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The Importance of Users' Emotional Factors Related to Design of E-Learning Interface Using Kansei Analysis

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Abstract: E-Learning is a popular information system used to facilitate learning activities without borders of time and place. Students, as users, play an important role in determining the design of an e-Learning system; incorporating the users' emotional requirements into e-Learning development is therefore crucial. A user interface is a critical software component that acts as a bridge to facilitate interaction between users and the system. The design of the user interface must consider the users' emotions in order to create a positive experience during the running of a software system. Kansei engineering is a methodology utilized to analyze users' feelings towards the software user interface. The goals of this research are to implement Kansei engineering with coefficient correlation analysis in order to analyze and explore students' emotional experiences in higher learning institutions and to identify the emotional factors related to the appearance of an e-Learning interface based on students' learning experiences. Most e-Learning is considered based on its functional aspect, but this paper attempts to explore e-Learning based on its emotional aspect by discovering the relationship between the user interface and students' emotional experience in e-Learning. The results found that Kansei was "excellent" for exploring students' most critical emotional factors, which could have a significant impact on designing and implementing an e-Learning system using open-source software. The result could also be used as a recommendation for educational institutions when selecting an open-source learning management system as a platform for e-Learning.

Keywords: emotional factor, Kansei, analysis, Kansei words' relationship, user, e-learning.

用户情感因素对使用感性分析设计电子学习界面的重要性

摘要：电子学习是一种流行的信息系统，用于促进不受时间和地点限制的学习活动。学生作为用户，在确定电子学习系统的设计方面发挥着重要作用；因此，将用户的情感需求纳入电子学习开发至关重要。用户界面是一个关键的软件组件，它充当促进用户与系统之间交互的桥梁。用户界面的设计必须考虑用户的情绪，以便在软件系统的运行过程中创造积极的体验。感性工程是一种用于分析用户对软件用户界面的感受的方法。本研究的目的是通过系数相关分析实施感性工程，以分析和探索学生在高等教育机构中的情感体验，并根据学生的学习体验确定与电子学习界面外观相关的情感因素 大多数电子学习是基于其功能方面考虑的，但本文试图通过发现用户界面与学生在电子学习中的情感体验之间的关系，从情感方面来探索电子学习。结果发现，完全的在探索学生最关键的情感因素方面"非常出色"，这可能对使用开源软件设计和实施电子学习系统产生重大影响。在选择开源学习管理系统作为电子学习平台时，该结果也可以作为教育机构的建议。

关键词：情感因素，感性，分析，感性词的关系，用户，电子学习。

1. Introduction

Recently, it has become clear that the implementation of e-Learning is required to support online learning activities at different levels of

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education; this was seen in particular during the COVID-19 pandemic.

Most learning management systems (LMS) are similar and have standard functions for performing online learning activities over the public internet. The problem is how to choose one of them to deliver a positive experience for students as active users and help them to gain the knowledge they require without the restriction of time and place [1]. This has forced educational institutions to consider the best mechanism for how to analyze and choose the most suitable LMS based on students' requirements.

An LMS requires functional factors that must be analyzed to find the basic facilities of the software available to support users' learning activities. On the other hand, other factors, such as emotional factors, are also an important consideration [2]. Sometimes software developers ignore the emotional factors in software development, including LMS, because the developer mostly focuses on functional factors. Considering LMS implementation based on students' emotions is also important to make sure their implicit needs regarding online learning are met [3-5]. For example, considering students' emotional factors could encourage making activities more fun during the learning process to help students gain greater knowledge.

Kansei analysis is an approach that has been widely used in the research of product development, including software, due to the psychological aspects or emotional factors [6, 7]. Kansei analysis is also able to explore what kinds of users' emotions are related to the concept of the software, including LMS [8, 9].

In general, software development aims to make software understandable and effective at communicating. During development, the developer has to include the users' emotions and communicate with them to grasp their implicit needs because user feedback helps establish the directions of future software [10, 11]. Kansei words in Kansei analysis efficiently represent users' preferences towards software based on how they look and feel [12].

