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Youth Perception of the Usage of Wearable Technology in Technical MOOC Education

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Abstract

Analysing youth learners' perception of the usage of wearable technology in technical education is reflected as the starting point towards a more effective and engaging learning environment. Previous research highlighted that one of the requirements for designing an engaging technical Massive Open Online Courses (MOOC) is to include a practice-oriented learning mode into its course structure. Therefore, this study aims to identify the learners' perception of the use of wearable technology in supporting the teaching and learning process specifically for technical course. This study adopted the case study methodology approach with quantitative analysis. The instruments used in this study include technical MOOC and wearable technology. A total of 375 engineering youth learners involved in this study and the data were analysed using descriptive and parametric testing. The survey results reflected that the learning materials produced by wearable technology do contribute towards positive perception in increasing the level of student's engagement with the learning process. Among key recommendations for future study are to implement the use of wearable technology for designing and developing other subjects as well.

Keywords: Youth Learner, Wearable Technology, TVET Learning, MOOC, Smart Glasses

Introduction

Youth leaners are a group of learners between the age of 15-30 years old as stated in Youth Societies and Youth Development Act (Amendment) 2019 and need continuous support from adult (Mursyid et al., 2021). In the year 2020, Department of Statistics reported that youth population was more than 9 million out of 32.6 million of Malaysia populations, which is around 28 percent, and the numbers are growing by this year. A study of engaging youth learners by Quigley et al (2020) highlighted on the use of connected learning theory that involve previous and new knowledge by digital technology and online information throughout the learning process.

The influence of technology innovation continues to expand and impact all industries as it evolves including in the education field. In education, the roles of technology have directly and indirectly changed the design and delivery of teaching and learning process (Attallah & Ilagure, 2018). Devices like smartphones, tablets, and wearable technology are starting to replace the conventional classroom teaching and learning system specifically adopted by the youth learners. The impact of technology-based learning affects the teaching practices, and the ways of learners acquire knowledge (Al-Taweel, Abdulkareem, Gul, & Alshami, 2020). Figure 1 illustrates a general overview of model for applying different technology in education platform (Fesol et al., 2018).

One of the most popular wearable technologies (WT) used in technical education are smart glasses (Strzys, et al., 2019). Smart glasses are wearable computing devices in the form of computerized eyeglasses that function to add information into reality or helps people to see better (Subin, 2021). Smart glasses collect information from internal or external sensors, retrieve data from other instruments or computers and support wireless technologies like Bluetooth, Wi-Fi, and GPS (Sapargaliyev, 2015). Figure 2 illustrates an example of smart glass, which is Google Glass hardware features being used for this study.

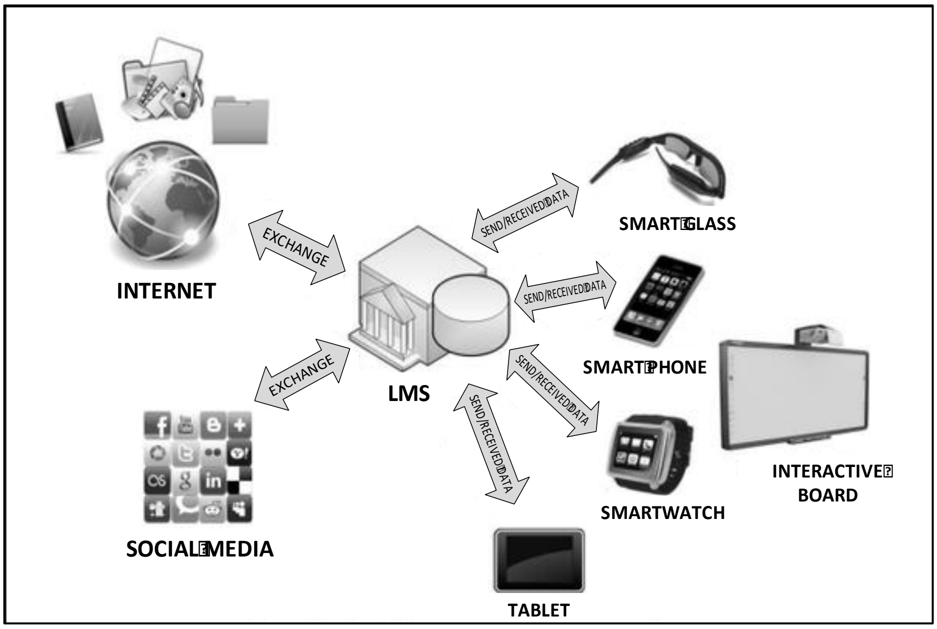

Figure 1**.** Model for applying divest integrated technology in education.
(Fesol et al., 2018)

