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Research Article

Ecosystem Model on Adaptive MOOC in Higher Education

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Abstract: This research aims to develop an adaptive MOOC ecosystem in universities. This study involved development research using the 4-D model, which consists of defining, designing, developing, and disseminating. The results indicate that in developing a MOOC ecosystem, it is necessary to conduct an in-depth analysis of users to find out what structures are needed. The context of MOOCs by companies is undoubtedly different from that of universities. As an educational institution, its stakeholders involve university leaders and researchers from lecturers. In the initial design, it is necessary to test user characteristics so that the MOOC system can make decisions on learning recommendations. We involved metacognitive testing and categorize so that users can learn to the fullest. In its application, validity tests were performed on experts to assess the product from development and on users. The test results showed excellent results. This ecosystem has also been disseminated to users and received a very good response. Moreover, several universities in Indonesia have the status of PTN-BH, which demands financial independence, so MOOC can be one of the breakthroughs to acquire income generation.

Keywords: adaptive MOOC, MOOC ecosystem, higher education

INTRODUCTION

The development of technology in the world of education is fast and massive, especially in terms of the use of the Internet in learning. Nowadays, each individual can access information and data from the Internet. The number of internet users as of January 2022 has reached 4.95 billion people (Pahlevi, 2022). The data from Kominfo (2014) showed that Indonesia was once listed as the sixth most internet users in the world. This demonstrates that the potential of the Internet in learning in Indonesia can answer the limitations of access to education and inequality of education. Massive Open Online Course (MOOC) is an internet-based learning alternative that provides ease, range, and diversity of topics in the course. Even UNESCO also emphasizes that the jargon "education for all" can be answered by MOOC's presence (Pahlavi, 2022; Kominfo, 2014; Kennedy & Laurillard, 2019; Laurillard, 2016).

A preliminary survey performed by researchers with a focus on academicians at Universitas Negeri Yogyakarta, MOOC users are very insufficient, namely 11.3% of 1003 respondents, and from 11.3%, there are 28.8% who did not complete online courses. In addition, the phenomenon of dropout MOOC is also quite rife lately, especially from

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2008 to 2015. This means that quite a lot of users still need to complete the course that is being followed. This will cause a negative sentiment in MOOCs. However, this is not a comprehensive, complete, and in-depth picture, and its users cannot obtain the advantages of MOOC. Various supports for MOOCs still need to be developed (Bozkurt et al., 2017; Zawacki-Richter et al., 2018).

The user satisfaction of MOOCs is influenced by system quality, user attitudes, and course quality (Albelbisi, 2019). In addition to satisfaction, the success of a MOOC is also influenced by self-regulated learning (Albelbisi et al., 2021). A preliminary study noted that the independence of student learning is one of its primary controls, and it is metacognitive (Corno, 1986). However, how a MOOC can achieve these two things is still being researched. This study aims to see the need for a MOOC that is adaptive to user conditions.

The MOOC ecosystem that has been recommended by Campos et al. (2018) showed the importance of interaction between networks involving MOOC provision, colleges, students, teachers, workers, course designers, and advertisers. In the same year, the aforementioned study also found a gap between the knowledge needs of users and existing courses. The gap problem is then given a solution in the form of course recommendations (Campos et al., 2022). Developing the MOOC ecosystem does, but the dominance of the role of universities with all the resources owned by universities, such as human resources, funding, and lecturer research results, has not been shown. Thus, this research takes a solid position to maximize the potential of universities that can act as MOOC providers.

Problems that will be solved through this research include how the MOOC ecosystem model is developed adaptively and metacognitive-based to support personalized learning in universities. The specific objective of this research is to develop an ecosystem model and test the feasibility and practicality of MOOCs that have metacognitive-based adaptive features that are still not widely provided by MOOC providers in Indonesia. This research is shown by the absence of research to support MOOCs in terms of the use of metacognitive-based adaptive features of users.

The rest of the paper provides the methodology used in dealing with the problems using the developmental research model. The next section presents the findings, followed by a comprehensive discussion. The last section concludes the results and provides the implications and future directions.

METHOD

Research Design

The research used research and development (R&D) methods to build and develop Adaptive MOOCs. This process is applied in order to be able to produce products with a high level of validity. In order to provide more real guidelines, this study uses the R&D method with a 4-D Model. This approach has measurable stages starting from Define, Design, Develop and Disseminate (Thiagarajan & Sivasailam, 1974).

Data

This research obtained qualitative and quantitative data. Qualitative data is obtained from the results of Focus Group Discussion (FGD) to obtain information about user needs. We have gathered 40 people who are often involved with MOOCs and 10 of them are experts in the field of learning technology and information technology.