Many researchers adopted Kansei analysis in e-learning systems to support and enhance learning performance. Kansei analysis is targeted to observe what students completely desire about e-Learning based on their learning experiences. The evaluations in the Kansei analysis use multivariate statistical methods such as coefficient component analysis and factor analysis [13-15]. The multivariate method explores psychological aspects presented by Kansei words towards specimens to find the kinds of element designs related to LMS.

Our goal for this research is to apply coefficient correlation analysis (CCA) and factor analysis (FA) to a Kansei analysis to analyze the relationship between students' emotional factors represented by Kansei words. We also find the effect of emotion on online learning activities. As a result, we can give a recommendation for educational institutions implementing online learning using an open-source LMS.

2. Data Collection

The data questionnaire used five specimens of open source e-learning software or learning management systems (LMS) such as Moodle [16], ATutor [17], ILIAS [18], Dokeos [19], and Opigno [20]. This software was chosen due to its widespread use in and around higher education institutions. We have to ensure that each specimen has unique design elements' characteristics, for example, page layout, color balance, and text type. Another important thing in Kansei is the selection of Kansei words. Kansei words mean a word that represents an emotional feeling. So eight adjectives are selected to analyze the emotional feelings of students toward each LMS. According to the opinions of educational experts, we gathered eight adjective words closely related to LMS. The restriction of using eight adjectives as Kansei words was because these words were considered to have a strong emotional relationship with the appearance of LMS. This research constructs a list of eight Kansei words using the five-point Semantic Differential (SD) Scale (from 1 to 5) to measure the average of students' feelings after looking at LMS specimens for a while.

Collecting data was done by coordination with one hundred undergraduate students of STMIK-LIKMI Bandung as respondents. Then, we calculated the average values from all respondents for each Kansei word and specimen (Table 1 and Fig. 1). According to this result, we found that each Kansei word's average has a value of between 2 and 4.

The Kansei word "dynamic" has the biggest value for Moodle. "Pleasant" has the biggest value for Opigno. "Simple" has the biggest value for Dokeos. "Clear" has the biggest value for ILIAS. "Harmony" has the biggest value for Moodle. "Unique" has the biggest value for ATutor. "Excellent" has the biggest value for ILIAS.

We also found that the Kansei word "pleasant" has a considerable impact on three LMSs (Moodle, ATutor, and Opigno), while the Kansei word "clear" has a significant impact on ILIAS and Dokeos. "Dynamic" has the greatest impact on ILIAS. "Pleasing" has an impact on Opigno. "Simple" has an impact mainly on Dokeos. "Clear" has an impact primarily on ILIAS. "Harmony" has an impact chiefly on Moodle. "Unique" has an impact mainly on "formal". The Kansei word "excellent" has the greatest impact on ILIAS. So, each Kansei word has an impact on different LMSs.

Table 1 Dataset of all respondents' averages

Kansei Words	Open Source E-Learning				
	Moodle	ATutor	ILIAS	Dokeos	Opigno
1. Dynamic	3.75	3.67	3.77	2.28	2.36

Continuation of Table 1					
2. Pleasant	4.02	3.94	2.96	2.86	4.18
3. Simple	3.47	2.31	2.25	3.75	3.62
4. Clear	3.76	3.68	3.92	3.86	3.79
5. Harmony	3.81	3.73	3.80	2.11	2.24
6. Unique	2.36	3.82	3.70	2.17	2.25
7. Formal	2.45	3.68	2.23	3.72	2.16
8. Excellent	2.80	2.87	3.16	2.23	2.20

In the following section, we continue to explore the data in Table 1 to analyze in detail the relationship among the Kansei words using coefficient correlation analysis (CCA).