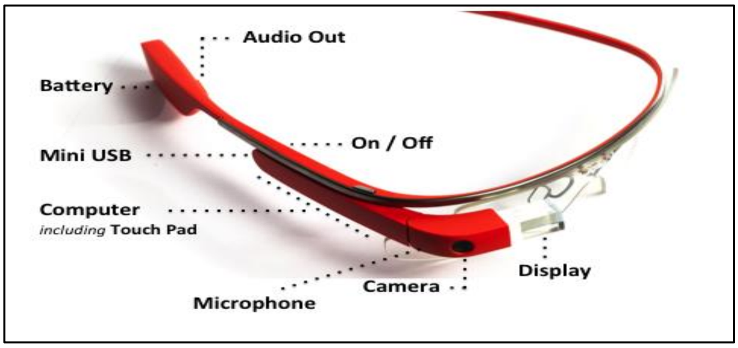

Figure 2. Google Glass hardware breakdown.
(Labus et al., 2015)

Researchers believed that smart glasses have enormous potential implication and benefits for augmentation of teaching and learning environments. Some of the potential advantages in education are: (a) wearable technology able to motivate, stimulate, and engage students to explore learning materials from different perspectives; (b) wearable technology offers educators an ability to explain topics where learners could not feasibly gain real-world first-hand experience by using virtual reality or augmented reality features; (c) wearable technology able to augment collaboration between students and educators; (d) wearable technology also can foster student creativity and imagination, help students manage their learning suited their own pace and on their own path; and (e) wearable technology able to stimulate an engaging learning environment appropriate to different type of students' learning styles (Buchem et al., 2015; Chaballout et al., & Shaw, 2016; Wei et al., 2018).

According to Fesol et al (2018), despite the advantages highlighted earlier, there are still lack of research that can be found in analysing the learners' perception on the use of wearable technology to support it usage and effectiveness in learning specifically in technical education. This is due to the limitation offers by wearable technology resulted in very few learning design, model, and framework being proposed by researchers that implement wearable technology in teaching and learning of technical education.

Therefore, the purpose of this study is to identify the learners' perception (where in this case referring to the youth learners) on the use of wearable technology in supporting teaching and learning process specifically for technical course.

Literature Review

Engineering Education and Technical MOOCs

Engineering education is the activity of teaching theory and principles related to the practice of engineering profession. Although the concept building of engineering education is very important for engineering students but the practice-based activities is the key element in engineering profession (Garcia, et al., 2014; Iqbal, et al., 2015; Iqbal, et al., 2015). Therefore, laboratory practices are a distinctive part of the engineering education. Since in engineering courses, the attendance of students in laboratories is essential, the theory must be augmented by hands-on training. In the connection with the online learning, where in this case we are referring to MOOCs, few researchers suggested to include the elements of in-person laboratories, remote laboratories, virtual laboratories and simulators can be instrumental in filling the theory-to-practice gap in online courses (Garcia, et al., 2014; Castro et al., 2014; Loro, et al., 2016; Zajdel & Maharbiz, 2016).

A study conducted by Loro, et al. (2016) introduced the use of a remote laboratory in MOOCs. The authors shared that remote laboratory are designed with pedagogical purposes. This advantage over in-person laboratories should be considered in their design and operation. But the main advantage of remote laboratories rests in its availability that has neither temporal nor geographical restrictions to access to a real laboratory (Loro, et al., 2016). The study also integrated the use of a remote lab with UNED-COMA platform into MOOCs and measure the students' dropout rate at the end of the course. The results from the study revealed that UNED-COMA platform is not intended or designed for the integration of a remote laboratory in MOOCs. Causing the students have less access to the learning materials and it is not possible for the educators to carry out a reliable learning analytics, which resulted in a high dropout rate (Loro, et al., 2016).

Kulesza, et al (2017) in their study explained that they included a remote laboratory platform Virtual Instrument Systems in Reality (VISIR) in their MOOC course and most of the MOOC videos focusing on handling the remote laboratory instruments. However, the authors highlighted that there is a limitation when working with the remote laboratory as it is not the same when dealing with the real circuit implementation where the lecturer existence element, showing the real circuit demonstration is a must (Kulesza, et al., 2017).