Furthermore, quantitative data is obtained from the results of expert validation. Then the results of our development were tested on 10 students in small groups and 30 students in large groups.

Procedures

This approach was introduced by Thiagarajan and Sivasailam (1974) to facilitate product development to be more scalable.

1. **Define—**this stage focuses on needs analysis as a condition for product development. This stage contains front-end analysis, learner analysis, and concept analysis.
2. **Design—**the design stage contains four steps, namely: *Criterion-referenced test*, at this stage we assign a test for metacognitive and a test to test the user's understanding of the course. *Media selection*, at this stage we determine the most suitable learning media for MOOCs. *Format selection*, at this stage we establish the procedure for following the course. *Initial design*, at this stage we do the initial design for the MOOC ecosystem.
3. **Develop—**this stage serves to produce development products through two steps, namely: *expert appraisal* including revision and developmental testing. The trial was conducted in small groups involving 10 students and large groups involving 30 students.
4. **Disseminate—**this stage is the final phase of the product to test, introduce, and promote the product to users both individuals and groups. This stage produces suggestions, corrections, and assessments as improvements to the product before it is released to users in real-time. This stage contains validation testing (user rating).

Data Analysis

Qualitative data will be obtained through interviews and input from reviewers. Quantitative data is obtained from the average of answers and standard deviations then after the data is collected entered into the interval with reference as shown in Table 1.

Table 1
Assessment Reference

Category classification	Interval formula
Not Worth It	Xmin ≤ Mi - SDi
Proper	Mi – SDi ≤ Mi + SDi
Very decent	Xmax ≤ Mi - SDi

Note. Mi=Average ideal; SDi=Ideal standard deviation

The formula used to find the average of the criteria is as follows:

$$Mean\ (Mi) = \frac{highest\ score + lowest\ score}{2}$$

Next, the tendency of each score is differentiated into three criteria using the average score counter (*Mean*) and standard deviation for each variable's total score. Analysis is carried out on each of the variables. The formula used in finding the mean and standard deviation is as follows:

$$Deviation\ standard\ (SDi) = \frac{highest\ score - lowest\ score}{6}$$

RESULT

Define

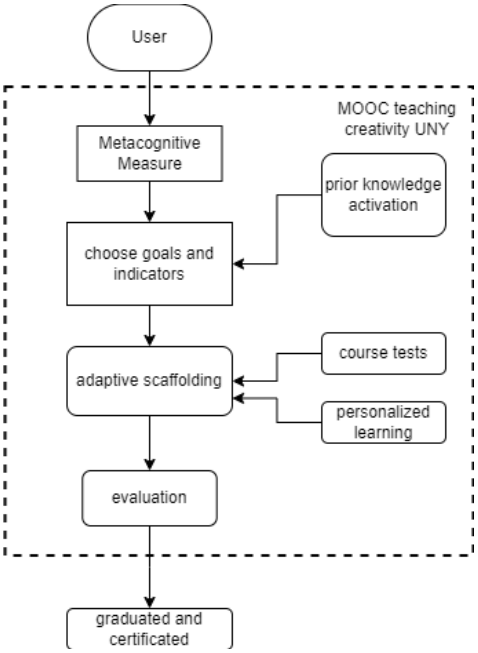
We have conducted a focus group discussion with 40 MOOC users and learning technology experts to identify the ecosystem concepts needed by universities to develop adaptive MOOCs. The key concept of this ecosystem is artificial intelligence technology that can psychologically test the metacognitive characteristics of MOOC users. Some of the elements that MOOC developers need to be provided in the following distribution: Organizational structure, Guardian, Referring, Head, Representative, Secretary, Financial coordinator, HR Coordinator, Material developer coordinator, Research coordinator and analyst, MOOC system developer coordinator, and MOOC digital marketing coordinator

In the context of Indonesia, by referring to the independent curriculum, a MOOC is needed which is positioned as a course institution to support student competencies listed in the certificate accompanying the diploma (SKPI). MOOCs can also implement credit acknowledgments, which means (1) Credit earning—if there are students who have taken courses at certain university MOOCs equivalent to three credits and get grades, then the course will be recognized by universities and no longer need to take it regularly, but there is a time limit for recognition, suppose in four years, (2) Credit transfer—courses taken at MOOCs can be recognized by all universities contained in the provider, and (3) Non-credit. Only obtain a certificate without obtaining credits equivalent to regular courses.

