

Sci-Learn: A Novel E-Learning Platform Based on Gamification and Social Media Approach

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Abstract—Sci-Learn is a website-based application that can be accessed at <https://www.sci-learn.com>. There are three types of functionalities in this software: general e-Learning functionality, social networking functionality, and functionalities that implement game design principles. General e-Learning functionality is functionality that always appears in various popular e-Learning while social networking and gamification functionality are basically derived from related research that discusses those two types of approaches. Target users of this software are students and educators who work in educational institutions and are able to use computer well. In this platform, Users of Sci-Learn can act as teachers or students. They can either create a new online class or join an online class that already exists. In addition, Users can also easily interact with other users through existing social networking features. Based on functionality test results, 85% (27 pieces) functional requirements have been implemented perfectly and 15% (4 pieces) have been partially implemented. In addition, all non-functional requirements have also been tested by involving 30 respondents.

Keywords—*e-Learning; social media; gamification*

I. PREFACE

Nowadays, there are a lot of researches about social media as a tool for online learning (e-Learning). Social media can spread information faster and make interaction easier. On the other hand, gamification in education which is implemented in e-Learning system or learning process in the class has been investigated. The main purpose of gamification in education is improving students' engagement to the material being learned. However, those researches only cover the application of social media and gamification review and analysis in education (includes e-Learning). Principal implementation of game design in e-Learning software is quite familiar although it is tend to be partially implemented. In other word, there is no research in functionality application of social media and game design principal in an integrated system with e-Learning. Because of that, there is a big opportunity to build e-Learning platform based on gamification and social media approach.

The flow of discussion through this paper is specified as mentioned below. In the next section, the methodology of this research will be explained; afterwards, there will be a deeper discussion about e-Learning platform; the next two sections

will discuss about gamification and social media in education; in the sixth section, there will be a brief explanation of Sci-Learn, includes functional and non-functional needs of Sci-Learn and software implementation; in the seventh section, the software implementation will be explained and the testing analysis is in the eighth section; and the last section concludes this paper.

II. METHODOLOGY

This research is done in four stages, which are: Analysis; Building the e-Learning platform; Testing; and Evaluation. In the first stage, there are three steps that had been done including analyzing the problem, analyzing the similar system, and analyzing the requirement.

In the second stage, the system architecture is designed and implemented. The architectural design includes the architecture of front end and back end framework and the user interface design. The back end architecture also covers the database architecture. Then the implementation will be done on the right framework.

In the testing stage, feature testing and integration with other systems testing are performed. The feature test is based on the system architecture that has been determined in the previous stage. In the final stage, the evaluation of social networking site features and gamification elements on the e-Learning platform are conducted. Then, conclusions from these steps will be made based on the results of the analysis.

III. E-LEARNING PLATFORM

E-Learning is a general term that refers to the form of learning activities between students and teachers separated by distance and time. Furthermore, e-Learning platform is defined as software that integrates various media functionalities that support online learning [11]. Based on Epignosis LLC's published book, e-Learning platform is a website-based e-Learning developed to organize online lectures/classes, distribute course materials, and allow collaboration between students and teachers [10]. In addition, students can also receive assignments and collect their work through the platform.

A. E-Learning Platform Media

Along with the development of science and technology, there are various technologies that have been implemented in e-Learning system. Kang and Kim summarized the form of e-Learning platform media into six groups [4], i.e.:

- Audio Recording
- Video
- Blogging
- Interactive Whiteboards
- Screen casting
- Virtual Learning Environment (VLE)

B. E-Learning Platform Example

In this section, some popular e-Learning platforms will be explained. The existing e-Learning will be used as a reference to determine the functionality of Sci-Learn. A various existing e-Learning are taken as examples of this paper. The goal is to get the main functionality that existed in any e-Learning software.

Basically, there is no e-Learning exists in a very similar way. They have a goal to be used as an online learning medium, but each has a different focus and concept. The concept of each e-Learning will not be explained in detail in this section as this paper will only analyze the main functionalities of e-Learning. Based on the type of proprietary rights, there are two groups of e-Learning platforms, i.e.:

- Proprietary E-Learning Platform, whose properties are owned by the developers, such as: Saba, edX, Khan Academy, and Coursera.
- Open Source E-Learning platform, such as: ATutor and Moodle.