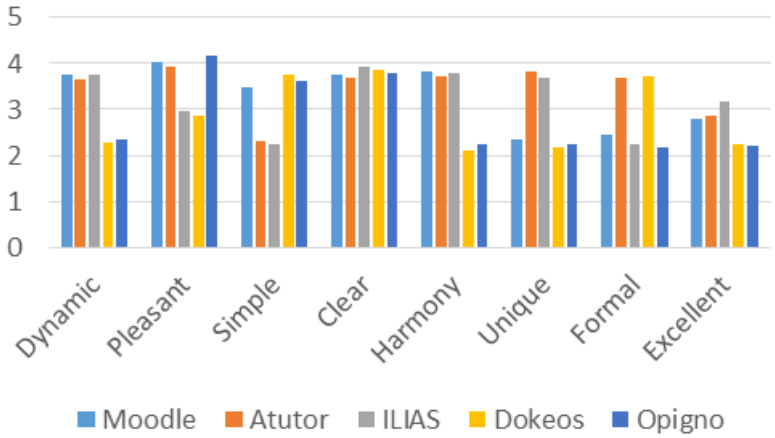

Fig. 1 The relationship of Kansei words

3. Relationship Analysis

The software XLStart is used to collect and process the questionnaire data (Table 1) using CCA to obtain the results shown in Table 2. We thus found that the relationship among the Kansei words went from weak to strong.

Table 2 Kansei words' relationship using CCA

Kansei Words	Dynamic	Pleasant	Simple	Clear	Harmony	Unique	Formal	Excellent
Dynamic	1	0,11	-0,74	-0,19	1,00	0,71	-0,17	0,95
Pleasant	0,11	1	0,14	-0,79	0,14	-0,13	-0,27	-0,13
Simple	-0,74	0,14	1	0,04	-0,74	-0,99	-0,03	-0,85
Clear	-0,19	-0,79	0,04	1	-0,22	-0,09	-0,34	0,05
Harmony	1,00	0,14	-0,74	-0,22	1	0,70	-0,17	0,95
Unique	0,71	-0,13	-0,99	-0,09	0,70	1	0,11	0,81
Formal	-0,17	-0,27	-0,03	-0,34	-0,17	0,11	1	-0,19
Excellent	0,95	-0,13	-0,85	0,05	0,95	0,812	-0,19	1

Further analysis of the relationship among the Kansei words is needed. It is important to find alternative emotions related to an interface's appearance.

Based on the results in Table 2, we found the strength of the relationship between the students' feelings and the Kansei words.

In this analysis, the value of the closeness of the relationship is determined by the extent to which the value of the CCA results is close to 1. Therefore, the closer the value is to 1, the closer the relationship between the two Kansei words. In contrast, a value close to zero (or even a negative value) means that the relationship is distant and cannot be considered an emotional alternative.

3.1. The Relationship among the Kansei Words

The relationship among the Kansei words (Table 2) can be divided into several relationship strengths, as shown in Table 3. It is very helpful to find an alternative Kansei word. Those that can be used for this purpose exhibit a "strong" or a "very strong" relationship. If the relationship is "fair" or "weak", the word cannot be recommended as an alternative.

Table 3 Kansei words' relationship classification

Relationship	Range	Kansei Words
Very Strong	0.95 – 1	Harmony – Dynamic
		Excellent – Dynamic
Strong	0.85 – 0.94	Unique – Excellent
Enough	0.5 – 0.84	Dynamic – Unique
		Harmony – Unique
Weak	0.00 – 0.49	Pleasant – Harmony
		Dynamic – Pleasant
No	Less than 0	Harmony – Clear
		Formal – Dynamic

Therefore, if one of the Kansei words is identified as an emotional factor that greatly influences interface design, then another Kansei word can be chosen as an alternative that has a "very strong" or "strong" relationship with it. This is the case on condition that the alternative is also identified as a strong emotional factor based on the results of the factor analysis. For example, the Kansei word "dynamic" can be substituted by or combined with the Kansei words "harmony" or "excellent" on condition that these are identified as strong emotional factors.