Design

This research develops a MOOC with an adaptive concept that looks at the metacognition of prospective users before taking the course. This is considering that so many user characters are considered unable to be given the same treatment/service in the course. This design uses the following user flow (see Figure 1).

Figure 1
Adaptive flow design of MOOCs developed



In the developed design, users will enter MOOC teaching creativity in http://tcuny.com. Then on the page will be given information about the course such as course pricing information and about metacognitive tests and their benefits. In this design, of course, the principle is "every user must have differences in metacognition, every difference in metacognition will be given different treatment according to their metacognition". After the user fills in the MAI, it is further categorized with combinations and permutations of regulated metacognition (RM). The detailed information is presented in Table 2.

Table 2
Format selection for Adaptive MOOC

	RM Low	**RM Medium**	**RM High**
Video	LM 1	LM 2	LM 3
Interactive	LM 4	LM 5	LM 6
Summarization	LM 7	LM 8	LM 9

Note. LM=learning media

LM 1 is a learning media using videos with many/intensive instructions given to users, where the instructions are related to how to learn or user learning strategies so that users are able to learn better and effectively. LM 2 (for medium RM users) and LM 3 (for high RM users) are also video learning media, but the difference is in the number of instructions given to users because the higher the student's RM level, the less instruction is given. The instructions given to users on LM 4 and LM 7 are equivalent to LM 1, LM5 and LM8 are equivalent to LM5, and LM 6 and LM 9 are equivalent to LM 6. The difference is in the type of learning media provided, namely LM 10, LM 11, and LM 6 are learning media that have *interactive* features, while LM 7, LM 8, and LM 9 are learning media that have *summarization* features or make summarization.

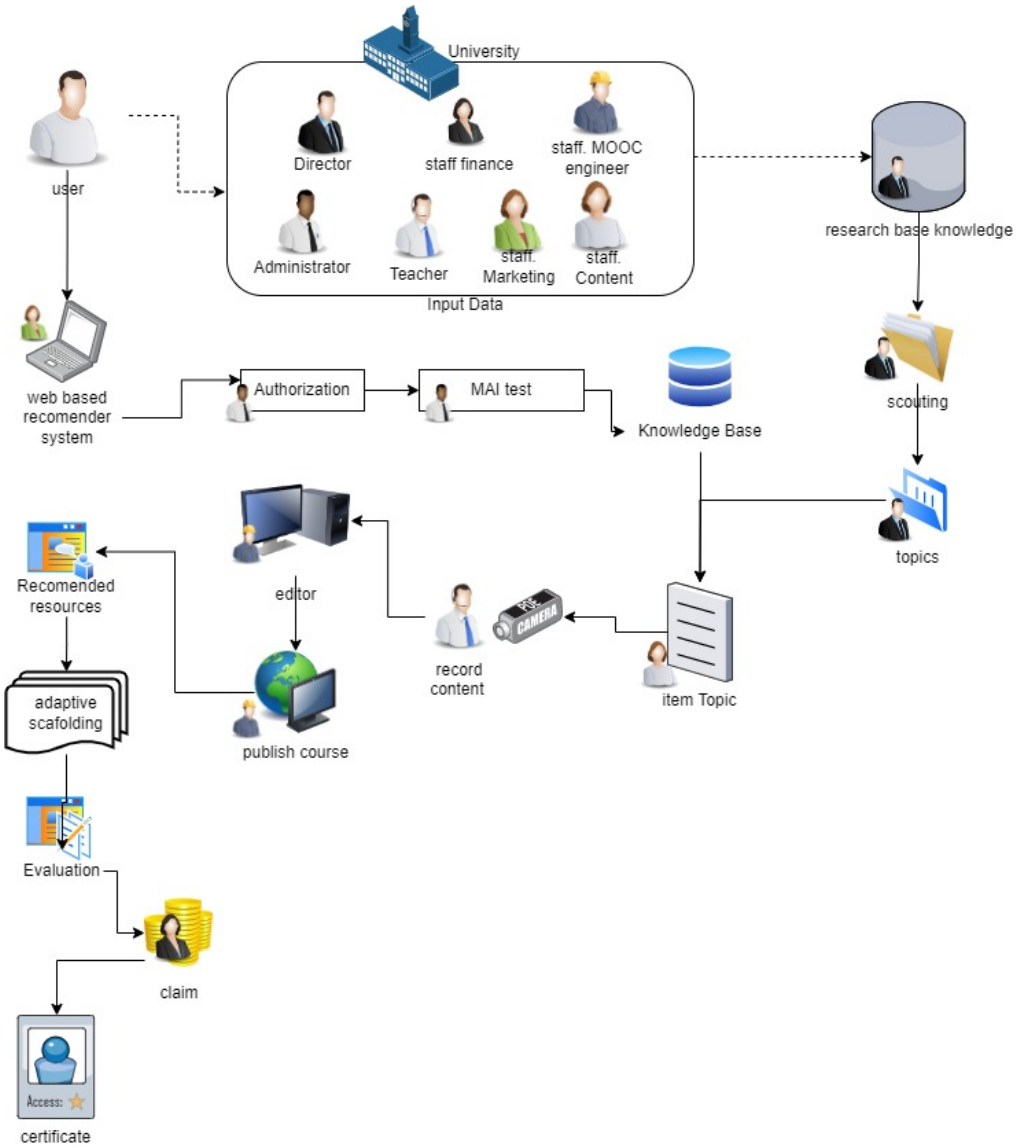
Quantitative treatment is given based on the metacognitive level, namely the higher the user's metacognitive level, the less the amount of treatment given, this is because the user is considered to have good learning abilities. If the user's metacognitive level is low, given a lot of help in learning, it is hoped that intensive intervention given to users can help users learn better and improve their ability to learn. Users who have high abilities in RM are given a little instruction to optimize the user's RM abilities because with high RM abilities, these users are considered able to manage themselves in learning. As well as users with moderate KM or RM capabilities, it is given a fairly intensive intervention. Those who are low will also be provided with learning assistance and consulting services.