Therefore, the integration of either in-person laboratories, remote laboratories, virtual laboratories or simulators remote with MOOCs platform, together with good practices in designing practical experiences, can alleviate the disadvantages of in-person laboratories, remote laboratories, virtual laboratories and simulators remote.

Wearable Technology in Education

Current researchers have offered some interesting findings of using wearable technology distributed in all fields with different implementation background. However, the practice used of wearable technology mainly being supported most in these two main areas which are in medical and education. Few studies in medical suggested to include the use of wearable technology in order to engage the medical students (Amft, 2018; McCoy, et al., 2019). Wearable technology is a technology that user can wear on their body. The recording ability possesses by wearable technology able to capture a first-person view and real time video especially for training purpose (McCoy, et al., 2019).

One of the main features offered by wearable technology (where this study refers to smart glasses) is equipped with the camera, allowing its user to take images, records videos, and teleconference. Lee, et al. (2017) categorized this capability classifies the smart glasses as one of the wearable camera technology or wearable action camera. As defined by WorldSIM (2017) wearable action camera is a digital camera that designed for recording action while being immersed in it. Usually, action cameras come with a range of accessories that enable its user to attach them to helmet, handlebars, take them under water and attach to practically anything that can be wear (WorldSIM, 2017).

A study was conducted by Lee, et al (2017) to identify the feasibility of utilization of action cameras in recording video of spine surgery. The study tested three commercially available cameras which are Google Glass, GoPro Hero series, and Panasonic HX-A100, and they were selected to record typical spine surgery, posterior lumbar laminectomy, and fusion. All the three cameras were used by one surgeon and video was recorded throughout the operation (Lee, et al., 2017). In the study, the authors made the comparison based on the perspective of the human factor, specification, and video quality. Results of the study appeal that Google Glass is the most convenient and lightweight device for wearing and holding throughout the long operation. In term of the image quality, all devices except Google Glass supported HD format and GoPro have unique 2.7K or 4K resolution and for the overall quality of the video, the resolution was best in GoPro (Lee, et al., 2017).

Another study that investigates the use of wearable technology in promoting hands-free learning cited that wearable technology allows educator and student to better collaborate between each other by using hands-free devices, and most of the applications are in the fields of medicine and higher education (Spyropoulou et al., 2014). In addition, Bower and Sturman (2015) highlighted 13 functionalities of wearable technology in technical education context which are the ability of in-situ contextual information, recording ability, simulation, communication, engagement, first-person view, in situ guidance, hands-free access, fast feedback, efficiency, presence, distribution, and gamification capabilities (Bower & Sturman, 2015).

The summary that can be derived based on the feasibility study conducted by current researches (Parslow, 2014; Paro et al., 2015; Evans, et al., 2016; Lee, et al., 2017; Ortensi, et al., 2017) that highlighted on the use of smart glasses especially in education fields are listed as below:

i. First-person view - ability to promote the learners to view the learning from the lecturer's perspective;
ii. Recording ability - ability either for video or picture recording;
iii. Real-time interaction - allows the wearer to access information in real time (either to retrieve, share, or store data);
iv. Student assessment - enables the observers to analyse the wearer's primary visual focus during the entire procedure/ activity;
v. Personalize learning - affords the opportunity to create specific interactions to fit a user's learning preferences.

The learning materials produced by wearable technology able to support the visual-based learning production, which is the preferred learning style by the majority of the technical students. In addition, the advantages offered by wearable technology such as first-person view, hands-free recording ability and ability to control the view to be put in the frame, allow the lecturer to fully control the video recording and all videos were captured from the lecturer's viewpoint. These unique criteria make wearable technology as one of the engaging tools to engage the students with the technical MOOC learning.

However as mentioned earlier, there is a scarcity of research into the use of wearable technology in education due to the limitation offers by wearable technology, resulted in very few design, model, and framework being proposed by researchers that focus on the use of wearable technology in education (Fesol, Salam, & Bakar, 2018). Thus, this study is interested to identify the learners' perception (where in this case referring to the youth learners) on the use of wearable technology in learning technical course.

Methodology

A quantitative based approach was chosen as the method in this study. An online questionnaire type is used as the main data collection method. This section explains the sample chosen, data collection procedures, and survey instruments.