IV. GAMIFICATION ON E-LEARNING

The term "gamification" began to be mentioned in the media in October 2010 [9]. It can be defined as the use of game design elements in a context other than the game itself, to create engagement effects (capable of influencing someone to perform actions based on their will) similar to playing video games. Engagement can be interpreted as an attempt to master the attention and willingness of a person. Engagement occurs when our brains are rewarded for what we achieve [6].

Gamification in education or the provision of teaching content like games intended to motivate learners to be interested to learn the material provided. Gamification is the use of game mechanical elements, aesthetics, and way of thinking like games to invite people, motivate players, encourage learning and solve problems. Gamification is able to support more effective learning with fun, interesting, and teaching-centered environment. The mechanical principle of the game is able to encourage users to explore and learn "all new things" through feedback mechanisms [6].

The table below contains the principles of game design in the field of education with an analysis of the appropriate types of game mechanical elements. Based on 34 papers from the journal from ACM Digital Library, IEEE Xplore, ScienceDirect, SCOPUS, Springer Link (book), ERIC, and Google Scholar, there are 15 types of game design principles as mentioned in Table 1.

V. SOCIAL MEDIA ON E-LEARNING

Social networking sites belong to the Web 2.0 category because users are not just as content consumers, but also content generators [7]. Social networking sites are web-based services that facilitate users (1) to build a public or semi-public profile within the system, (2) to articulate friendships among users, and (3) to view or add connections based on other user connections [12].

TABLE I. GAME DESIGN PRINCIPLE AND THE IMPLEMENTATION IN E-LEARNING [2]

No.	Game design principle	Gamification representation of e-Learning platform
1	Goal: specific, clear, not too difficult, immediate goal	-
2	Quest: clear, concrete, contains action that can be learned, the complexity is increasing	-
3	Customizable: self-experience, adjustable difficulties, challenges that match the player's level of ability, increased difficulty levels along with increasing levels	-
4	Progress: level of mastery can be seen from the visualization of the progress.	Point, progress bar, and level
5	Feedback: quick response or instantaneous feedback mechanism; Intermediate achievement rather than long-term achievement.	-
6	Competition and cooperation (social engagement)	Badge, scoreboard, level, and avatar
7	Perform a gradual assessment	Point
8	Shows status: reputation, social credibility and recognition	Point, scoreboard, level, and avatar
9	Unlocking content functionality	-
10	Freedom of choice: provides many ways to achieve victory, allowing students to choose their own sub-goals in order to reach the final goal	-
11	Freedom to fail: the risk of minimal failure, ability to try again and again	-
12	Storyline	Avatar
13	New identity/role	Avatar

14	Orientation based	-
15	Limited time	Timer

Basically, social networking sites implement a wide variety of technical functionalities, but the most important functionality is the storage of friend lists. Once a user joins a social networking site, the system will provide various questions or forms used to compile the profile. Some sites also allow users to upload their profile photos, such as Facebook, Twitter, and Google+.

The increasing amount of people use social networking sites in all areas, including education area especially for upper secondary education. Researchers strongly recommend the use of social networking sites as an alternative to e-Learning platforms. Many educators are trying to integrate online service sites like Google+, LinkedIn and Facebook as a learning tool. On the other hand, e-Learning platform actually also has the potential to provide learning tools that can be accessed anytime and anywhere. However, with 1.7 billion people in the world using social networking sites, communication through social networking sites is undeniably beyond the popularity of e-Learning platforms [12].

Functionality on social networking sites can support the concept of e-Learning by facilitating students of various personal functionalities and engage them through social connections (friendship) [8]. Social networking sites provide a dynamic and novelty to the user's learning experience. Furthermore, the social networking approach can encourage users to manage their own learning environment and train their independence. In addition, students can also facilitate various learning resources that can develop their understanding and solve the problems they encounter.

A. Functionalities of Social Networking Sites in Education

Below is a category of social networking site functionality that supports the learning process [7]:

- Blog

Blogs can facilitate some of the following learning activities: i) create a portfolio of student task sets, essays, reflections (published as posts) and feedback from teachers; ii) organizing daily learning, documenting the progress of a project/learning activity, reporting each completed task; iii) publish interesting ideas and discoveries; iv) describing problems encountered, asking for help and receiving feedback; v) communicate and collaborate with co-workers.
- Wiki

Wiki facilitates students and teachers to become writers/creators of materials in the online classroom, to exchange ideas and share views, increase engagement and writing skills and enhance a sense of community cooperation. Wiki can be used to construct mutually editable materials, accumulate and organize knowledge, and integrating resources from multiple web sources.
- Social Bookmarking

This functionality can be used within the scope of education, which is to: build a collection of materials

based on an interest; share things with group of friends based on particular interests; organize material resources in certain categories; find friends with the same interests based on the same list of bookmarks.