Develop

At this stage we create an adaptive MOOC prototype along with an ecosystem model to support the main product of the system. In this first part, the main aspect that is the basis is the ecosystem contained in the MOOC Teaching Creativity platform. MOOC teaching creativity was developed within Universitas Negeri Yogyakarta through the research scheme of the Center for Science and Technology Excellence under the Directorate of Research and Community Service. Progressively, it is currently carried out by a research team of five lecturers from various disciplines. The lead researcher has a background in informatics education expertise with e-learning expertise. Senior members are Professors from the Faculty of Education with expertise in sociology of society. One

member has an informatics education background, one member from education policy and one from economic education. In staffing, in this case the chairman concurrently serves as director with senior members. Finance staff and temporary content staff are held by lecturers with economic education backgrounds. MOOC engineering staff is held by lecturers with informatics engineering backgrounds and for administrators and marketing staff while held by lecturers from education policy (see Figure 3).

Figure 3
Adaptive MOOC ecosystem to support personalized learning



The ecosystem model that runs on adaptive MOOCs developed has several differences with existing MOOCs in Indonesia. Some of the characteristics in the model:

1. There are metacognition measurements in potential users so we have profiles of registered users.
2. The system will provide several treatments on different user profiles.
3. The material produced is selected based on superior research results.
4. Interactivity with learning resources is tailored to the user's profile.

This MOOC ecosystem involves university involvement. From staffing that must be directors, finance staff, MOOC engineer staff, administrator staff, teacher staff, marketing staff and content staff. The responsibilities and duties are shown in Table 3.

Table 3
Division of staff responsibilities

No	Staffing	Icon	Responsibility
1	Director		The Director is fully responsible for all adaptive MOOCs developed. Furthermore, maintaining the vision of the research knowledge base, then scouting for the talents of lecturers and determining the topic of the course to be developed.
2	Finance staff		Financial staff are responsible for bookkeeping, calculating and awarding honorariums as well as tax management.
3	MOOC technical staff		MOOC engineers are responsible for developing Moodle-based LMS systems, embedding AI in adaptive features and validating participants.
4	Admin		Responsible for authorizing and collecting user metacognitive profiling data at the time of initial registration. Analyze course progress based on user progress.
5	Instructor		Instructors are lecturers or professional instructors who have been appointed by the director who is responsible for developing material content and making assessments for users.
6	Marketing		Marketing staff have the responsibility to market MOOCs on various platforms including social media. Conduct market analysis and promotions.
7	Content staff		Content staff serves to assist instructors in developing course materials. Starting from script preparation, recording, editing and publishing with the MOOC engineering team.

The user flow on this MOOC is

a. Users will get MOOC recommendations from the web-based recommender system.
b. After the user is directed and first registers in MOOC Teaching creativity will be authorized and after that will take a metacognitive test
c. After that, you will get the source that has been recommended by the system according to the MAI profile that has been obtained before.
d. Then the user will get a treatment based on the results of the MAI test
e. After completing the course, the user will conduct an assessment
f. Then to be able to claim the certificate, the user will make a payment that is confirmed by the financial staff
g. The user gets a certificate.

