

Online Learning Content and Learning Management System for Early Detection of Cervical Cancer

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Abstract

Cervical cancer is the second leading type of cancer causing death in women in Indonesia. The mortality rate could be reduced through an early detection program, which would require training for healthcare workers in educating women in Indonesia. The aim of this research was to investigate the type of online learning content and management system suitable for informing both the public and medical personnel about early detection of cervical cancer. The research method utilized was based on British Columbia's standard for online learning content with four main criteria. Furthermore, the study also employed the method by Jeong and Kim (2009) to design the content of an instructional approach while Bloom's taxonomy theory was followed as the reference theory in designing the online learning material. The system requirements were gathered through observations, interviews, and benchmarking. The Learning Management System (LMS) was designed using Unified Model Language (UML) tools. The study resulted in online-learning multimedia and an LMS design of early detection of cervical cancer.

Keywords: *Online Learning, Learning Content, Learning Management System, Early Detection*

1. Introduction

Online learning eliminates the geographical constraints of traditional learning. Students could use technology to access learning materials from anywhere [1]. Online learning could be delivered through a variety of technologies, such as the world-wide-web, email, chat, newsgroups, text, and audio and video conferencing over a computer network (local area network, intranet or the public Internet) to provide education and training, either remotely or in the classroom. A web-based system manages student access to content, group interaction, assessment, and support functions (such as online registration and student records) [2].

Among the advantages of online learning are [3] the time flexibility to learn any lesson, reducing the dependence on faculty and student time constraints; a greater freedom to express thoughts and opinions during a discussion, and a wider time-frame and better platform for posing questions. The organization of materials also allows for a convenient reviewing process, enhancing both accessibility and availability. This enhances self-learning and the development of independent ideas. Success rates of students engaged in online learning is high due to the method of instruction being designed for independent learning which will greatly help the student remember the material [4].

Meanwhile, the disadvantages of utilizing online learning includes the creation of a less supportive environment, such as [5] a reduced level of direct social interaction within an academic session; the tendency of the teaching and learning process to move more towards training rather than a formal education; an added demand on the educator to master conventional teaching methods as well as teaching techniques using ICT (Information, Communication and Technology); and the unavailability of internet facility (which is heavily related to access to sources such as electricity, telephone line, computer, etc.).

A Learning Management System (LMS) emphasizes learning management rather than course management, i.e. the ability to store educational content that can be referenced by many courses and the ability to streamline e-learning over a distance [6]. LMS features can be utilized to maximize the widespread transfer of knowledge due to their interactive, reliable, and user-friendly nature. Multimedia and Internet hold a crucial role in the implementation of interactive e-learning without the requirement of a physical class session. To achieve efficient learning and improve student persistence, LMS should provide well-structured resources such as course calendar, help, and online library that are easily accessible. Student persistence can also be evaluated from monitoring by reviewing the forum

and chat room discussions [7]. To improved communication, LMS should support both text message and voice since student prefer asking questions via text, while teachers prefer to use a microphone to call upon the student to elaborate [8]. Through LMS, an administrator manages various aspects of online learning, such as maintaining content and managing user access. Additionally, LMS also allows for the organization of content as well as the administration of quizzes and exams through a single portal.

LMS in principle is to develop structures and algorithms to meet the needs of the online learning system. On a general level, an LMS possesses the following features [9]: centralized, automatic administration; self-paced learning of content and knowledge-sharing; accelerated preparation and distribution of content; heightened portability of materials; and personalization of content.