- Microblogging

Users can use it to: follow friends or teachers; posting short questions and receiving feedback from friends; sending updates regarding project status.
- Social Networking

This functionality can support teaching and learning process in terms of: interacting with friends, sharing experiences and ideas, asking and receiving answers from friends or expert teachers.
- Media Sharing

This functionality is very valuable for searching study materials and also for publishing material.

B. Example of Social Networking Sites

- Facebook

Facebook is a social networking site that facilitates its users to socialize in cyberspace, for example: send messages, share videos, pictures, or writing.
- Twitter

Twitter is a social networking site that focuses on micro blogging concepts. Users can broadcast the writing (tweet) to the followers.
- Google+

This social networking site is known as an interest based social network that facilitates its users to form a circle of friends based on their interest in certain things. In addition, Google+ also has functionality similar to Facebook that allows users to share photos/videos/posts.
- LinkedIn

LinkedIn is widely used by professionals to find business relationships as it provides the functionality to store the career track of its users. This site is also often used as a place to recruit workers and promote business.

VI. SCI-LEARN

In the previous section, it has been explained that there are two approaches that can be used to create a new generation of e-Learning that can optimize the role of students, students with teachers, or among learners. Those are the approach of gaming and social networking. Both approaches are expected to complement each other and be able to provide new user experience for e-Learning users. Sci-Learn is an e-Learning platform built on these two approaches.

In general Sci-Learn looks like a social networking site. All users have the same role in this software. Users can share content with their connections / friends via their home page.

The shared content may be commented, liked, or shared by other users. In addition, users can chat to other users as a communication medium. Users will get notifications if there is any activity from other users associated with their account.



Figure 1 Course List Page at Sci-Learn

In this platform users can create groups. Within the group, the user can share the discussion content as well as other content related to the members of the group. Next, users can create online classes within this group and share roles in each group member. There are two roles needed for this online class sustainability. The first is the teacher and the second is the student. A teacher can do various things related to the delivery of learning materials until the evaluation of the learning process. While students have access rights to get the subject matter and do the tasks either online/offline.

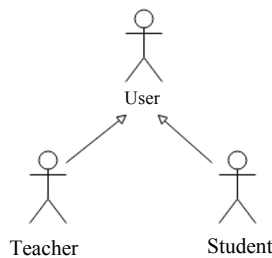


Figure 2 Sci-Learn Actor Hierarchy

The application of the game design principles in this software includes the locking of the material (Levelling), the giving of activity points, the quiz/exam (Challenge), the provision of the badge, and the score of the test (Grading).

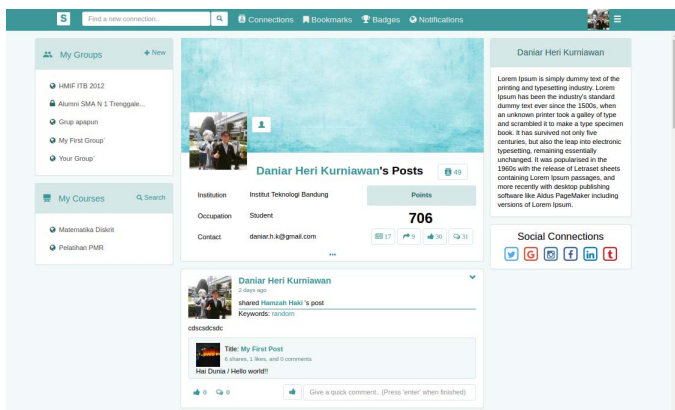


Figure 3 Profile Page at Sci-Learn

A. Sci-Learn Functionality

To support the development of e-Learning platform, it is necessary to analyze the main functionality of e-Learning, social networking site functionality and game design principles. The functionality and design principles applied should support and be suitable for the main functionality of e-Learning. The results of the study and analysis are then used to build e-Learning platforms that fit the needs of the application.