3.2. The Distribution of the Kansei Words

We continue to perform factor analysis to obtain the Kansei word distribution, as shown in Fig. 2. The distribution is divided into 4 quadrants, of which quadrants I and II show the area of the strong Kansei words, especially quadrant I. Fig. 2 thus shows which Kansei words have the strongest influence on the specimen. As we can see, "harmony", "dynamic", "unique", and "excellent" are located in the same cluster.

Because they are found in the right quadrants, these four Kansei words can be said to have the greatest influence on the specimen. These words highlight the emotions that must be considered when implementing e-learning.

The Kansei words "formal", "clear", "simple", and "pleasant" are in the left quadrants (III and IV), which means they have a weaker influence on the specimen. Therefore, the emotions linked to these Kansei words are not important enough to be considered as a basis for students' e-learning experiences.

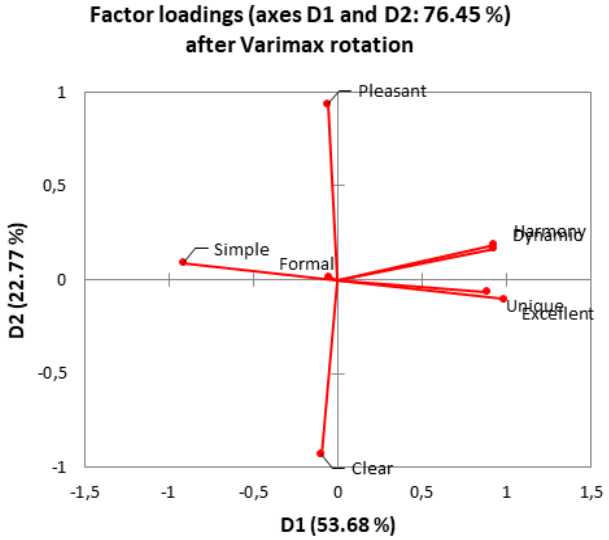

Fig. 2 Kansei words' distribution

4. Factor Analysis

Factor analysis is performed to rank all the Kansei words. By doing so, we understand which emotional factors have strength and are thus helpful in designing an e-learning interface using Kansei engineering. The results are sorted from the highest to the lowest coefficient value and shown in Table 4.

Table 4 Factor analysis of Kansei words

Kansei Words	Coefficient Value
Simple	-0.909
Clear	-0.098
Pleasant	-0.059
Formal	-0.054
Unique	0.885
Harmony	0.923
Dynamic	0.925
Excellent	0.980

Overall, the results in Table 4 indicate the degree of the relationship between the eight Kansei words and the five open-source e-learning software tools analyzed in this study. The results are divided into two major parts: the Kansei words that have a negative value are influential, while those that have a positive value are not influential.

Four Kansei words—"excellent", "dynamic", "harmony", and "unique"—have the highest coefficient values, which means that they are very influential in the interface design. In this context, it is especially important to consider the Kansei word "excellent".

To obtain the other Kansei word alternatives (namely "dynamic", "harmony", and "unique"), we have to check again the data in Table 3, which shows the relationship among these words. We can only select a Kansei word as an alternative if it has a strong relationship with another word.

In this case, we can choose the word "dynamic" because, in addition to the results of the factor analysis, it has a high coefficient value. Furthermore, based on the results of the CCA, it has a strong relationship with the word "excellent".

If we choose a design based on the Kansei word "dynamic", the word "harmony" can be used as an alternative. However, the Kansei word "unique" has no alternative, so it should not be recommended as a design concept because its influential emotional factor is insignificant (less than 0.9).

According to Tables 1 and 4, the most considered in the design and implementation of online learning using an open-source LMS is the Kansei word "excellent" and its alternatives.

5. Conclusion

A user interface is a critical part of e-learning software, so it must be designed by involving users to build a suitable appearance. Kansei engineering helps the developer design the software interface by considering the user's emotional factors.