Mortality caused by cervical cancer can be reduced through the detection of invasive cancer at its early stages. At this point, the 5-year survival rate is approximately 92%. A significant reason for this is the detection and treatment of preinvasive lesions, reducing the overall incidence of invasive cancer [12]. Despite this known fact, the lack of cervical cancer knowledge has been hampering early detection efforts [13], calling for learning protocols to overcome this obstacle. Currently, the traditional course that teaches early detection of cervical cancer requires a classroom and a lecturer to conduct the class during a specific time frame. Healthcare workers taking the course are also obliged to pay for transportation and accommodation for class attendance. With this learning content delivery method, educating healthcare workers on early cancer detection at a nation-wide scale will require a significant amount funding in the long term. However, the use of online learning has been proven to lead to significant cost reduction. Online programs can be developed to achieve a wider scope for the promotion of health in developing countries, among them Indonesia, a nation that is an appropriate target for the pilot telemedicine program due to its expansive geographical distribution that often hampers the extension program [14].

2. Method

The research data were obtained through literature review, formal observations, interviews, and questionnaires. Bloom's taxonomy theory was used as the reference theory in the design of the online-learning material [15] while the instructional approach employed was based on a method by Jeong & Kim [16]. The theory of learning-content design consists of several steps, as illustrated in Figure 1.

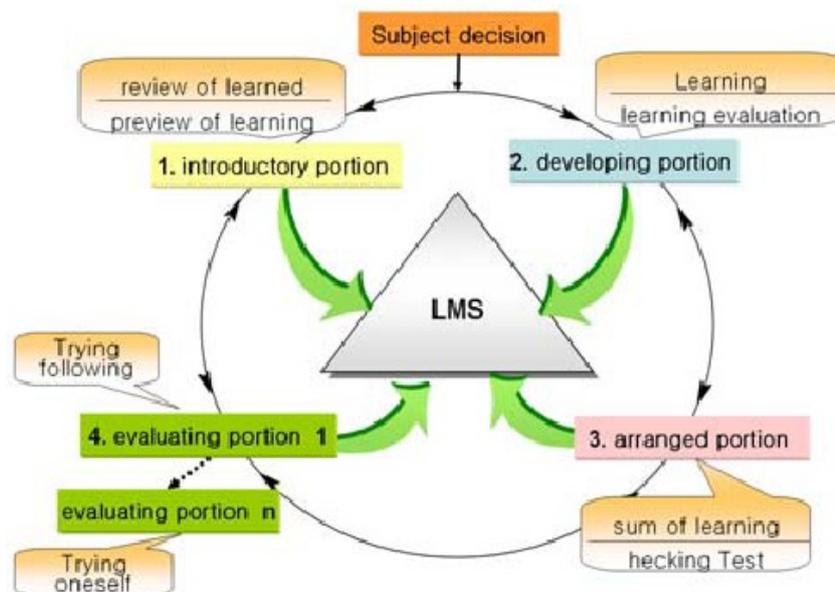


Figure 1. Designing Instruction Learning Flow [17]

The first step in creating the design was to perform a requirements analysis. This process determined content characteristics based on users' needs. Based on this, a learning subject was designed to evoke student curiosity through features in the syllabus. The 'Introductory Portion' stage defined the learning-content delivery overview as well as the proposed training method based on interviews and formal observations. The 'Developing Portion' stage focused on creating a syllabus along with course descriptions, expected learning outcomes, and learning subjects/topics based on current learning materials [17].

Formal observations were conducted during classroom sessions of early detection of cervical cancer training. In-depth interviews were conducted with expert physicians to determine examine the types of learning content that would be easily comprehended by the members of the healthcare community and medical personnel. These collected information were then utilized in the design of online-learning content.

Quantitative data were gathered through questionnaires to obtain a representation sample the healthcare population and medical personnel in four of the largest cities in Indonesia: Jakarta, Bandung, Yogyakarta, and Makassar. Based on the statistical data up to the year 2010, Jakarta has the highest HDI ranking, amounting to 77.6% [18]. HDI (Human Development Index) is used as a measurement and ranking tool of countries or cities according to their socio-economic development based on the specified region's capability to survive and be healthy, to be knowledgeable, and to enjoy a decent standard of living. HDI is also used to track changes in development levels over time and to compare development levels among different countries or cities [19].