At this stage, six e-Learning applications are mentioned in section II, Example E-Learning Platform, to identify its functionality. The six applications are selected because it is very popularly used in various institutions, including educational institutions. It is also highly influenced by the main purpose of the application that is to facilitate e-Learning learning. In this paper, the sixth type of e-Learning will not be discussed, so it only focuses on the identification of functionality to find out basic functionality or functionality that is common to e-Learning tools.

The functionality that is implemented on four or more e-Learning platforms will be considered as main functionality. This functionality focuses on building online classes to support teaching activities. Online classes can be created by users who play a role as a teacher. In the online class there is at least one user who acts as a student. In the online classroom, teachers can provide materials that students can access. In addition, teacher is able to conduct an evaluation to the students with an online quiz.

TABLE II. MAIN FUNCTIONALITY IN E-LEARNING

No.	Actor	Action
1	Teacher	Creating online class
2	Teacher	Posting syllabus and lesson description
3	Teacher	Giving assignment to student
4	Teacher	Giving score/rank/badge
5	Teacher	Viewing the attendance list
6	Teacher	Setting up an online exam/tests/quizzes
7	Teacher	Preparing a class schedule
8	Teacher	Viewing the class schedule
9	Teacher	Uploading course materials (videos, text, images, slides, books, etc.)
10	Teacher	Removing student from the student list
11	Teacher	Approving student who enroll to his class
12	Teacher	Inviting student to join his class
13	Teacher	Preparing weekly material
14	Teacher	Maintaining the progress of each student's learning
15	Student	Gathering assignments
16	Student	Viewing the score
17	Student	Doing exams/quizzes/online test
18	Student	Viewing the class schedule
19	Student	Joining a class
20	Student	Accepting an invitation to join a class
21	Student	Exiting a class
22	Student	Searching for online classes
23	Student	Viewing learning progress
24	User	Downloading learning material
25	User	Viewing student list
26	User	Posting discussion topics/questions
27	User	Answering discussion topics/questions

28	User	Receiving notification
29	User	Sending text messages to other Users
30	User	Signing up, logging in, and logging out
31	User	Logging in with other social media (Facebook, Google+, LinkedIn, etc.)
32	User	Leaving an impression/trail in the form of a review/like/rating/ share on a post/profile/online class
33	User	Getting post and online classes recommendations
34	User	Bookmarking

B. Analysis of Game Design Principle Application

Functionalities that contain game design principles can be analyzed by taking into account the points mentioned in Table Game Design Principle and the Implementation in E-learning. Here are the results of the Sci-Learn functionality analysis.

TABLE III. FUNCTIONALITY ANALYSIS OF GAMIFICATION

No.	Functionality	Related Game Design Principle
1	Teacher can create student achievement milestones	No. 1
2	Teacher can create a challenge/quest (can be in a form of a quiz) to student	No. 2
3	Teachers can provide the level of difficulty of a material	No. 3
4	Teacher can manage the accessibility of a material/content based on the level/achievement of the Student	No. 9
5	Teacher can provide various types of challenges/quizzes that student can choose freely	No. 10
6	Teachers can give a time limit to solve a challenge/quiz/material	No. 15
7	Student can fill milestone	No. 1
8	Student can do quest/challenge (can be in a form of a quiz)	No. 2
9	Student can earn points according to activity and achievement	No. 4
10	Student can get an appreciation of the system based on activity and achievement	No. 5
11	Student can earn group points based on his group activity	No. 6
12	Student can choose the type of challenge/quiz desired	No. 10

C. Analysis of Social Networking Functionality

With reference to the functionality of the example of social networking mentioned earlier, the following is the result of identification of social networking functionality based on the functionality categories in section IV.

TABLE IV. MAIN FUNCTIONALITY OF SOCIAL NETWORKING

No.	Actor	Action
1	Teacher	Creating a portfolio of student, essay, reflection (published as post) tasks and feedback from teacher
2	User	Adding another user to his/her connection
3	User	Removing other user from his/her

		connections
4	User	Getting updated from his/her connection
5	User	Having a public profile page
6	User	Joining a group/forum
7	User	Sharing the topic of discussion/reading/writing to his/her connection through his LearningSpace/wall
8	User	Leaving group
9	User	Getting recommendations on interesting topics
10	User	Leaving an impression such as like, comment, or share another user post
11	User	Creating mutually editable material/content to accumulate and organize knowledge

D. Priority for Implementation of Sci-Learn Functional Need

From the results of identification and functionality analysis in Table 2, Table 3, and Table 4, it can be further analyzed on the functionality that will be implemented in e-Learning platform. The combined functionality of the three tables is considerably a lot, so in the course of this paper only the main functionality will be implemented.