The course production flow on this MOOC is provided as follows:

a. The Director conducts scouting from the results of a research database owned by the Directorate of Research and Community Service.

b. The director and team of content staff will select the topics that will be used as courses so that they will have a bank of topics that will be used as course content.
c. Furthermore, the content recording process is based on instructors/lecturers who become talents.
d. The editing process and then will be published by the MOOC engineering team so that it becomes a recommended source to users.
e. The material is studied by the user and ended in an assessment to obtain a certificate.
f. For new users, it will be facilitated by the registration process through a Google account and then can complete the user profile. When the user has registered, the user will be directed by the system to fill out a metacognitive assessment.

Figure 4
Questionnaire entry page to measure metacognition of potential users

After filling out the MAI questionnaire in the form of multiple choice as shown below. Users will fill in the instrument with a duration of under 10 minutes. After that, upon entering the course, the results of the MAI test will be notified and will get a recommendation of action from the system. This program was tested for feasibility by *expert judgment,* namely Information Technology experts, education policy experts and SPADA Brightspace Indonesia team members who handled the Learning Management System for National PPG. There are 17 statement items with the lowest alternative value 1 and the highest 5 then the interval is between 17 – 85 (see Table 4). Based on the feasibility test results, it shows that the MOOC *Teaching Creativity product* is declared "Very Feasible". Thus, the ideal mean and ideal standard deviation are:

$$Ideal\ Mean\ (Mi) = \frac{highest\ score + lowest\ score}{2} = \frac{85 + 17}{2} = 51$$

While the formula to measure deviation standard is provided as follows:

$$Deviation\ Standard\ (SDi) = \frac{highest\ score - lowest\ score}{6} = \frac{85 - 17}{6} = 11.33$$

Table 4
Percentage of score tendency from expert validators

No	Interval	Category	Summary				
1	17 – 39.66	Not Worth It					
2	39.67 – 62.32	Proper					
3	62.33 – 85	Very Worth It	72*	76**	83***	72****	100%

Note. *Expert validators from learning technology experts, ** Expert validator from education policy experts, *** Expert validators from information technology experts, **** Expert Validator from SPADA Brightspace Indonesia team

Figure 5
Due diligence results by experts

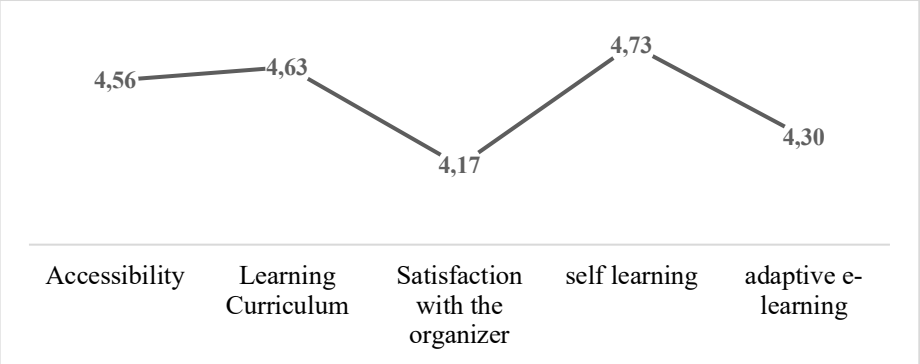


Figure 5 explains that experts consider the feasibility of an adaptive MOOC prototype very good. Especially in a curriculum that is designed and able to support user self-learning. This is inseparable from the add-in feature contained in Moodle which is the basis for MOOC design. The lowest rating on satisfaction with the manager. This can be possible because currently no organization has been officially formed and legally institutionalized.

Table 5
Statistical analysis

		Accessibility	Learning Curriculum	Satisfaction with the organization	Self-learning	Adaptive e-learning
N	Valid	16	8	12	11	20
	Missing	4	12	8	9	0
Mean		4.5625	4.6250	4.1667	4.7273	4.3000
Std. Error of Mean		12809	18298	.20719	.14084	.14690
Median		5.0000	5.0000	4.0000	5.0000	4.0000
Mode		5.00	5.00	4.00	5.00	4.00
Std. Deviation		.51235	.51755	.71774	.46710	.65695
Variance		.263	.268	.515	.218	.432
Range		1.00	1.00	2.00	1.00	2.00
Minimum		4.00	4.00	3.00	4.00	3.00
Maximum		5.00	5.00	5.00	5.00	5.00
Sum		73.00	37.00	50.00	52.00	86.00
Percentiles	25	4.0000	4.0000	4.0000	4.0000	4.0000
	50	5.0000	5.0000	4.0000	5.0000	4.0000
	75	5.0000	5.0000	5.0000	5.0000	5.0000

Then after getting a feasibility assessment from experts, the MOOC system was tested in a small group of 10 students as shown in Figure 6.