The questionnaire design consisted of twenty eight Likert-scale questions and was based on four criteria in accordance to the standard for online-learning, focusing on technical standards, layout (visual design) standard, instructional design, pedagogy standards, and assessment standards [20]. Table 1 further details these criteria.

Table 1. Dimensions and Factors

Dimension	Factor
<i>Technical Standards</i>	<i>Ease of shared-content access</i>
	<i>Capability of content control</i>
<i>Layout (Visual Design) Standards</i>	<i>Ease of content comprehension</i>
	<i>User friendliness</i>
<i>Instructional Design and Pedagogy Standards</i>	<i>Support of various learning styles</i>
	<i>Completion time of learning activities</i>
<i>Assessment Standards</i>	<i>Useful content evaluation</i>
	<i>Evaluation in accordance with the materials</i>

The LMS was designed with Unified Modeling Language (UML) tools, such as class diagram, use-case diagram, and navigation diagram. Additionally, user interfaces were presented as an example of the display.

3. Results

The Subject Decision stage needs to be done because users online learning is grouped in two groups, the healthcare members and the medical personnel. Healthcare members comprise voluntary members of the community who assist in the socialization of the cervical cancer early detection program. Generally, members of this group did not have an educational background in the medical sciences, rendering their unfamiliarity with some medical terms.

The 'Introductory Portion' stage produced the learning-content delivery overview of current (traditional) and proposed training methods, as presented in Table 2.

Table 2. Current and Proposed Learning-Content Delivery Methods for Online Learning

Description	Traditional Learning	Recommendation for Online Learning
Syllabus	Not available	Available for review
Chapter	Not divided	Chapter divisions
Chapter Preview	Delivered only at the beginning of the session	Available for review
Chapter Quiz	Delivered only at the end of the session	Available for review

At the course development stage, the course descriptions and learning outcomes were defined. The main focus of this study was to increase knowledge and awareness about cervical cancer through early detection activities, which requires the training of healthcare workers to disseminate information on cervical cancer prevention. The learning outcomes were designed in accordance with the hierarchy of each level of Bloom's Taxonomy of learning theory, as described in Table 3.

Table 3. Learning Outcomes (LO)

Bloom's Taxonomy Level	Learning Outcomes
Knowledge	LO1. Mastery of concepts and purposes of early detection of cervical cancer
Comprehension	LO2. The ability to explain and describe the definition and effects of cervical cancer screening tests
Application	LO3. The aptitude to prepare and explain the steps of early detection tests using mothers IVA
Analysis	LO4. The knowledge in analyzing the signs of the possible cervical cancer diagnosis
Synthesis	LO5. The capability of categorizing a case as high risk from early detection prior to confirming the cervical cancer diagnosis
Evaluation	LO6. Sufficient competency in assessing the results of cervical cancer diagnosis from early detection

Within the chapter on IVA test and assessment, the material delivery technique could utilize animations and a variety of other visual aids to explain the stages of an IVA test procedure. Each chapter initiated learning with a preview chapter to refresh the memory on the learning-material content from the previous chapter. The online quiz feature aimed to evaluate and monitor the learning progress of users, as presented in Table 4.

Table 4. Quiz Online per Chapter

Quiz per Chapter	Question Type	Number of Questions	Working Time Estimation (Minutes)
1	Multiple Choice Questions	5	5
2	Multiple Choice Questions	10	10
3	Multiple Choice Questions	10	10
4	True/False Question	15	10
5	True/False Question	15	10
6	Multiple Choice Questions	10	10

To access the learning features, each user must first log-in. Figure 2 depicts the learning process that can be accessed by users who have successfully logged-in.