This research resulted in several emotional factors that must be considered in implementing an LMS by focusing on how the LMS looks. The research proved that there is a relationship between the interface and the users' feelings, the relationship between Kansei words that affect the desired appearance of the interface. CCA is proven to be an effective method for determining the relationship between Kansei words. FA effectively determines the strength of Kansei words to the interface of e-learning so that it can be determined which Kansei words should be considered in selecting and implementing e-learning, especially using open source LMS for high educational institutions. The results show that four students' emotional factors influence behavior, while the most influential is only one, namely "dynamic." Kansei word "dynamic" has a very strong relationship with two Kansei words such as "harmony" and "excellent."

Additional e-learning research on students'

emotional feelings using Kansei engineering is required to translate these factors into the basic structure of design elements that describe the model of interface appearance for e-learning using an LMS based on user feelings.

Collecting data questionnaires also requires a higher number of Kansei words and a longer research time so that other factors can still be explored using different analytical methods.

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References

[1] TURUMUGON P., & BAHARUM A. Identifying a User Interface Web Design Standard for Higher Learning Institution Using Kansei Engineering. *Indonesian Journal of Electrical Engineering and Computer Science*, 2018, 11(1): 90-97. https://doi.org/10.11591/ijeecs.v11.i1

[2] LOKMAN A. M. Kansei Analysis for Design Web. *Journal of ITM*, 2021, 4(2): 2-20.

[3] ABDURRAHMAN, RAHMAN A.A., HADIANA A., and LOKMAN A. M. Emotional Preferences Analysis Using Kansei in Designing the Appearance of User Interface for E-Voting Application. *International Journal of Computer Science and Network Security*, 2021, 12(11): 193-198. https://doi.org/10.22937/IJCSNS.2021.21.11.27

[4] LOKMAN A. M. *Go Green with Emotion.* LiU Electronic Press, 2018.

[5] REDZUAN F., LOKMAN A. M., and OTHMAN Z. A. Kansei Semantic Space for Emotion in Online Learning. Proceedings of the 3rd International Conference on User Science and Engineering, Shah Alam, 2014, pp. 168-173. https://doi.org/10.1109/IUSER.2014.7002697

[6] ISMAIL N. N. N. N., & LOKMAN A. M. Kansei Engineering in Implementation in Web-Based Systems: A Review Study. In: SHOJI H., KOYAMA S., KATO T., MURAMATSU K., YAMANAKA T., LÉVY P., CHEN K., and LOKMAN A. M. (eds.) *Proceedings of the 8th International Conference on Kansei Engineering and Emotion Research. KEER 2020. Advances in Intelligent Systems and Computing*, Vol. 1256. Springer, Singapore, 2020: 66-76. https://doi.org/10.1007/978-981-15-7801-4_7

[7] TURUMUGON P., BAHARUM A., NAZLAN N. H., NOH N. A. M., NOOR N. A. M., and RAHIM E. A. Users' Emotional Evaluation Towards Kansei-Based Higher Learning Institution Website Using Geneva Emotion Wheel. *Indonesian Journal of Electrical Engineering and Computer Science*, 16(3): 1547-1554. https://doi.org/10.11591/ijeecs.v16.i3.pp1547-1554

[8] HUSSIN S. N., & LOKMAN A. M. Kansei Website Interface Design: Praticality and Accuracy of Kansei Web Design Guideline. Proceedings of the International Conference on User Science and Engineering, Selangor, 2011, pp. 30-35. https://doi.org/10.1109/iUser.2011.6150531

[9] BIDIN S. A. H., & LOKMAN A. M. Enriching the comfortability emotion on website interface design using Kansei engineering approach. In: LOKMAN A., YAMANAKA T., LÉVY P., CHEN K., and KOYAMA S. (eds.) *Proceedings of the 7th International Conference on Kansei Engineering and Emotion Research 2018. KEER 2018. Advances in Intelligent Systems and Computing*, Vol. 739. Springer, Singapore, 2018: 792–800. https://doi.org/10.1007/978-981-10-8612-0_82