TABLE V. MAIN FUNCTIONALITY OF SCI-LEARN

No.	Actor	Action
1	Teacher	Creating online class
2	Teacher	Posting syllabus and lesson description
3	Teacher	Uploading course materials (videos, text, images, slides, books, etc.)
4	Teacher	Removing student from the student list
5	Teacher	Approving student who enrolls to his class
6	Teacher	Inviting student to join his class
7	Teacher	Preparing weekly material
8	Teacher	Providing the level of difficulty of a material
9	Student	Viewing the score
10	Student	Joining a class
11	Student	Accepting an invitation to join a class
12	Student	Exiting a class
13	Student	Searching for online classes
14	Student	Doing quests/challenges/quizzes
15	Student	Getting points according to activity and achievement
16	User	Downloading course material
17	User	Viewing the list of Student
18	User	Posting discussion topics /questions
19	User	Answering discussion topics /questions
20	User	Receiving notifications
21	User	Sending text messages to other users
22	User	Signing up, logging in, and logging out
23	User	Adding another user to his/her connection
24	User	Removing other users from his/her connections
25	User	Getting updated from his connection on his LearningSpace/wall
26	User	Having a public profile page
27	User	Sharing the topic of discussion to his/her connection through his LearningSpace/wall
28	User	Leaving an impression/trail in the form of a review/like/rating/share on a post/profile/online class

29	User	Leaving group
30	User	Bookmarking
31	User	Getting recommendations on interesting topics

E. Non-functional Need for Sci-Learn

The following are non-functional requirements that are implemented.

TABLE VI. LIST OF NON-FUNCTIONAL NEED OF SCI-LEARN

No.	Explanation
1	This software can be used on popular web browsers such as Google Chrome and Mozilla Firefox
2	This software can respond to any request in less than 4 seconds when saving thousands of user data
3	The view of this software is not damaged when the monitor size changed
4	The functionality of the gamification that is implemented can improve the user's engagement / interest towards e-Learning software

F. Learning Media Analysis on E-Learning Software

Determining the type of learning media on e-Learning is quite important because it will affect the priority of implementation of its functionality. In general, learning media at e-Learning software can be voice recording, blogging, interactive whiteboard, screen casting, video, and VLE/ Virtual Learning Environment. Taking into account the timing and resources available, the types of learning media developed in Sci-Learn are blogging/writing and video that can be accessed via PC (Personal Computer). With these two types of media, Users can share their knowledge in written form and also through video. These media are suitable for User type which is more dominant as visual-learner.

Writing and video media are considered more familiar and accessible than other media, such as VLE (Virtual Learning Environment), because it does not require large bandwidth. In a state of minimal internet access, users are expected to still be able to use this system because it mostly contains text like social media timelines such as Facebook, Twitter, and LinkedIn. In the future, other media will be taken into account, but will still pay attention to the complexity of its functionality. There are many good open-source e-Learning, but most of them are too complex and ultimately not many users use it.

G. Implementation of Sci-Learn

This e-Learning software architecture includes the server's general architecture or back-end architecture and the interface or front-end architecture. Users can interact with the system through the system interface. Each request is sent over an HTTP protocol and processed by the server. In addition, requests may also come from other registered systems. The system can send requests through the API (Application Program Interface) with special authentication and then the request will be processed on the same server.

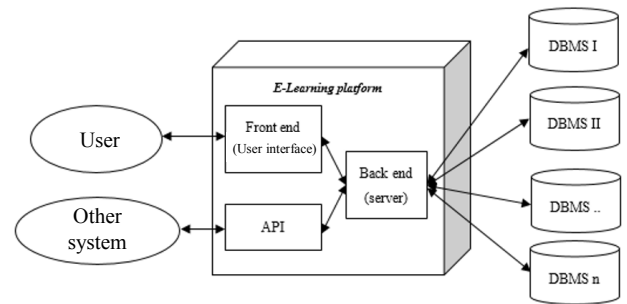


Figure 4 General Architecture of E-Learning Platform

The server uses a distributed database to support system scalability. This is necessary because the e-Learning platform being built must be accessible to the user even if the number of users has reached millions. Figure 4 shows the general architecture of the system and in Figure 5 shows the detail of the technology used for system implementation. The back-end architecture includes the database architecture used and the server. Back-end systems will use MongoDB as NoSQL DBMS and NodeJS framework as the main server. The front-end section will use HoganJS and AngularJS.