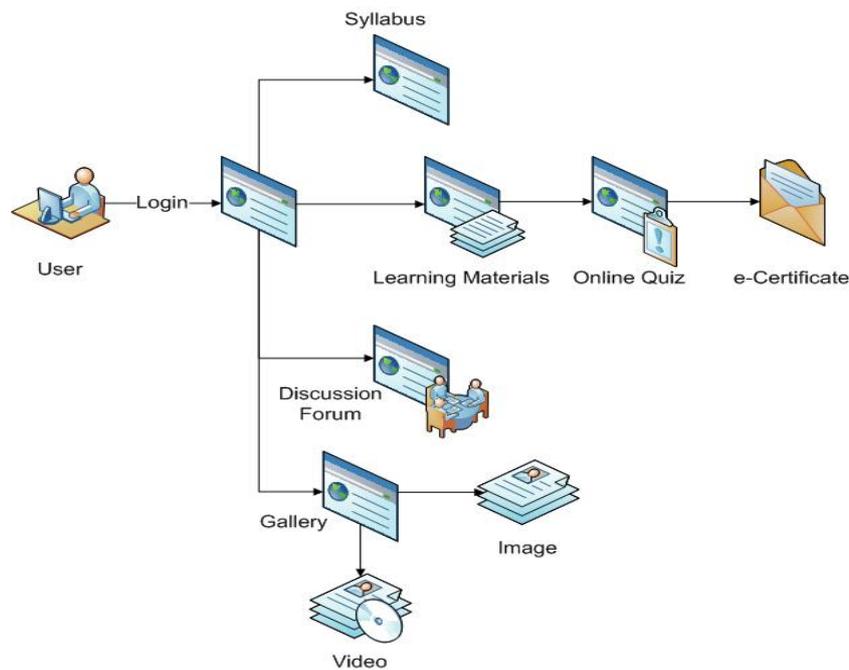


Figure 2. Early Detection of Cervical Cancer Online Learning

Users were expected to learn the material discussed in each chapter within a predetermined time period. Subsequently, the user was asked to take an online quiz based on the material of the recently studied chapter. At the end of the study, users who have completed all online quizzes for every chapter would receive an e-certificate proving the completion of the online training.

Within the allocated time for a given chapter, materials would be accessible for approximately one week. The online quiz would be open at the end of this one-week time frame. The users must achieve at least the predetermined minimum score on the online quiz prior to gaining access to the materials of the next chapter.

A discussion forum was open along with the learning material in the chapter but questions asked in the forum would receive priority for response and feedback over comments. On the third and fifth day of each week, specialist doctors would assist in answering questions that have accumulated during the previous days.

Users were expected to solve the online quiz problems within the allotted time. A countdown timer is provided during the quiz to limit quiz processing time. If the user failed to achieve the predetermined quiz score, then the user was prompted to retake the online quiz until the minimum score was at least achieved. Otherwise, the user would not have access to any subsequent materials in the training program. For users who gained a greater than or equal to value of the quiz score, access to materials in the next chapter was granted.

Finally, in the 'Evaluation Portion' stage, the division and arrangement for the entire portion of chapter's learning-content were enhanced based on noted improvements for the next training session.

The LMS was used by administrators to manage its contents as well as share knowledge and advise from specialized doctors and other medical personnel experts, such as general practitioners, midwives, and healthcare community members (this includes the non-medical volunteers and participating patients). The main tasks encompassed the following: to perform registration processes, course management and preparation, delivery of learning materials; to administer and assess quizzes; to monitor comprehension of participants; to address any lingering questions and concerns voiced in the discussion forums. Further details on LMS procedures are as follows:

- Registration procedure: In order to follow the course, applicants must register themselves through the completion of the registration form. An email address listed in the form ensured that a unique email address would be used as the identity of potential participants. Emails were sent automatically by the system containing a link that would direct potential users to a

registration confirmation page. By clicking on the link in the email, the status of applicants is changed formally to a 'participant' status.