[10] HADIANA A., & LOKMAN A. M. Kansei Engineering in Malaysia and Indonesia: A Systematic Literature Review. In: SHOJI H., KOYAMA S., KATO T., MURAMATSU K., YAMANAKA T., LÉVY P., CHEN K., and LOKMAN A. M. (eds.) *Proceedings of the 8th International Conference on Kansei Engineering and Emotion Research. KEER 2020. Advances in Intelligent Systems and Computing*, Vol. 1256. Springer, Singapore, 2020: 115–126. https://doi.org/10.1007/978-981-15-7801-4_12

[11] NUGROHO I. M., HADIANA A., and SINGASATIA D. Design of Watsu Mobile Interface Using Kansei Engineering. Proceedings of the 4th International Conference on Informatics and Computing, Semarang, 2019, pp. 1-8. https://doi.org/10.1109/ICIC47613.2019.8985955

[12] HADIANA A., & ABDURROHMAN. Analysis of Customers' Emotional Preferences Using Kansei Engineering and AHP. Proceedings of the 4th International Conference on Science and Technology, Yogyakarta, 2018, pp. 1-5. https://doi.org/10.1109/ICSTC.2018.8528675

[13] ADNAN H., & REDZUAN F. Evaluating students' emotional response in video-based learning using Kansei Engineering. Proceedings of the 4th International Conference on User Science and Engineering, Melaka, 2016, pp. 237-242. https://doi.org/10.1109/IUSER.2016.7857967

[14] NAIM N. F. B. M., & IBRAHIM A. A. Aesthetics in E-Learning Websites Interface Design Using Kansei Engineering Method. Proceedings of the International Conference on Information Science & Application, Seoul, 2014, pp. 1-4. https://doi.org/10.1109/ICISA.2014.6847351

[15] HADIANA A. Web based e-learning system analysis using Kansei Engineering. Proceedings of the 3rd International Conference on Information and Communication Technology, Nusa Dua, 2015, pp. 558-562. https://doi.org/10.1109/ICoICT.2015.7231485

[16] MOODLE. *Documentation*, 2022. https://docs.moodle.org/400/en/Main_Page

[17] ILIAS. *Solution for Universities*, 2021. https://www.ilias.de/eng/lms-ilias-solutions-university

[18] ATUTOR. *ATutor Features*, 2022. http://atutor.github.io/atutor.feature.html

[19] OPIGNO. *Our customizable e-learning platform*, 2022. https://www.opigno.org/solution

[20] DOKEOS. *The training platform designed for growing teams*, 2022. https:/www.dokeos.com/lms-platform-training

参考文:

[1] TURUMUGO P., & BAHARUM A. 使用完成 代理 羽林 g 确定高等教育机构的用户界面网络设计标准。印度尼西亚电气工程与计算机科学杂志, 2018, 11(1): 90-97. https://doi.org/10.11591/ijeecs.v11.i1

[2] LOKMAN A. M. 设计网络的完全的分析。ITM 杂志，2021 年，4(2)：2-20。

[3] ABDURRAHMAN、RAHMAN A.A.、HADIANA A. 和 LOKMAN A.M. 在设计电子投票应用程序用户界面外观时使用完全的进行情绪偏好分析。国际计算机科学与网络安全杂志，2021，12(11)：193-198. https://doi.org/10.22937/IJCSNS.2021.21.11.27