Figure 6
Small Group Test

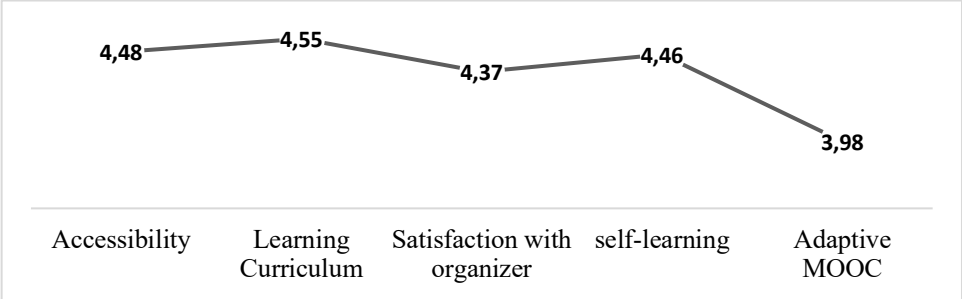


Figure 6 shows that for the user group learning curriculum and self-learning are also as high as the assessment of experts. The Adaptive MOOC feature still needs to be improved so that the impact can be felt more by users. By following up on input from small groups, improvements were then made and testing was carried out on large groups consisting of 30 students with the following results (see Figure 7). After improvements were made to the prototype, testing in a larger group showed improvements in better adaptive MOOCs. These improvements include the form of treatment results from categorization after the user performs the MAI test.

Figure 7
Large group test

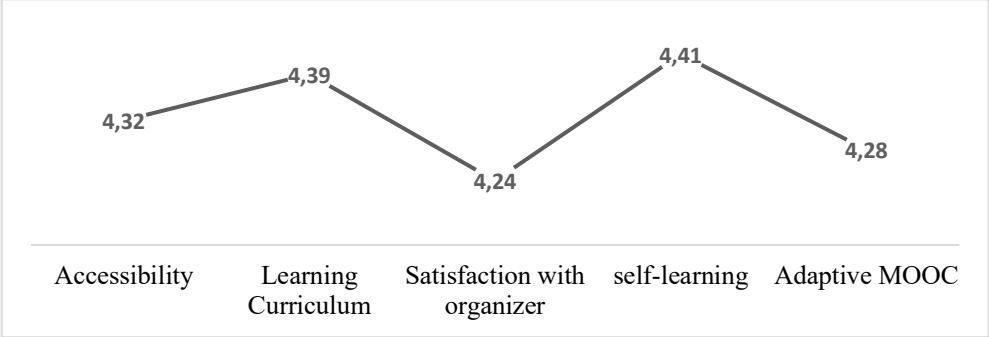


Figure 8
MAI profiling display

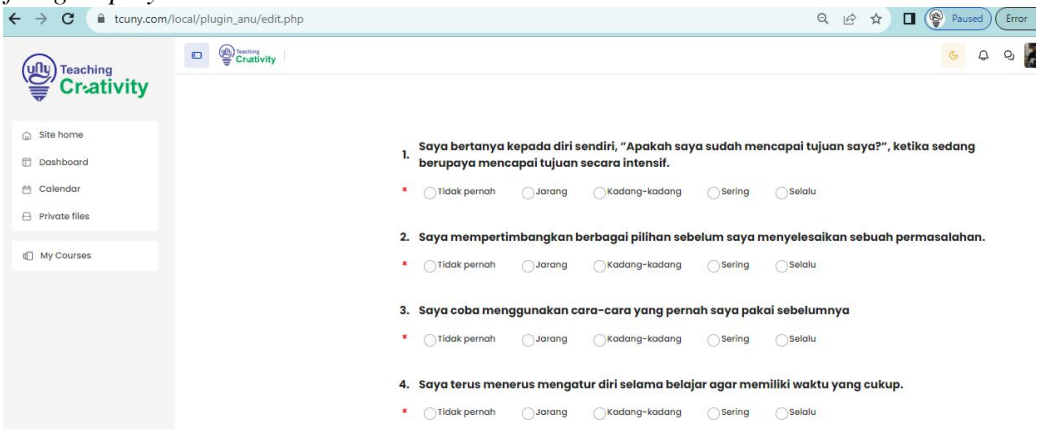


Figure 8 presents that stage where the user performs an MAI test to find out the user's metacognitive profile. This is useful to help users take classes in MOOCs. Users will get help in the form of interactivity in the content and also summarization features if users have a low metacognitive profile.

