# e-Learning readiness and perceived learning workload among students in an Indonesian university

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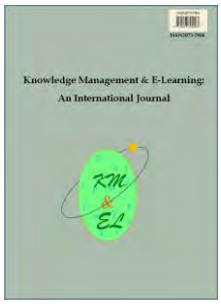


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# e-Learning readiness and perceived learning workload among students in an Indonesian university

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**Abstract:** e-Learning has been widely used in educational settings especially in developing countries like Indonesia. The purpose of this study was to investigate e-learning readiness among Indonesian university students and to compare students' perceptions of their workload (including mental demand, physical demand, temporal demand, performance, effort, frustration, and sleepiness) in e-learning and classical learning settings. A survey was conducted with students in an Indonesian university. The results show that students have a high level of e-learning readiness. Mental workload is significantly higher in e-learning than in face-to-face learning. No significant difference in sleepiness was found between e-learning and face-to-face learning. The correlation between e-learning readiness and the mental workload was not significant. Implications of the results are discussed.

**Keywords:** e-Learning; Perceived workload; Sleepiness; e-Learning readiness

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## 1. Introduction

e-Learning, an interactive way of learning whereby learning content is provided online (Paulsen, 2002) and has been applied widely in education. e-Learning has become a strategic way of lifelong learning as well as dissemination of higher education (Mason & Rennie, 2006). e-Learning also has a beneficial feature of the openness of opportunities to implement innovative learning environments, where learners are required to be active, independent, self-reflective, and collaborative. Compared with classical learning (i.e., face-to-face learning, seminars, and lectures) e-learning has clear advantages because it gives the flexibility of place and time during the learning process. On the other hand, some research found that e-learning has some disadvantages, for example, it reduced the socialization process of individuals due to lack of face-to-face communication (Kear, 2010).

Considering the weaknesses and strengths of classical learning and e-learning, blended learning has been promoted. However, a successful blended learning program requires the integration of all stakeholders such as students, faculty, and institution. Most importantly, a proper infrastructure must be integrated to support students and faculty (Moskal, Dziuban, & Hartman, 2013). Therefore, the use of e-learning has been increased in line with the use of blended learning. In addition, Dziuban, Graham, Moskal, Norberg, and Sicilia (2018) stated that both blended learning and e-learning are increasingly used for its flexibility in providing learning opportunities for students with their own pace, time, and place.

One consequence of e-learning applications is the mental workload imposed on the user. Mental workload is defined as the difference between a person's cognitive abilities and the demands required to perform a job (Gopher & Donchin, 1986; Johnson & Widyanti, 2011; Longo, 2018). It is possible that the use of technology in delivering information exceeds the human ability to process information (Rubio-Valdehita, López-Núñez, & Díaz-Ramiro, 2017). Research conducted by Clarke, Ayres, and Sweller (2005) indicates that the learning process using technology as learning media will result in higher pressure if the user does not have enough technical ability to use the technology. In a study conducted by Hove and Corcoran (2008), they found that the use of e-learning increases the frustration level of its users compared with classical methods. e-Learning required users to have the ability to operate high-tech equipment such as computers and the Internet. If the ability of users to use the equipment is low, there is a chance that it can increase the user’s mental workload. Sleepiness is another consequence of e-learning because of the lack of face-to-face communication. Sleepiness will reduce attention, which in the end reduces learning performance (Feidakis, Daradoumis, CaballÃ, Conesa, & Conesa, 2014).

One possible effort to reduce mental workload and sleepiness during e-learning is by increasing the e-learning readiness level, defined as the preparedness of mental or physical an organization for some e-learning situation (Borotis & Poulymenakou, 2004). It requests an institution to design not only e-learning strategies but also to implement its information and communication technology comprehensively to reach its goals (McConnell International, 2000). The availability of equipment plays an important role because the e-learning process requires appropriate equipment, and above all, requires an Internet connection. The readiness of the users is also important to be noted because e-learning requires users to be able to control their own learning (Hartley & Bendixen, 2001) and demands sufficient expertise in high-tech equipment such as computers and the Internet (Wu & Tsai, 2006) which was not necessarily needed in traditional learning. For example, the e-learning readiness approach has been stated as one factor that influences the success of gamified online learning because the readiness can increase motivation to perform (Bovermann, Weidlich, & Bastiaens, 2018).