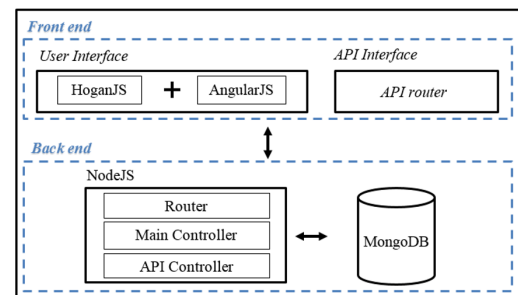


Figure 5 Front-end and Back-end Architecture

VII. TESTING

Testing on Sci-Learn consist of two types: functional testing and non-functional testing. This test is generally related to the application of elements of game design and social networking. The things to be tested refers to the specifications of functional and non-functional requirements of the software. Functional testing is done by testing every feature that is included in the main functionality. And then testing the effectiveness of the application of elements of game design and social networking are done by respondents. Respondents were asked to use e-Learning platforms that have been built and fill out the questionnaire to be explained in the next section. This test is performed according to the test scenario and the results will be analyzed for the evaluation material of the system.

A. Functional testing

This test refers to the list of functional requirements specifications listed in Table 5. This functional test consists of unit testing and integration testing. Testing is done by testing and evaluating each functional requirement that has been implemented through the pages that have been deployed on the domain <https://sci-learn.com>. The results of functional testing will be assessed in three categories, namely: Implemented perfectly, partially implemented, and not implemented.

B. Non-Functional Testing

The non-functional requirements to be tested are listed in Table 6. The first three non-functional requirements, namely: this software can be used on various web browsers, this software can respond to requests of less than 4 seconds, and the display can adjust desktop size was not tested by respondents, while the last non-functional need was tested by respondent. Testing by respondents will not test all the functionality in detail. Respondents were given the opportunity to use the software that had been built. Then they are expected to provide an objective opinion of the e-Learning concept introduced through this software compared to the concept of e-Learning platform on the market today, such as Moodle, EdX, Khan Academy, and so on. This test is conducted on 30 people.

Non-functional testing aims to ensure some requirements that must be met by this software. In testing the last non-functional requirements, user input is needed as an evaluation of implemented functionality. Respondents indirectly also perform functional testing as they will try some major functionality in the concept of e-Learning platform. The results of this non-functional testing will be analyzed to infer some things related to the development of this software in the future.

VIII. EVALUATION

Based on functional testing, 85% (27 pieces) functional requirements have been implemented perfectly and 15% (4 pieces) are partially implemented (marked in a bold writing at Table 5). Then, the non-functional test shows that 100% non-functional requirements are met. Different from the others, the 4th non-functional requirement is evaluated based on test results through questionnaires. The opinion of the majority of respondents, functionality in this software is already able to represent the implementation of the concept of e-Learning development with the approach of games and social networking.

In general, Sci-Learn has been well implemented. In addition, the results of the questionnaire also proved that the implementation of social networking functionality and design elements of the game considered quite interesting and effective although there are some functionality that still need improvement.

IX. CONCLUSION

The development of e-Learning platform with game and social networking approach has been made by referring to e-Learning functionality implemented in popular e-Learning and implementation of game element according to related research. The main functionalities of e-Learning platforms with gaming and social networking approaches are obtained by analyzing the existing functionality of popular e-Learning software (Moodle, Saba, EdX, Coursera, Khan Academy, and ATutor) and referring to related research on social networking and game design principles on e-Learning software.

The main functionalities of social networks identified to be included as system functional requirements are: sharing of posts, creating groups, adding friends/connections, commenting and liking, having public profiles, and

bookmarking. Implementation of design elements of games that have been identified to be included as functional requirements of the system are: material locking, activity point assignment, quiz/exam (Challenge), badge giving, and grading test (Grading). In general, 90% of respondents/testers agree that the social networking functionality and game design elements implemented in this tool are effective for improving the engagement and active role of the User. The data proves that the non-functional requirements related to the user's engagement have been met.

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