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Digitalization of Smart Student Assessment Quality in Era 4.0

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ABSTRACT

Era 4.0 has had a significant impact on information technology, especially in digitalization that has entered the field of education. The purpose of this study is to explore how from lecturers to department heads to understand and proficiency in digitizing student assessment in the 4.0 era. This study uses the SDLC waterfall method in building gamification-based smart assessment. Researchers need to explore how to understand the concept of skills towards digitizing student assessments required to produce an effective and efficient system. The findings show that lecturers are able to see digitalization with broad and complex concepts including the pedagogical, technical, administrative and academic structures of the University. The role of the lecturer seems to play an essential and complex role due to digitization so that it impacts on the level of student motivation. However, time, human resources, as well as professional development, continue to influence in supporting the learning process of lecturers and students. This paper contributes to the digitization and quality of lecturers' smart assessment of students. The contribution shown for lecturers is trying to implement and be able to digitize in 4.0 era as a form of transformation in the field of education. The application of smart assessment helps the quality of lecturers' quality of input scores in students effectively and accurately so that it impacts on students knowing the value in real-time and becomes motivated by gamification.

Key words: Digitalization, Era 4.0, Smart Assessment, gamification, transformation.

1. INTRODUCTION

Advances in information technology in the 4.0 era are demonstrated by activities that are often carried out online so that they are readily available to meet educational needs [1]. A critical part of education is about assessment. It should be remembered that the main effect of an assessment on learning is not only from the success of educational programs but rather the quality of assessment [2]. Quality the assessment includes all elements of an evaluation practice such as the assignment, the score report, the assessment, the feedback, the programs, the criteria, and the policies [3]. At present, school leaders have the responsibility to encourage development and lead digitalization, starting from students, lecturers, to higher education organizations [4][5]. So, according to school leaders, accessibility to technology is a challenging and robust condition in development [6]. However, information about the assessment is still of minimal quality and is not digitized.

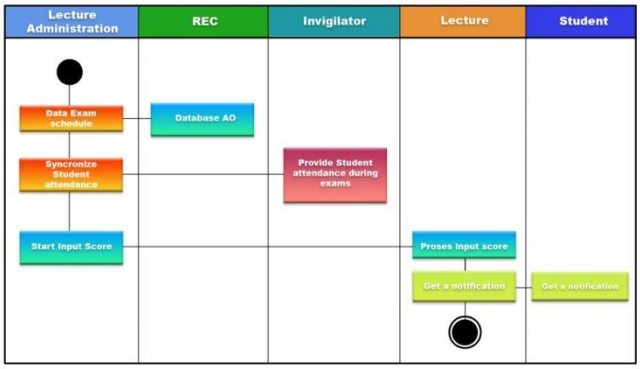

Figure 1: Activity diagram of a conventional assessment system

Figure 1 is a general description of the process of obtaining an assessment from start to finish as a list of reports and to be a reference for this information system. Starting from the data collection on the Online Attendance Database (AO) for making the exam schedule, which is then synchronized by the Administrative lecturer and given to the supervisor to conduct attendance during the exam, then proceed to the submission of attendance from the supervisor to the administration lecturer again to record the

students present during the exam. The attendance is then given to the lecturer for inputting grades until finally, the student gets a notification related to the value. The announcement of grades is still being made on school bulletin boards.

So it is necessary to use the Internet of Things in the 4.0 era to increase the transparency of information from the application of digital technology [7][8[9]. One example is financial technology with digital payments such as OVO and Gopay [10]. Through digitalization, it allows radical openness of innovation so that it can drive for digital transformation [11]. The development of online communication technologies (CT) contributed to the academic environment in the era of digital transformation to improve communication between students and teachers in the arena of higher education [12]. Specifically, this research is to improve the academic information system in the notification of lecturer assessment to students digitally, quickly and accurately with the presence of the Pen + system. Student assessment is combined with gamification elements to stimulate motivation towards student characteristics [13,14].

2. PREVIOUS RESEARCH

Previous research by Gerritsen-van, et al showed that perceptions about the quality of student assessment consisted of six variables: 1) The effect of assessment on learning, which refers to the alignment between assessment and learning (for example feedback and motivation), 2) Fairness of assessment, which refers on the eligibility and honesty of the test requirements for students (for example comparability and validity), 3) Conditions of assessment, refer to the assessment conditions that cannot be controlled by students but will affect them (for example, soundness and manageability), 4) interpretation of test scores, referring to the meaning of student test scores (eggeneralisability and construct validity), 5) Authenticity of assessment, which refers to aligning an assessment with one's desired professional life (for example authenticity and transparency), and 6) Credibility of assessment, refers to students' trust in assessment (ex. trustworthiness and consistency) [15]. Further research is knowledge about student competency-based assessment and stimulation of educational practice as well as future research assessment based on competency-based assessment (CBA) in AVET [16].