Indonesia, one of the emerging developing countries in Asia, is ranked 9th highest growth rate of e-learning usage for 2010 to 2015 (Adkins, 2011). The Indonesian government has a plan to increase the use of e-learning in Indonesian universities due to its advantage. The purpose of this study was to evaluate e-learning readiness of Indonesian university students and to compare students' perceptions of workload (including mental demand, physical demand, temporal demand, performance, effort, frustration, and sleepiness) in e-learning and classical learning settings. The possible correlation between e-learning readiness, mental workload, and sleepiness were also explored.

## 2. Methodology

### *2.1. Participants*

Fifty-one university students from the Bandung Institute of Technology (Institut Teknologi Bandung, ITB) in Indonesia participated in this study. The participants had the experience of using e-learning in ITB. The study was approved by the ethical committee of Department of Industrial Engineering ITB (approval number EK-ITB-02-2018).

### *2.2. Instrument*

e-Learning readiness was assessed using a questionnaire of Hung, Chou, Chen, and Own (2010). The questionnaire is chosen because it describes in detail the behavioral abilities that must be possessed by e-learning users. The questionnaire consists of 18 items: 3 items of Computer/Internet self-efficacy, 5 items of Self-directed learning, 3 items of Learner control (in an online context), 4 items of Motivation for learning (in an online context), 3 items of Online communication self-efficacy. A 5-point Likert scale is used in the questionnaire. The score of each dimension is obtained by finding the average value of each question representing the dimension. The score of e-learning readiness of this questionnaire is obtained by finding the average value of all dimensions.

Students' perceptions of workload during learning processes was measured using NASA-TLX (Hart & Staveland, 1988), a multidimensional rating procedure with six sub-dimensions: Mental demand (defined as the extent to which mental activity to complete the job/task), Physical demand (defined as the extent to which physical activity was required to complete the task, whether the task is easy or demanding), Temporal demand

(defined as the extent to which time pressure is experienced during the task, whether the pace is slow or rapid), Performance (defined as the extent to which the goal of the task is perceived as accomplished), Effort (defined as the extent to which mental and physical effort is invested to complete the task), and Frustration level (defined as the extent to which the feelings of being insecure, discouraged, irritated, and stressed is perceived during task completion). The anchor points of low (equivalent to 0) and high (equivalent to 100) are used for each dimension of the NASA-TLX. The score of the NASA-TLX is calculated by averaging the score of all dimensions of the NASA-TLX.

Sleepiness was assessed using the Karolinska Sleepiness Scale (KSS, Miley, Kecklund, & Akerstedt, 2016). The KSS has been frequently used to study sleepiness in various contexts, such as in shift work, sleep deprivation, and driving. The KSS also has been used in the laboratory setting. The scale ranges from 1 (extremely alert) to 10 (extremely sleepy, can't keep awake).

All the questionnaires are adapted into Bahasa Indonesia using the back-translate (translate the Indonesian version into English) technique (see Brislin, 1990; Johnson & Widyanti, 2011; Widyanti, de Waard, Johnson, & Mulder, 2013; Widyanti, Johnson, & de Waard, 2013 for a review). First, two Indonesian bilinguals with TOEFL score more than 550 out of 667 were assigned to translate the original English questionnaire into Indonesian. Based on the two Indonesian versions, one best Indonesian version was determined; revisions and further discussions with an expert were conducted. Later, a third Indonesian bilingual who had never seen the original English version of the questionnaires was assigned to back-translate. Then, the original English version and the back-translated version were compared, the necessary revision was applied after discussion.