Participants and Data Collection

Using a case study research method to assess engineering students' perceptions based on the technical MOOC course offered to them. In addition, an online questionnaire was used to collect quantitative data for the study. There is a total of 375 engineering students (n=375), with valid respond who took part in this study. The number of respondents of 375 reflected that this study caters adequate sampling size as per suggested by (Krejcie and Morgan, 1970). The adequate sample size is a crucial factor of any quantitative-based study in which the aim is to make inferences about the overall population based on the sample and for further generalization of the hypothesis in the next part of the data analysis (Krejcie & Morgan, 1970). Adequate and approximate sampling size can influence the quality and accuracy of the research (Barlett et al., 2001).

Among them 31 percent (116) are female, and the remaining 69 percent (259) are male respondents. Majority of the respondents currently in their 3rd and 4th semester of study in a degree programme, who has more experience in the learning of technical courses compared to a diploma or 1st-year-degree students. Thus, the bias in the different level of learning understanding was believed avoidable to have the students to answer the online questionnaire.

The data collection involved three major phases. First, the respondents were asked to experience the used of Open Learning platform (which is MOOC) by the respective lecturers during the lecture hours. Seconds, they were asked to enrol into required technical MOOC course and participate in it for three weeks: watching videos, answering online quizzes, posting responses to forums, uploading videos, peer evaluation, and other activities included inside the technical MOOC. Third, the respondents were asked to critically evaluate the technical MOOC course effectiveness based on specific criteria being set using the online questionnaire platform. A descriptive analysis is used to further analyse the students' perception on the technical MOOC.

Survey Instrument

The title of the MOOC course that being evaluated is Principle of Electrical and Electronic MOOC. The questionnaire was design based on the combination of wearable technology features, a model of engaging online students organized around self-determination theory (SDT), and MOOC features as per suggested by (Hew, 2015). The variables used for the survey consist of five (5) variables of technical MOOC learning design and three (3) variables of wearable technology. There is a total of 48 items with eight survey constructs were finally used after getting approval from the expert reviewers. Figure 3 illustrates an overview of constructs used to measure the youth's perception on technical MOOC.

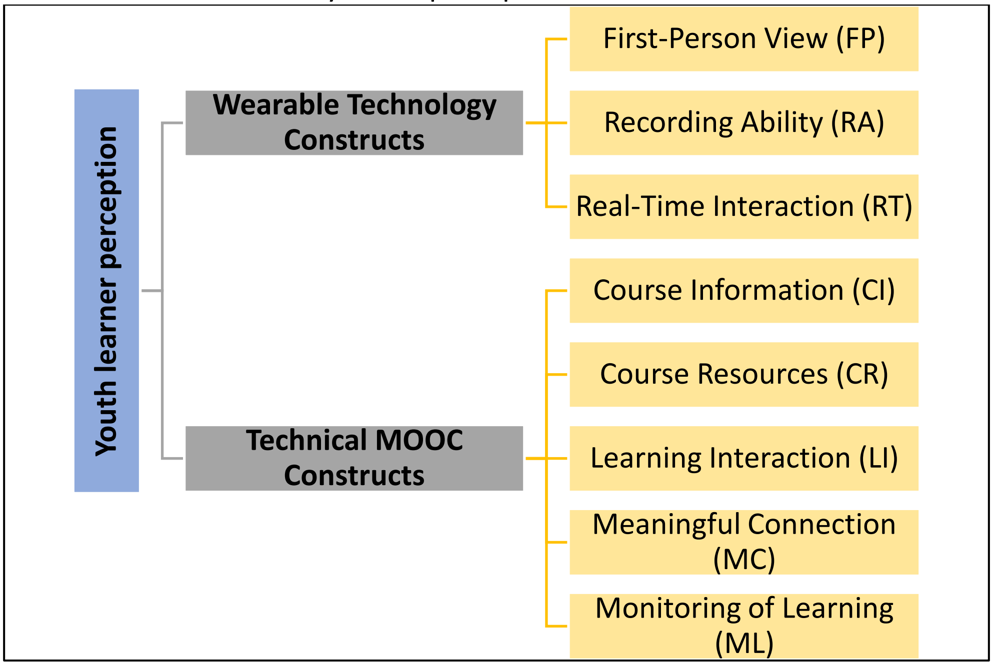

Figure 3. An overview of constructs used to measure youth's perception on technical MOOC used in this study.

Figure 4 shows a picture of lecturer using Google Glass to do the recording on lab demo activity. While Figure 5 shows a screenshot of a video from one of the lab tutorial modules captured using Google Glass which uploaded in the MOOC platform.