Subsequent research analyzed thematic content that revealed characteristics of 'authenticity' and 'feedback' assessments that had a positive influence and provided a clear view of self-efficacy related to the assessment phase [17]. Other research shows that increased personalization and flexible learning in higher education require equal attention to cohesive learning assessment practices; besides that, teachers and institutions are responsible for developing 'flexible students' [18]. Other research, regarding accelerating digitalization as a substitute for the "traditional" electronic approach, then the requirements for the education system to the concept of "industry 4.0" [19]. Gamification design is applied to online learning with a combination of technology in the millennium era so that it has an impact on students' attitudes towards test scores [20].

Next, the research discusses e-learning technology with the principle of gamification, which is designed and implemented for the learning management system MOODLE-Learning gamification [21]. Other studies discuss a comprehensive research analysis regarding the transformation of digitalization that has an impact on communication that is preferred by students to teachers [22]. Other research in the field of health is the digitalization of CTG signals from imprints printed by CTG for future assessment [23]. Subsequent research on digital exam assessment with a more dominant crossover design showed better assessment than the paper-based exam in the undergraduate program in Mechanical Engineering and Aerospace [24]. Research in the field of health is the existence of a digitizing framework for hospital services to improve quality services and save costs in terms of patients [25]. The latest research is digitalization on journalism education, which has a significant impact on changing the nature of journalist work, where the new generation of standards increases competence [26]. From previous research, it can be concluded that digitalization has a significant impact on change with technology to improve the quality of a system. However, there is no research on digitizing lecturing assessment, so this study discusses significantly the application of gamification based digitalization of a lecture assessment given by lecturers so as to increase student motivation and improve lecturer assessment quality.

3. METHOD

This study uses the SDLC waterfall research method because it can describe the structure clearly and can produce maximum output from each stage that has been completed [27]—starting with making the initial plan for the system up to the maintenance of the system after it was released. The method used in developing the system includes 6 (six) steps in Figure

2.

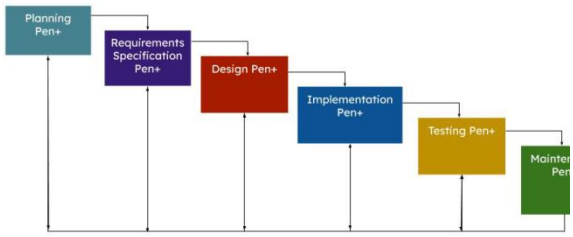

Figure 2. Method Waterfall

This Waterfall method has six stages:

- Planning
  The initial stage is making a plan for the system to be made [28]. Researchers design plans for the assessment of intelligent students as a solution to the problems that have been found.
- Requirements Analysis. Stages of Analysis needs analysis of software requirements [29]. At this stage, the researcher looks at the requirements required by the manager and user to complete the agreement needed to achieve the agreed objectives. Besides, analyze system requirements such as a server, programming language, database, UI / UX. Then transform into a bright and complete description to be entered into the system.
- System design. Stages of software design that focus on several attributes that have been analyzed, such as database structure, UI / UX architecture, to the details of the gamification algorithm on the system. Besides, this stage can be interpreted as the process of translating needs that have been analyzed into a software model that can estimate the quality of the system implementation [30].
- System implementation. This stage converts pre-designed designs into a computer programming language [31]. It is starting from creating a database such as a structure that has been planned using MySQL, writing algorithms that suit your needs with the PHP programming language based on the Yii Framework framework such as gamification and other features, to making an attractive User Interface using the CSS Bootstrap Framework library. The computer will perform functions that have been defined so that it can provide various features created by the user.
- Testing system. This system testing uses BlackBox testing to adjust the desired output to the user [32].
- System maintenance. The final stage is the maintenance of the system and repairing the system at any time, which raises problems. Also, at this stage we can develop the system to add the need for new features for the system [33].

4. RESULT AND DISCUSSION

4.1 Requirement & Analysis

This study requires direct information data through interviews with the academic department involved [34]. The following is the flow of the system that runs in the collection of student grades before the digitization system.

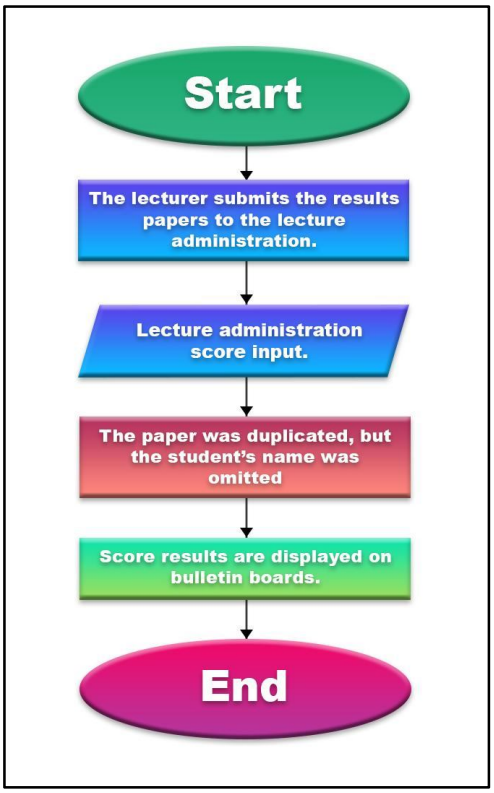

Figure 3: Pen + system flowchart

In Fig 3, it is explained that there are six flowchart processes in the delivery of general student assessment information. So students cannot know the highest or lowest grades automatically regarding midterm, final exam, and independent assignments.