- Course Management procedure: The role of an administrator was to manage course categories. A course could belong to one category only. Once the course is created, the material was prepared for the learning activities.
- Preparation and Submission of Learning Materials procedure: To prepare materials, specialized doctors collected, organized, and converted the materials into a digital format. The specialized doctor would submit the digital version of the materials to the administrator, who would then upload the materials to the LMS.
- Quiz Creation and Assessment procedure: To create a quiz, the administrators must create a new quiz prior to uploading the questions. Participants would submit answers into the system. The LMS automatically calculated the score of each quiz for each participant.
- Discussion Forum procedure: users could create a new topic in the forum or post an opinion to an already existing thread after a successful log-in.
- Monitoring Participant Comprehension procedure: Any user with a completed quiz would have answers stored in the database and a calculated score based on the answers. If the user achieved a passing grade in every quiz in the training program, a certificate of completion was produced.

3.1. Cluster

The LMS model consisted of user cluster, course cluster, grade cluster, assignment cluster, enrollment cluster, group cluster, chat cluster, forum cluster, and quiz cluster, as shown in Figure 3 below.

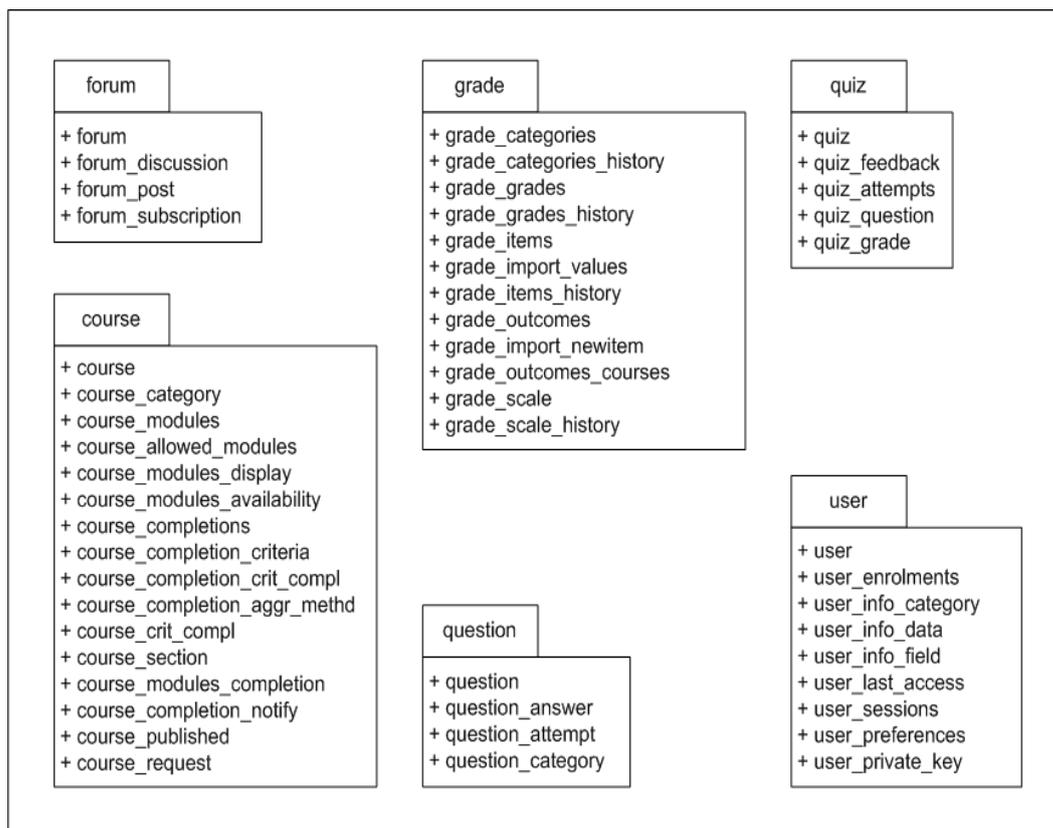


Figure 3. Clusters in LMS

3.2. Class Diagram

A class diagram was created based upon the cluster and relation between classes. For example, the relationship between a user and a forum could range from one (participant) to zero (forum) to one to many; this means that a user could never participate in a forum (former scenario) or could participate in many forums (latter scenario). On the other hand, the forum must always have at least one user involved; that is, the creator of new forum. Due to the large size and complex nature of the complete class diagram from this study's result, Figure 4 depicts only a simplified version of the class diagram.