Figure 1. Lecturer using Google Glass to do the recording on lab activity.

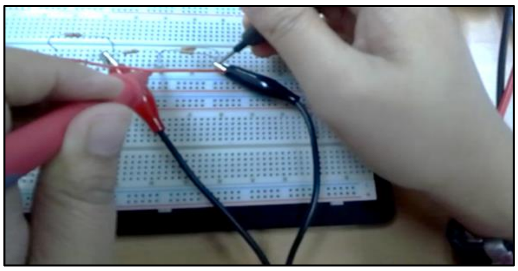

Figure 2. Screenshot of a video from one of the lab tutorial module

Results and Analysis

This section discusses all the results and findings gathered from the data analysis. The data was analysed using SPSS. In this study, the analyses of the data are based on reliability test, mean of the data, and correlation analysis results. The youth perception was analysed by identifying the relationship of wearable technology variables on each correlated technical MOOC learning design, either possess a positive or negative relationship using correlation analysis.

Reliability Test

To ensure the reliability of the constructs used to measure the students' perception on MOOC used in this study, reliability test has been conducted. Finding from the Cronbach's Alpha value reflected that all variables used in this study are acceptable where the values are all above .70, as per suggested by (Denis, 2018). Table 1 presents the Cronbach Alpha value for each of the construct and a total number of items per each construct.

Table 1

Cronbach's alpha results

Variables	N of Items	Cronbach's Alpha	Result
Technical MOOC Constructs			
Course Information (CI)	5	0.894	Reliable
Course Resources (CR)	13	0.909	Reliable
Learning Interaction (LI)	4	0.831	Reliable
Meaningful Connection (MC)	11	0.911	Reliable
Monitoring of Learning (ML)	4	0.850	Reliable
Wearable Technology Constructs			
First-Person View (FP)	4	0.874	Reliable
Recording Ability (RA)	4	0.838	Reliable
Real-Time Interaction (RT)	3	0.859	Reliable

Descriptive Analysis on Technical MOOC

The data gathered were further analysed using descriptive analysis, based on the mean values. From the technical MOOC construct, the data shows that majority of the youth learners agreeable that the technical MOOC course information are clearly explained (CI), they able to engage with the course resources provided (CR), they found that the interaction between friends and lecturers much easier via forum (LI), the course materials (e-content and e-activities) able to increase their understanding to the key concepts of technical course (MC), and weekly quizzes, discussion activities, as well as getting badges helped them to motivate and engage more with the learning process. Table 2 summarized the overall results by percentage for rating (3 = Somewhat agree, 4 = Agree, and 5 = Strongly agree), mean and standard deviation SD for each technical MOOC item.

Table 2
Distribution of mean and std. deviation for technical MOOC items.

Item	**Percent (3,4 and 5)**	**Mean**	**Std. Deviation**
Course Information (CI)			
The following information are clearly explained at "Course Overview" and "Course Outline" section.			
Course objectives	94.6	4.028	.6881
Course duration	95.1	3.955	.7236
Course syllabus	95.1	4.040	.6446
Course requirement (type of assessment, criteria for earning badges, activities deadline)	94.1	4.074	.7331
The learning schedule (course plan/ lesson plan) is easy to follow	94.1	4.091	.7580
Course Resource (CR)			
I engage more with lecture videos to understand the electrical and electronic concepts better	94.6	4.199	.6678
I engage more with lab demo videos to understand the hands-on exercises better	94.6	4.210	.7140
I engage more with tutorial solution videos to better understand the circuit calculation	95.1	4.273	.6455
I found that watching tutorial solution videos explaining on circuit solutions able to help me to easily memorize the learning better	92.4	4.045	.7621
I understand the electrical and electronic concepts better by reading the lecture slides provided	93.0	4.119	.7801
The course content provided able to meet my learning needs	94.6	4.165	.7259
I engage more with online quizzes to understand the electrical and electronic concepts better	93.5	4.080	.7593
I engage more with drag-and-drop activity to understand the electrical and electronic concepts better	92.4	4.051	.7729
The Circuit AR Game is able to increase my understanding on the circuit construction	93.0	4.091	.7803
The use of Remote Lab is able to reinforce my circuit construction's skills	93.5	4.057	.7228
The Circuit Clinic section is able to increase my understanding on the electrical and electronic concepts	94.6	4.170	.6714
I engage more with Resistor Color Code practice to understand the electrical and electronic concepts better	94.1	4.199	.7331
I engage more with tutorial activities to understand the circuit calculation better	94.6	4.273	.7364