### *2.3. Procedure*

First, the respondents filled out the e-learning readiness questionnaire. The classical and e-learning sessions of the Industrial Management course were delivered in different weeks. The learning content for the classical session was different from that of the e-learning session but at a similar level of difficulty. In classical learning, teachers provided learning materials using a face-to-face method with the assistance of PowerPoint presentations and a whiteboard. After the class session, students were given a quiz on a piece of paper. The scale of 0–100 was used in grading the quiz papers. Students were asked to complete the NASA-TLX questionnaire to measure their perceived workload during the face-face class. Students were also asked to complete the KSS questionnaire to assess their sleepiness during the class.

In the second condition (i.e., e-learning class), learning materials were provided through the learning management system of ITB. Participants downloaded and read the material for learning. The instruction was given through the learning management system. Online communication was available through the system. A similar procedure was applied, in which the students were given a quiz to be completed on the learning management system. The NASA-TLX questionnaire was completed by the student to measure their perceived workload during the e-learning session, in addition to the KSS questionnaire used to measure sleepiness.

## 3. Result

The demographic data of the 51 participants are: mean age = 21.5 years, SD = 1.2 years, 37 males and 14 females.

### *3.1. e-Learning readiness*

The score of e-learning readiness of the participants can be seen in Table 1.

**Table 1**
e-Learning readiness score of participants

| e-Learning readiness' dimensions | Mean | SD |
|---|---|---|
| Computer/Internet Self-Efficacy | 4.31 | 0.66 |
| Motivation for Learning | 3.97 | 0.55 |
| Self-Directed Learning | 3.66 | 0.60 |
| Online Communication Self-Efficacy | 3.65 | 0.61 |
| Learner Control | 3.21 | 0.73 |
| Readiness Score | 3.76 | 0.44 |

### *3.2. Performance*

A paired-sample t-test was applied in the performance of classical and e-learning (i.e., in the context of the score of the quiz). No significant difference was found between performances of the two learning conditions.

### *3.3. Mental workload*

The scores of the NASA-TLX both for classical learning and e-learning can be seen in Fig 1. The NASA-TLX dimensions for both classical and e-learning can be seen in Fig 2. Sleepiness scores for both classes can be seen in Fig 3.