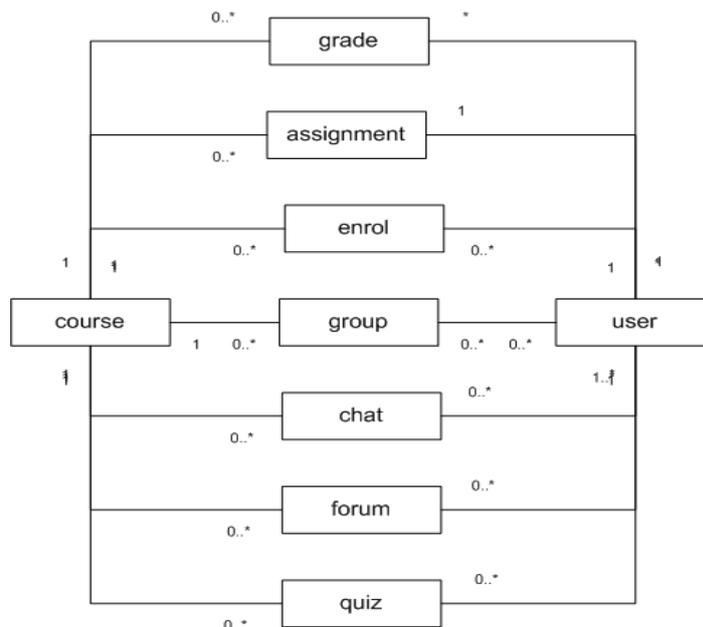


Figure 4. Simplified Class Diagram

3.3. Actor Table

There are three actors who used the LMS, namely Administrator, Specialized Doctor, and Participant (general practitioners, midwives, and health community members). The relationship between the actors and the use-case on the LMS is shown in Table 5.

Table 5. Actor Table

Use-case	Actor		
	Administrator	Specialized Doctor	Participant
Registration	v	v	v
Course Management	v		
Event Management	v		
Forum Management	v		
Course-contents Preparation		v	
Forum Posting	v	v	v
Online Chat Sessions	v	v	v
Quiz Taking		v	

3.4. Navigation Diagram

In the simplified version of the navigation diagram, seven pages represented each use-case: home, login, registration, event, forum, quiz, and course. The navigation diagram illustrated the relationship between pages. Each page is described in detail in Figure 5.

