higher level of frustration experienced, this is possible because in the engineering group the material presented often requires a demonstration or a two-way discussion process to better understand the material, while online learning situations limit the process. The lack of direction given by lecturers can also have an impact on increasing the level of frustration experienced by students when participating in online learning.

Meanwhile, the non-engineering group had a higher performance score. This situation indicates that, in the non-engineering student group, the online lecture process, which was carried out during the pandemic, provided an opportunity for students to be able to demonstrate the achievement of their best work results. If it is associated with the characteristics of the sample of respondents, where in the non-engineering group the majority of respondents had a GPA score of more than 3.75 in the previous semester. The success rate in participating in online learning in the non-engineering group was better than the engineering group.

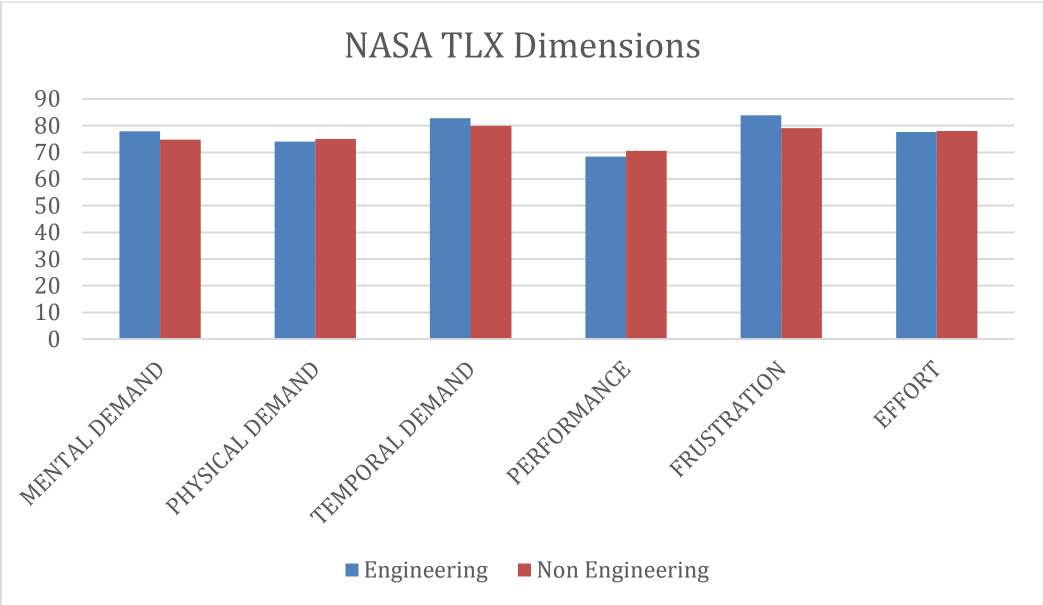

Figure 3 - Comparison NASA TLX Dimensions between Engineering and Non-Engineering Department

The composition of the distribution of NASA TLX categories in the engineering and non-engineering groups can be seen in Figure 4. Most respondents in the engineering and non-engineering groups have a very high perception of workload during online learning, as many as 53.3% and 51.1%, respectively. However, in the non-engineering group there are 1.1% who have a low workload perception during online learning.

Based on these findings, it is important for the educational institution environment to be able to organize and allocate online learning activities more precisely. The online learning process allows students to obtain a variety of information with high intensity, thus making students experience an overload of available information. The difference in the pattern of interaction between students and in the learning process also has an impact on the ability of students to accept the material presented to be more limited. The perception of mental workload experienced by students is very high in online learning situations, in line with the findings of the research of [2].

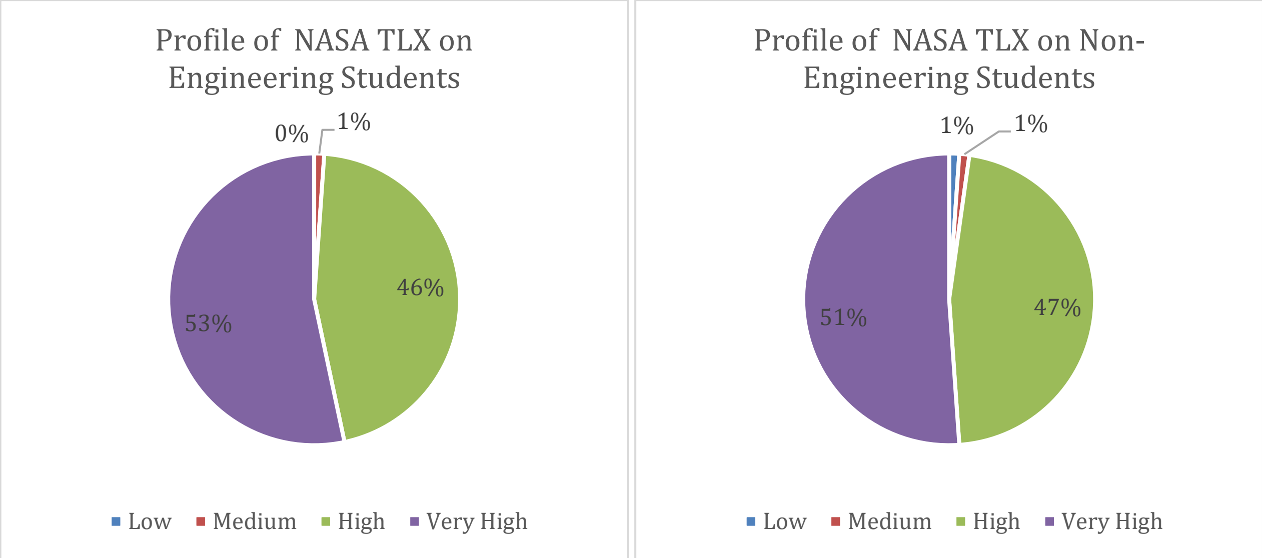

Figure 4 - NASA TLX Classification among Engineering and Non-Engineering Department