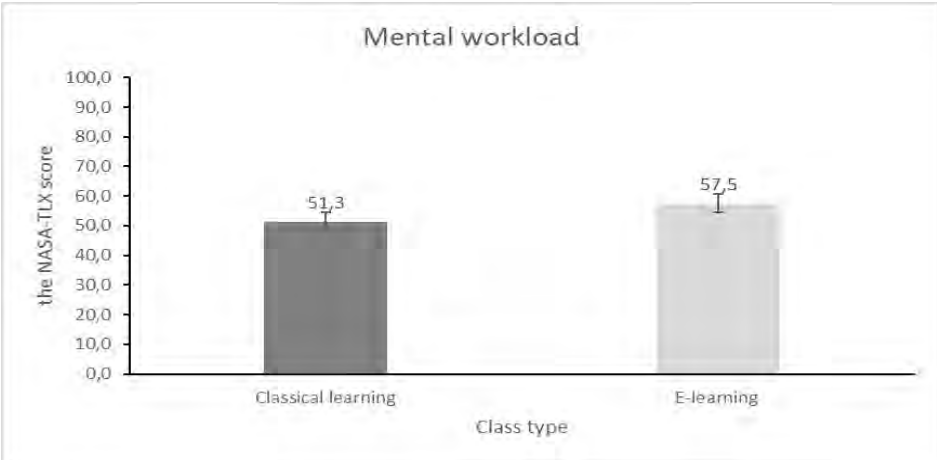


**Fig 1.** Perceived mental workload for classical learning and e-learning

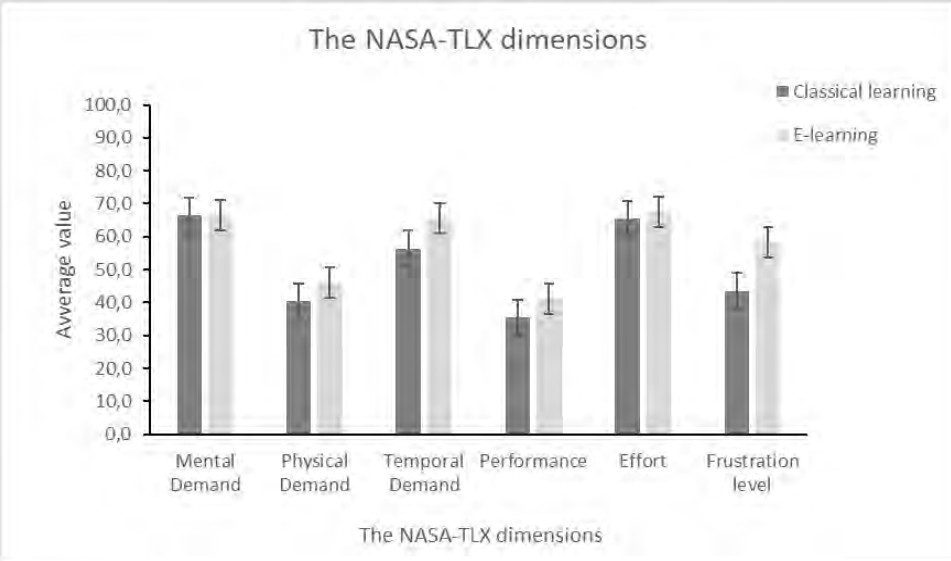


**Fig 2.** Perceived workload in multiple dimensions for classical learning and e-learning

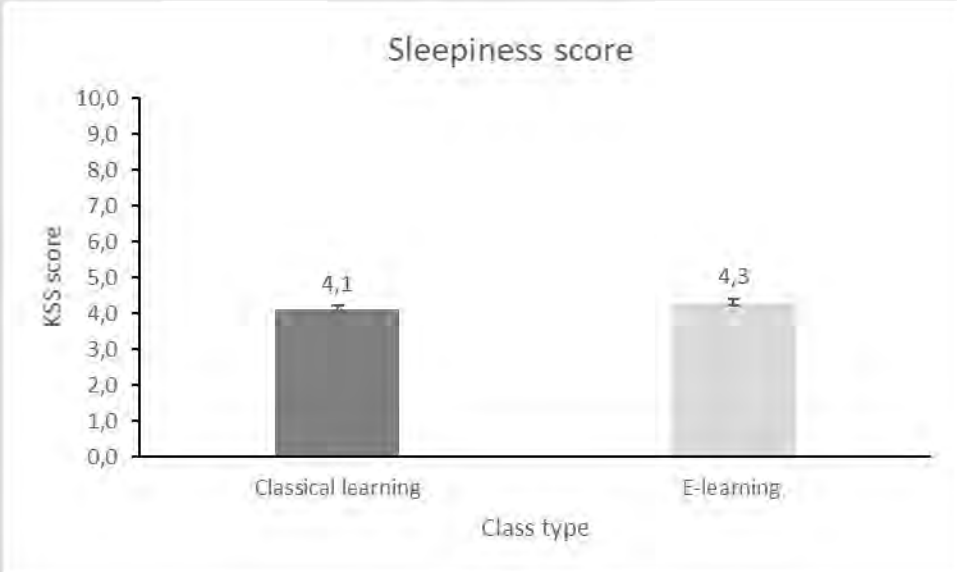


**Fig 3.** Perceived sleepiness for classical learning and e-learning

A paired t-test analysis is applied to observe the mental workload differences between the two learning conditions. There is a significant difference between mental workload in e-learning and classical learning ($t = –3.39$, $p < 0.01$), in which the NASA-TLX of e-learning is significantly higher than for classical learning. Significant differences are also found in the NASA-TLX sub-dimensions that are temporal demand ($t = –2.75$, $p < 0.01$) and frustration level ($t = –3.80$, $p = 0.00$). No significant difference is found between the score of sleepiness between e-learning and classical learning.