Learning Interaction (LI)			
Opportunity to interact with large number of students is beneficial for my learning	91.4	4.000	.8281
I find it easy to communicate with others through Circuit Clinic	94.6	4.068	.7375
I find it much easier to communicate with lecturer via forum	93.5	4.011	.7855
I find it much easier to communicate with friends via forum	94.1	4.068	.7375
Meaningful Connection (MC)			
The following course materials (e-content) able to increase my understanding to the key concepts of electrical and electronic with the real scenario:			
• Lecture video	95.1	4.290	.6686
• Lab demo videos	94.6	4.295	.6703
• Tutorial solution videos	95.1	4.364	.6707
• Lecture slides	94.1	4.335	.6728
The following course activities (e-activity) able to increase my understanding to the key concepts of electrical and electronic with the real scenario:			
• Online quizzes	92.4	4.108	.7744
• Drag-and-drop activity	94.6	4.068	.7218
• Circuit AR Game	94.1	4.210	.6813
• Remote Lab	93.0	4.142	.7229
• Circuit Clinic	93.5	4.119	.7348
• Resistor Color Code practice	93.5	4.170	.7285
• Tutorial activities	94.6	4.239	.6844
Monitoring of Learning (ML)			
Weekly quizzes helped me to achieve the learning objectives	93.0	4.097	.7685
Assignments given helped me to understand better the learning objectives	95.1	4.136	.6876
I find that group discussion activity allows me to participate actively	94.6	4.125	.6980
I find that badges given able to increase my motivation to complete each of the activities	93.0	4.097	.7832

Descriptive Analysis on Wearable Technology

Next, the data gathered from the wearable technology construct revealed that overall, more than 91 percent of the youth learners do agree that the used of wearable technology in technical MOOC education able to help them to engage with the learning. This is where majority of them decided between 'Somewhat Agree', 'Agree', and 'Strongly Agree' options. They found that they can engaged more with the video lectures that recorded using lecturer's view-point able to help them to understand the topic better (FP). They also agreed upon the recording ability produced by wearable technology, which are the pictures and videos recorded, able to help them to understand the learning better (RA). Lastly, the youth learners also found that the live-video stream features in wearable technology is useful for their learning (RT). Table 3 summarized the overall results by percentage for rating (3 = Somewhat agree,4 = Agree, and 5 = Strongly agree), mean and standard deviation (SD) for each wearable technology item.

Table 3
Distribution of mean and std. deviation for wearable technology items.

Item	Percent (3,4 and 5)	Mean	Std. Deviation
First-person view (FP)			
I found that lab tutorial videos are useful for my learning.	94.1	4.313	.6837
I engaged more with lab tutorial videos to understand the hands-on better.	94.1	4.352	.6768
I prefer to watch lab tutorial videos explaining about the hands-on activities compared to reading the lab handouts.	95.1	4.250	.7051
The video production based on the lecturer's view-point able to help me to understand the lab assessment better.	94.1	4.233	.7385
Recording ability (RA)			
I found that pictures of complete circuit construction on each lab tutorials able to help me to understand better.	94.6	4.199	.7485
I found that pictures of complete solution for each exercise able to help me to understand better.	95.1	4.199	.6847
I found that exercise solution videos are useful for my learning.	94.6	4.290	.6937
I engaged more with exercise solution videos to understand the learning better.	93.5	4.301	.7133
Real-time interaction (RT)			
I found that live-video stream is useful for my learning.	91.9	4.188	.8445
I enjoy watching lecturer conduct the lesson via live-video stream.	93.0	4.216	.7921
I found that question and answering session during live-video stream able to help me to understand the learning better.	93.0	4.290	.7717

Correlation Analysis
There are several statistical analyses that can be used in exploring the relationship between variables such as correlation analysis, regression analysis, and factor analysis. However, the one that best suits this study is correlation analysis. Correlation analysis is used to explain the strength and the direction of the linear relationship between two variables. Therefore, in this study, we tried to identify the positive or negative relationship between variables of technical MOOC with the students' perception. The correlation value explains the effect size and can describe the strength of the correlation which identified as *r* using the following suggested interpretation by Cohen (1992): (i) *r* =.10 to .29, a week; (ii) *r* = .30 to .49 as moderate; and (iii) *r* = .50 to 1.0 as strong (Cohen, 1992). The below correlation results were based on the total number of 375 (n=375). Table 4 summarizes the correlation results between respective wearable technology variables (FP, RA, RT) with each correlated technical MOOC learning design variables (CI, CR, LI, MC, ML).