Disseminate

Dissemination is carried out by inviting students to get to know MOOC Teaching Creativity. The activity begins by telling the background of the research carried out then explaining the advantages of the product that has been developed, and then continues by explaining the product workflow. This activity was attended by 30 students from FEB and FIP Universitas Negeri Yogyakarta.

Figure 9

Dissemination of research results

Figure 9 explains the dissemination process carried out by the research team to users, namely students from various majors. This dissemination emphasizes more on disseminating research results and providing motivation to dissemination participants to build a culture of literacy through MOOCs. Socio-culture to continue learning independently needs to be built by involving various ways. One of the ways we strive through this research is by providing a massive and open learning platform that can be accessed anytime and anywhere.

DISCUSSION

The management of MOOCs in universities looks different from MOOCs that are managed by companies. Based on the results of long discussions with MOOC users in a focus group discussion, several interesting things surfaced. First, many find the fact that they do not continue the course due to payment in the middle of the course if the user

wants to continue learning, this model is called freemium. Free for some parts of the initial course and paid for subsequent courses. Thus, it raises the question of what is the economic aspect of MOOCs in Higher Education? If in some critical discussions conducted by Trehan et al. (2017) Showing the high cost constraints MOOCs overcome by monetization on content which certainly has an impact on the price of courses that become more expensive and no longer free, so with the ecosystem we developed we found a way out through a combination of monetization with content fees obtained from university research funds. Sharing both of these demonstrates efficiency in economic management in MOOCs.

In content development, MOOCs in universities benefit from the large number of lecturer research results that can be converted into content in MOOCs. This provides a great opportunity for each faculty to develop their institutional branding. This is in line with the idea (Rhoads, 2015) that explains the importance of the role of faculty in MOOCs. In a tertiary education environment, MOOCs can take a role in the independent learning curriculum (Alwi et al., 2021). The independent learning curriculum is a characteristic that has become a new identity in education in Indonesia. This curriculum provides extensive opportunities for students to learn and gain knowledge from within the university and from outside the university legally. MOOCs with their ability to be open and accessible from anywhere provide opportunities for students to learn as widely as possible.

Based on the findings, the adaptive concept was able to solve user problems that we found during the FGD. Where there are problems with self-regulation and their beliefs before attending the course. We detect that user is hesitant to join MOOCs due to their readiness to understand online learning technologies. The adaptive concept that refers to metacognition can perform early detection of user profiles and adaptively MOOC systems provide treatment to users according to their metacognition, this is in accordance with research that has been conducted by (Davis et al., 2018; Moreno-Marcos et al., 2020).
The downside to this research is the long-term impact on users. Although users welcome categorization based on MAI testing, in the long term and more in-depth studies there needs to be further research that looks at changes in attitudes and skills in users. It is also necessary to look at the socio-cultural aspects of MOOC users.

CONCLUSION

This development research resulted in a MOOC ecosystem that is adaptive to its users. The still high dropout rate in MOOCs demands a change in MOOC development. One solution is to give different treatment to each user characteristic. Not only content and technology are needed but also the ecosystem of MOOC management that involves several personnel consisting of directors, financial staff, MOOC technicians, admins, instructors, marketing and content staff. This ecosystem is considered capable of overcoming governance and economic aspects of MOOCs in universities.

Implication

The development of technology has a tremendous impact on the world of education. Technology provides seamless ease of access. The presence of MOOCs can solve the problem of open access to learning so that users can take courses from anywhere and anytime on the internet network. The practical impact of this research is the discovery of ecosystems in adaptive MOOCs. The MOOC in this study was developed with an

adaptive concept based on metacognition to support *personalized learning* following the principles of *long-life learning*. This prototype has been tested by experts consisting of learning technology experts, education policy experts, information technology experts, and practitioners from SPADA. This research has had an impact on the theory of educational technology which shows that the metacognition ability of MOOC users' needs to be known so that MOOC output can be maximized.

Limitation and Future Direction

MOOC development research in Indonesia is currently not much. This research has been able to develop an ecosystem model on adaptive MOOCs, but changes in attitudes and skills of users after using MOOCs cannot be measured in long-term observation. It is necessary to conduct an analysis of MOOC users that focuses on improving cognitive, affective, and psychomotor competencies. There is still a big question about the socio-culture of MOOC users who still show low literacy even though technology in the world of education is growing rapidly.