### 3.4. Correlation between e-learning readiness and mental workload

The correlation between e-learning readiness and the mental workload during e-learning was evaluated using Pearson Correlation. The result shows no significant correlation between the score of the NASA-TLX on e-learning conditions with e-learning readiness score (all $p > 0.05$). In addition, breaking down the NASA-TLX into its dimensions and correlating them with the dimensions of the e-learning readiness shows no significant correlation as well (all $p > 0.05$).

## 4. Discussion and conclusion

This study is intended to observe e-learning readiness among an Indonesian sample, to observe performance, mental workload, and sleepiness during classical and e-learning, and to observe possible relationships among e-learning readiness and those variables in e-learning conditions. The result shows that e-learning readiness of the sample of Indonesian university students in this study is quite high. Comparing classical and e-learning conditions, performance, and sleepiness are not different between them. However, the mental workload of e-learning is significantly higher than for classical learning. No significant correlation between the score of the NASA-TLX on e-learning conditions with e-learning readiness score was found.

The result of high e-learning readiness in the student sample in this study can be explained because the sample is taken from the Bandung Institute of Technology (ITB), the top technology institute in Indonesia. In addition, the condition of e-learning readiness from ITB students is not very different from that of other universities in Indonesia (Suwarsono, 2015; Hasanah, Nurdin, & Herbert, 2014). Most students in Indonesia have high technical skills to operate the equipment needed when using e-learning. The lowest readiness aspect from student participants mostly concerns the ability of learning behavior that students need when using e-learning. This result is in line with research conducted by Suwarsono (2015) who found that the ability of self-directed learning is the lowest readiness aspect of the samples of university students. In addition, research conducted by Hasanah, Nurdin, and Herbert (2014) found that learning motivation was the lowest aspect of e-learning readiness possessed by university students.

The fact that sleepiness (i.e., measured by the KSS scale) is slightly higher during e-learning than the KSS scale in classical learning indicates that the e-learning class makes the learner more sleepy. This result conforms a study conducted by Coelho Junior et al. (2018) who stated that online learning environments distract the focus and motivation of the learners. In addition, it is considered that there is no significant difference between the two because the degree of sleepiness may be highly related to the content of classes.

In relation to the mental workload, the significantly higher mental workload during e-learning than during classical learning might be caused by the absence of a teacher during the e-learning process. During study time, the teacher has a role to limit the scope of material given to students and give emphasis to the important points of the material (Maki & Maki, 2002; Shuja, Qureshi, Schaeffer, & Zareen, 2019). In the absence of teachers when using e-learning, there is a possibility of an overload amount of information received by students. This can happen because of the absence of teachers, which usually limits the material learned by students. These conditions make students feel that they need to learn all the things listed in the material without knowing which material is important to learn more seriously and which material is not very important to learn. This may explain why the mental workload level measured when using e-learning

is higher than when using face-to-face learning methods (Olasina, 2018; Guspatni, 2018). In addition, as stated by Ejubović and Puška (2019), self-regulated learning influences the performance in e-learning environment.

In particular, for Indonesians, the higher mental workload in e-learning than in the classical learning environment can be explained by a study conducted by Sulistyo-basuki (2007). The study said that Indonesians prefer classical to e-learning environments. Indonesians prefer talking and direct communication rather than a writing/virtual environment. Furthermore, Shapiro and Hughes (2010) and Venable (2011) stated several key features of distance learning, such as teacher-learner communications and active control from the students. In addition, as stated by Shu and Gu (2018), the interaction in classical learning was more in-depth than that in the online learning mode. Olasina (2018) also stated that social factors are missing in e-learning.

Talking about mental workload cannot be separated from cognitive load theory. The cognitive load theory is based on an assumption that working memory is limited (Pass, Tuovinen, Tabbers, & Van Gerven, 2003), in which strain on this memory can be reached. The strain on memory, in particular, arises from three sources: the individual learning characteristics (i.e., germane load), the instructional procedures (i.e., extraneous load), and the complexity of the information being presented (intrinsic load, Homer, Plass, & Blake, 2008). Therefore, it is not surprising that instruction and learning characteristics play a role in the higher mental workload in the e-learning environment.