[4] LOKMAN A. M. 带着情感走向绿色。刘电子出版社，2018。
[5] REDZUAN F.、LOKMAN A. M. 和 OTHMAN Z. A. 完全的在线学习中的情感语义空间。第三届用户科学与工程国际会议论文集，莎阿南，2014 年，第 168-173 页。https://doi.org/10.1109/IUSER.2014.7002697
[6] ISMAIL N. N. N. N. 和 LOKMAN A. M. 完全的工程在基于网络的系统中的实施：回顾研究。在： SHOJI H.、KOYAMA S. 、 KATO T. 、 MURAMATSU K. 、 YAMANAKA T.、LÉVY P.、CHEN K. 和 LOKMAN A.M.（编辑）第 8 届感性工程与情感研究国际会议论文集。 科尔 2020。智能系统和计算的进展，卷。1256 施普林格，新加坡，2020：66-76。https://doi.org/10.1007/978-981-15-7801-4_7
[7] TURUMUGO P.、BAHARUM A.、NAZLAN N.H.、NOH N.A.M.、NOOR N.A.M. 和 RAHIM E.A. 使用日内瓦情感轮对基于完全的的高等教育机构网站的用户情感评估。印度尼西亚电气工程与计算机科学杂志，16（3）：1547-1554。https://doi.org/10.11591/ijeecs.v16.i3.pp1547-1554
[8] HUSSIN S. N. 和 LOKMAN A. M. 完全的网站界面设计：完全的网页设计指南的实用性和准确性。国际用户科学与工程会议论文集，雪兰莪，2011 年，第 30-35 页。https://doi.org/10.1109/iUser.2011.6150531
[9] BIDIN S. A. H., & LOKMAN A. M. 使用感性工程方法丰富网站界面设计的舒适感。在：LOKMAN A.、YAMANAKA T.、LÉVY P.、CHEN K. 和 KOYAMA S.（编辑）2018 年第七届感性工程和情感研究国际会议论文集。科尔 2018。智能系统和计算的进展，卷。739 施普林格，新加坡，2018：792–800。https://doi.org/10.1007/978-981-10-8612-0_82
[10] 马来西亚和印度尼西亚的 HADIANA A. 和 LOKMAN A. M. 完全的工程：系统文献综述。在：SHOJI H.、KOYAMA S.、KATO T.、MURAMATSU K. 、 YAMANAKA T. 、 LÉVY P. 、 CHEN K. 和 LOKMAN A.M.（编辑）第 8 届感性工程与情感研究国际会议论文集。科尔 2020。智能系统和计算的进展，卷。1256 施普林格，新加坡，2020：115–126。https://doi.org/10.1007/978-981-15-7801-4_12
[11] NUGROHO I. M.、HADIANA A. 和 SINGASATIA D. 使用完全的工程设计瓦津移动界面。 第四届信息学与计算国际会议论文集，三宝垄，2019 年，第 1-8 页。https://doi.org/10.1109/ICIC47613.2019.8985955
[12] HADIANA A., & ABDURROHMAN。使用感性工程和层次分析法分析客户的情感偏好。 第四届国际科学技术会议论文集，日惹，2018 年，第 1-5 页。https://doi.org/10.1109/ICSTC.2018.8528675
[13] ADNAN H., & REDZUAN F. 使用完全的工程 评估学生在基于视频的学习中的情绪反应。第四届用户科学与工程国际会议论文集，马六甲，2016 年，第 237-242 页。https://doi.org/10.1109/IUSER.2016.7857967
[14] NAIM N. F. B. M. 和 IBRAHIM A. A. 使用完全的工程方法进行电子学习网站界面设计的美学。 信息科学与应用国际会议论文集，首尔，2014 年，第 1-4 页。https://doi.org/10.1109/ICISA.2014.6847351
[15] HADIANA A. 使用完全的工程进行基于网络的电子学习系统分析。 第三届信息和通信技术国际会议论文集，努沙杜瓦，2015 年，第 558-562 页。https://doi.org/10.1109/ICoICT.2015.7231485
[16] 穆德尔。文档，2022 年。https://docs.moodle.org/400/en/Main_Page
[17] 伊利亚斯。大学解决方案，2021 年。https://www.ilias.de/eng/lms-ilias-solutions-university
[18] 导师。导师功能，2022。http://atutor.github.io/atutor.feature.html
[19] 奥皮尼奥。我们可定制的电子学习平台，2022 年。https://www.opigno.org/solution
[20] 多克奥斯。为成长型团队设计的培训平台，2022 年。https://www.dokeos.com/lms-platform-training