Table 4
Correlation results between WT and technical MOOC learning variables

DV	Correlations (*r*)			Result
	FP	RA	RT	
Course Information (CI)	.567**	.616**	.495**	There is a significant strong positive correlation between wearable technology variables (FP, RA, RT) with technical MOOC learning variable (CI).
Course Resource (CR)	0.741	0.732	0.704	There is a significant strong positive correlation between wearable technology variables (FP, RA, RT) with technical MOOC learning variable (CR).
Learning Interaction (LI)	-	-	0.597	There is a significant strong positive correlation between wearable technology variable (RT) with technical MOOC learning variable (LI).
Meaningful Connection (MC)	0.768	0.701	0.687	There is a significant strong positive correlation between wearable technology variables (FP, RA, RT) with technical MOOC learning variable (MC).
Monitoring of Learning (ML)	-	-	0.678	There is a significant strong positive correlation between wearable technology variables (FP, RA, RT) with technical MOOC learning variable (ML).

**. Correlation is significant at the 0.01 level (2-tailed).

From the above table, all the correlation values between the independent variables (FP, RA, and RT) with the respective dependent variable (CI, CR, LI, MC, and ML), were positive values and above the preferable cut-off point of 0.30 (Denis, 2018). In addition, all the correlation values were in the range of strong correlation where *r* value between 0.5 to 1.0. This reflects that all wearable technology variables correlated substantially and held a strong positive relationship with technical MOOC learning design variables, r=.5 to 1.0, n=375, $p < .0005$. This suggests that the learning materials produced by wearable technology which consist of the elements of the first-person view, recording ability, and real-time interaction contributed towards positive perception in technical MOOC learning among the youth learners.

Discussion

As overall, the correlation analysis revealed that youth learners found all five (5) instruments of technical MOOC constructs draw a positive direction of the relationship with wearable technology in guiding by the adult as an expert, in which reflected as positive youth leaners' perception through Youth-Adult Partnership (Mursyid et al., 2021). It can be concluded that an adequate course information does influence the positive perception of youth leaners on the MOOC course. Besides, engaging MOOC course resources also bring a positive perception of the youth leaners and active learning strategies included in the MOOC course do influence the positive perception of the learners (Fesol et al., 2018). Moreover, effective monitoring of learning over the MOOC course and implementation of meaningful connection does bring the positive perception of the youth leaners. The interactions among learner and learner, and learner with lecturers do affect the positive perception of the youth leaners on the MOOC course itself. Therefore, wearable technology can capture a first-person view and real time video especially for training purpose (McCoy, et al., 2019).

Conclusions

This paper presents the results of youth learners' perception on the current practice of technical MOOC design (e-content and e-activity) by combining the functionalities offered by the wearable technology that build-up an engaging technical MOOC. We also conducted a survey in order to identify the youth perception on technical MOOC. Based on the findings, adequate course information about the MOOC course, engaging MOOC course resources, and active learning strategies included in the MOOC course able to lead towards a positive perception of the students. In addition, effective monitoring of learning over the MOOC, meaningful connection implemented in MOOC, and two ways interactions (student-student, student-lecturer) in MOOC also another important aspect that able to lead towards a positive perception of the youth in learning. The correlation analysis results revealed that all five variables contribute positive relationship with youth learner perception.

Understanding the relationship of youth learner perception on the usage of wearable technology in technical MOOC is only the beginning phase to further develop more effective and efficient learning environment. By introducing wearable technology as one of the options that can be used by educators to engaged the youth learners specifically in the technical courses.

Future Works

The proposed framework has only been tested in the development of the electrical and electronic subject. It is recommended that future studies implement the use of wearable technology for designing and developing other subjects as well. The respondents of this study were students who have a background education in the field of electrical and electronic. Therefore, research can be extended to other respondents who are a novice or even have no knowledge at all in the field of electrical and electronics to generalize the findings for more concrete results. The proposed framework has only been tested based on quantitative measurement. Thus, it is recommended that a qualitative study should also be done to obtain more precise results on the effectiveness of the proposed framework.

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