REFERENCES

Albelbisi, N. A. (2019). The role of quality factors in supporting self-regulated learning (SRL) skills in MOOC environment. *Education and Information Technologies, 24*(2), 1681-1698. https://doi.org/10.1007/s10639-018-09855-2

Albelbisi, N. A., Al-Adwan, A. S., & Habibi, A. (2021). Self-regulated learning and satisfaction: A key determinants of MOOC success. *Education and Information Technologies, 26*(3), 3459-3481. https://doi.org/10.1007/s10639-020-10404-z

Alwi, A. C., Dwiningrum, S. I., Suyanto, Sunarto, S., & Surono. (2021). MOOC model to support freedom to learn program. *Jurnal Kependidikan*, *5*(1), 111–122. http://dx.doi.org/10.21831/jk.v5i1.35316

Bozkurt, A., Akgün-Özbek, E., & Zawacki-Richter, O. (2017). Trends and patterns in massive open online courses: Review and content analysis of research on MOOCs (2008-2015). International Review of Research in Open and Distributed Learning, 18(5), 118-147.

Campos, R., Dos Santos, R. P., & Oliveira, J. (2018). Web-based recommendation system architecture for knowledge reuse in MOOCS ecosystems. *Proceedings - 2018 IEEE 19th International Conference on Information Reuse and Integration for Data Science, IRI 2018*, *October*, 193–200. https://doi.org/10.1109/IRI.2018.00036

Campos, R., Santos, R., & Oliveira, J. (2021). *Recommendation System for Knowledge Acquisition in MOOCs Ecosystems*. *November*, 93–108. https://doi.org/10.5753/sbsi.2020.13132

Campos, R., Santos, R. P., & Oliveira, J. (2018). Recommendation Systems for Knowledge Reuse Management in MOOCs Ecosystems. *Anais Estendidos - XIV Simpósio Brasileiro de Sistemas de Informação*, *October*, 146–148.

Corno, L. (1986). The metacognitive control components of self-regulated learning. *Contemporary Educational Psychology, 11*(4), 333-346.

Davis, D., Chen, G., Hauff, C., & Houben, G. J. (2018). Activating learning at scale: A review of innovations in online learning strategies. *Computers and Education*, *125*, 327–344. https://doi.org/10.1016/j.compedu.2018.05.019

Kennedy, E., & Laurillard, D. (2019). The potential of MOOCs for large-scale teacher

professional development in contexts of mass displacement. *London Review of Education*, *17 (2)*, 141-158

Kominfo. (2014). Pengguna Internet Indonesia Nomor Enam Dunia. In *https://kominfo.go.id/content/detail/4286/pengguna-internet-indonesia-nomor-enam-dunia/0/sorotan_media*.

Laurillard, D. (2016). The educational problem that MOOCs could solve: Professional development for teachers of disadvantaged students. *Research in Learning Technology*, *24*, 29369, https://doi.org/10.3402/rlt.v24.29369

Moreno-Marcos, P. M., Muñoz-Merino, P. J., Maldonado-Mahauad, J., Pérez-Sanagustín, M., Alario-Hoyos, C., & Delgado Kloos, C. (2020). Temporal analysis for dropout prediction using self-regulated learning strategies in self-paced MOOCs. *Computers and Education*, *145*, 103728. https://doi.org/10.1016/j.compedu.2019.103728

Pahlevi, R. (2022). Pengguna Internet di Dunia Capai 4,95 Miliar Orang Per Januari 2022. In *https://databoks.katadata.co.id/datapublish/2022/02/07/pengguna-internet-di-dunia-capai-495-miliar-orang-per-januari-2022*.

Rhoads, R. A. (2015). *MOOCs, High Technology, and Higher Learning* (W. G. T. and L. W. Perna (ed.)). Johns Hopkins University Press.

Sugiyono. (2020). *Metode penelitian kuantitatif, kualitatif dan kombinasi (Mixed Method)* (edisi 2). Penerbit Alfabeta.

Thiagarajan., & Sivasailam. (1974). *Instructional develoment for traning teacher of exeptional children: A Sourcebook* (p. 194).

Trehan, S., Sanzgiri, J., Li, C., Wang, R., & Joshi, R. (2017). Critical discussions on the massive open online course (MOOC) in India and China. *International Journal of Education and Development using ICT, 13*(2), 141-165. https://files.eric.ed.gov/fulltext/EJ1153318.pdf

Zawacki-Richter, O., Bozkurt, A., Alturki, U., & Aldraiweesh, A. (2018). What research says about MOOCs–An explorative content analysis. *The International Review of Research in Open and Distributed Learning, 19*(1),1–11.