Breaking down the dimensions of the mental workload using the NASA-TLX, higher temporal demand of the NASA-TLX during e-learning than classical learning might be caused by e-learning characteristics that require self-learning ability from users. With demands from e-learning to users that they must have the ability to learn independently, e-learning users should be able to manage their own learning time without help from outsiders. This is also discussed by Song, Singleton, Hill, and Koh (2004) who stated that there is a need for e-learning users to develop strategies in time management. In contrast to face-to-face learning where teachers can arrange the portion of material needed, when using e-learning users must manage their learning time portion independently to complete the material given on time before taking additional tasks or quizzes to be given afterward. Students who cannot manage their own learning rhythms are expected to feel a higher temporal demand when using e-learning because of the time pressure given to complete the material on time so they can work on additional tasks or quizzes given afterward.

The performance dimension of the NASA-TLX shows that participants rate their performance during e-learning lower than during classical learning. It indicates that students feel more successful in classical learning than when using e-learning. This may be caused by students who feel that the enthusiasm of teachers while teaching in classical learning can improve the effectiveness of learning. Ragusa (2017) found that students gave higher learning effectiveness ratings to teachers who had more enthusiastic presentations compared with teachers with less enthusiastic presentations. From the findings, it can be concluded that the presence of teachers who show enthusiasm can improve students' perceptions of effectiveness in learning. It is different from the e-learning method, which requires students to study independently without company from the teacher. This explanation is strengthened by the fact that the teacher who took part in this study received the honor of the best teaching technique.

The level of frustration of the NASA-TLX when using the e-learning method is significantly greater than in classical learning. It is similar to the results of research conducted by Hove and Corcoran (2008). This can happen because no teacher usually has

a role to provide direction during the learning process. In general, the role of the teacher is to direct the student, organize the amount of information, and present it in an acceptable form to the student (Hove & Corcoran, 2008). In the absence of direction given during the e-learning process, it is suspected that an increase of frustration level arises for students when using e-learning.

From the result of the correlation test, there is no significant correlation between e-learning readiness and mental workload during e-learning. Although Hansen and Gladfelter (1996) state that the use of technology in delivering information can go far beyond human capability to process such information, and Clarke, Ayres, and Sweller (2005) indicate that learning using technology as media will result in higher mental workload than usual if the user does not have enough technical ability to use the technology, it seems that e-learning readiness does not influence the mental workload. Indeed, the e-learning environment, in particular, interaction with the instructor, is more influencing.

This study has several limitations worth noting. First, the number of respondents is limited. However, it should be noted that this present study is an experimental study, which differs from a survey that usually needs a large number of respondents based on the number of variables. For an experimental study, the sample size required with 0.95 statistical power (i.e., the probability that the test rejects the null hypothesis (H0)) and 0.8 effect size (i.e., the difference that is expected between the means of values of the control and experimental group, divided by the expected standard deviation), is 42. Fifty-one of participants in this present study is therefore considered to be appropriate. Second, although some external factors that influence mental workload have been controlled, such factors that might influence mental workload in the learning situation such as the different levels of cognitive abilities among students will be interesting to be observed. However, because the experiment is designed as a within-subject experiment, those differences might not affect the result.

Despite the above-mentioned limitations, this study provides novelty and a valuable contribution in providing an empirical result of higher mental workload during e-learning than in classical learning. This study also provides data on e-learning readiness and the relation between e-learning readiness and mental workload. This study also supports the result of a previous study, by showing an empirical result about the crucial role of the instructor in e-learning. Overall, as stated by Galvis (2018), one of the most common challenges in higher education institutions is related to ensure quality and expand coverage of education, in which effort can be invested to obtain the objective by determining which teaching and learning environments should be used.

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