3.3 Correlation of e-Learning Readiness and Workload

To find out how the relationship between e-learning readiness and students' perceptions of workload is, a correlation test was conducted between the dimensions of self-directed learning (SDL), technical readiness (TC), comfort with non-face to face communication (CFT) and the NASA TLX score. The test was carried out using the Spearman correlation test. The results of the correlation test are shown in the Table 3. Based on the test results, there is a significant correlation between e-learning readiness scores and NASA TLX scores. There is a negative and significant correlation between the self-directed learning dimension scores and the NASA TLX scores ($p < 0.05$), but no significant correlation with other dimensions (technical readiness and comfort with non-face to face communication). From the results of the correlation test, then H1 can only be partially supported. The correlation between perceived workload and self-directed learning readiness was found to be significant in the context of engineering ($p < 0,05$) and non-engineering students ($p < 0,1$). In the engineering student group, the correlation coefficient is greater than that for non-engineering students.

These results indicate that the more ready students are to carry out a full online independent learning process, the lower the perceived mental workload perception. This situation also has an impact on reducing the risk of stress among students due to full online learning. The findings from the research conducted provide a new understanding where research [2] did not find a significant correlation between e-learning readiness and perceived workload in the implementation of online learning. This finding supports the results of research [37] where workload is significantly correlated with student acceptance to carry out online learning. While the results of research [38] revealed that the stress faced by students who carried out independent learning and had an impact on the mental workload felt by students. Stress coping ability can reduce the perception of workload among students. Based on these findings, it is important for universities, lecturers, and students to be able to increase the independence factors for students in conducting independent learning to support the online learning process running optimally.

Table 3 - Correlations between E-Learning Readiness and Workload

Variables	Total		Engineering Group		Non-Engineering Group	
	Spearman Correlation	Significant	Spearman Correlation	Significant	Spearman Correlation	Significant
SDLR - NASA TLX	-0,249	0,001**	-0,294	0,005**	-0,206	0,051*
TCR - NASA TLX	-0,049	0,514	-0,164	0,121	0,103	0,336
CFT - NASA TLX	0,117	0,117	0,116	0,278	0,121	0,255

**Significant at 0,05 level
*Significant at 0,1 level

Interesting findings from this study are: 1) engineering students have lower perception of e-Learning readiness than non-engineering students, and 2) engineering students have higher perception of their academic workload conditions. It is necessary to be considered by the institution and students, to consider Self Directed Learning Readiness dimension as a priority for student development to support the success of the e learning process, aside from the other two dimensions. As the students' ability to manage their learning process increased, students' perceptions of the academic workload will be lowered. It is also hoped that students will achieve optimal performance. Some of the recommendation for improvement are designing instructional methods that stimulate student independence in the form of face-to-face and non-face-to-face, as well as providing the training needed by students to improve their learning strategies, especially in the first year. In addition, it is also necessary to consider the number of activities and the allocation of tasks and appropriate information to avoid the perception of academic workloads that are currently still perceived as high by students.

3.4 Limitation and Future Work

Limitation of this study also had not considered the characteristics of each department. Even though they come from engineering or non-engineering departments, there may be differences in characteristics between study programs. Further studies need to be more specific in explaining whether there are differences between the study programs studied. Objective measurements also need to be measure especially on workload, due to socially desirable to answer self-assessment questioner [35]. Comparison between objective and subjective workload can give broader perspective about correlation between e-Learning readiness and objective and perceive academic workload [34].Seeing further of Pandemic COVID-19 situation, there will be a change from full online learning to hybrid learning, thus further research needs to see whether there is a difference between the conditions of full onsite, full online learning and hybrid learning to e-Learning readiness and academic workload perceived by students.

4. CONCLUSION

These results indicate that the e-learning readiness of students in carrying out the independent learning process (Self-Directed Learning readiness dimension) can reduce perceptions related to the mental workload experienced by students. This result is different from the findings in the study of Widyanti et al. [2] which shows there is no significant correlation between e-learning readiness scores and NASA TLX scores. There were no significant difference score between engineering and non-engineering students in E-Learning Readiness but there were on SDL Readiness and NASA TLX Score. Further study should look the characteristic of the study programs. Non-engineering students perceive higher SDL Readiness but lower in NASA TLX Score. Average score on Self-Directed Learning Readiness both in engineering and non-engineering students, mean that average of students were not fully ready with full online learning situation, especially on engineering students. Pandemic COVID19 that forced students to experience fully online learning required students to have higher Self-Directed Learning readiness. According to Clarke et al. [30] the use of technology in the learning process can increase the perceived mental workload, if the user does not have sufficient technological capabilities. In this study, the readiness of the use of technology did not show a significant correlation to the perception of mental workload felt by students in facing the online learning process, as in the research findings of Widyanti et al. [2]. Related to the results of this study, to deal with the online learning process, it is more important to prepare independent learning abilities among students, as well as to manage active interactions between lecturers and students.

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