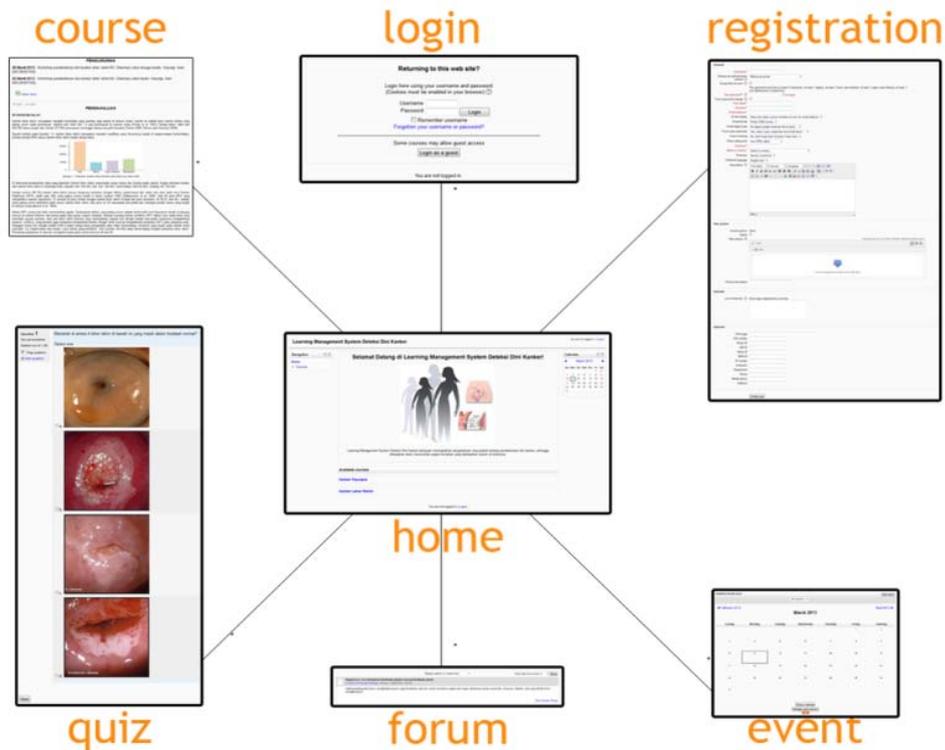


Figure 5. Navigation diagram

Home was the first page a user would encounter in the LMS. From the home page, a user could perform any of the following: log-in with an existing account, register into a course, continue with a previously started course page, view any present or upcoming events in the calendar, participate in forum, and take quiz.

4. Discussion

This study determined the best learning model to deliver cancer detection knowledge as widespread as possible. This study found that most respondents preferred visual learning. Fewer participants preferred tactile sensory experience (kinesthetic) while auditory experience was the least preferred learning method. These findings are consistent with the Reid study in which studies under stratum 1 (learning visually) was the preferred model for learning, whereas in the strata would prefer to experiment and feel (kinesthetic). This was influenced and found to be correlated with different education levels of the participants, i.e. between those with medical education (physicians) and those without (the healthcare community members and volunteers) [21].

Features required in the study's LMS included the interaction between media and chat forums, the presentation of the learning materials (course), the administration of quizzes to gauge participants' comprehension of the material, and the automatic generation of a graduation certificate upon the completion of the training. The forum was considered to be one of the most helpful features of the LMS in terms of improving the users' ability to understand and absorb the instructional materials. Discussions among participants led to a pro-active and engaging form of learning and teaching. To further quantify the usefulness and quality of a forum's structure and content, each forum post had a

ratings feature available to users. Each forum post could also have variety of formats. Attachments could also be appended to a forum post to enhance discussion quality [22].

The LMS provided early detection of cancer with a myriad of information dissemination tools, the most valuable features being the forum, the online chat, the quiz, and the certification features. The LMS also has great potential for improving the efficiency of information dissemination. It could also lead to implementation cost reduction since additional expenses, such as costs from transport of attending a class and accommodation logistics of a physical classroom, would be eliminated. The need for these resources crucial to a traditional class would be replaced by the need for high-speed internet connection, which would be the major limitation of LMS implementation in remote areas.

5. Conclusion

This study produced the contents and the Learning Management Systems (LMS) design suitable for information dissemination on early detection of cervical cancer. The content and LMS design have the potential to minimize variables that could become learning obstacles, such as differences in teaching methods and inconsistent materials delivery. As a result, learning would become more consistent in quality and standards. The learning method was supported by the presence of features, such as forums and chat interactions, allowing for simultaneous and/or real-time learning and teaching sessions free from the constraints of geographical distance and time. The LMS facilitated communication among the healthcare community members, midwives, and general practitioners during the learning process. The LMS was also designed to reach remote areas to relay the knowledge on early cervical cancer detection. With the support of web-based technologies, the delivery of training content and the learning process of an individual participant could be done anytime and anywhere without added costs from transportation and accommodation. The online learning could eventually contribute to the efforts of reducing the number of deaths caused by cervical cancer in Indonesia. This study could also become a reference for further research in the topic of LMS development and application for early detection of other types of cancer.

6. Acknowledgment

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