There are 5 (five) conditions encountered in the process of collecting student grades to display the results of these grades, as follows:

1. The assessment system is less than optimal in terms of information to students.
2. The information presented is not yet online; it is still informed through the bulletin board.
3. The inputted value is still using Ms. Excel,

which can be confused with differences in formulation.
4. Processing student data values that still have to be reprocessed by the admin to be inputted into the database.
5. Students do not know the highest or lowest grades automatically.

Judging from the systems running above we can get 5 (five) conditions for further system requirements both functional and non-functional, namely:

1. The system can be accessed anywhere and anytime.
2. All devices and browsers can access the system.
3. The system can input TM, UTS, and UAS grades conducted by lecturers independently.
4. The system can display class updates.
5. The system can display the results of overall student grades ascending and descending the user interface.

4.2 Design & Implementation

To solve the problem that has been summarized from the results of the analysis process, the next step is the process of designing a system model. In making lecture assessment system models, I used an Object-based system that is Unified Modeling Language (UML), which consists of 2 (two) diagrams, namely use cases and sequence diagrams. UML is a standard language for documenting, specifying, and building software systems [35]. In the picture, there are 2 (two) users, namely Lecturers and students who have their respective roles and tasks.

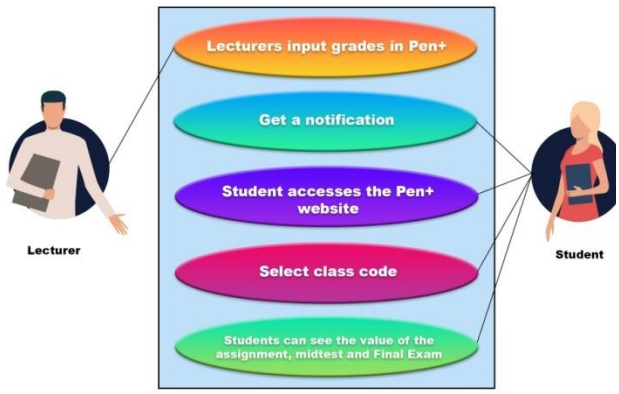

Figure 4: Use Case Diagram Pen+

Figure 4 is a use case diagram of the digitization system of student assessments that are already online. There are 2 (two) actors involved, namely lecturers and students. Where the policy covers the whole process of accessing and delivering grades of UTS students, UAS, and independent assignments, the lecturer has also independently inputted student grades on the Pen + system online, and students can also find out the overall value. They can be measured from ascending and descending.

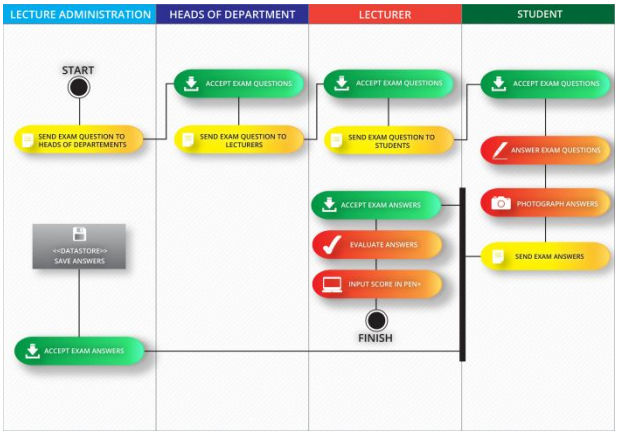

Figure 5. Activity Diagram Pen+

Figure 5 is an activity diagram that illustrates the flow of digitizing smart assessments, namely Pen +. Lecturers input student grades online so that the data is accurate and quickly produces overall value information—the impact on students who quickly see the value in real-time and easily accessed online. Then, the implementation of the exam becomes easier without having to involve many people and minimize paper to inform the results of student exam scores.

4.3 Testing & Deployment

In general, in testing the web that can be accessed through an extensive internet network, it is a development of web technology. The supporting role of the software is to run hardware in generating information using PHP, MySQL, and the Yii Framework. Yii framework is a PHP component for website development on a large scale in programming so that it can improve websites quickly and significantly [36].

Pen + is a student assessment application that can be accessed anywhere and anytime, where students can see the overall value. The development of the assessment website uses the framework so that the site is a user interface on the part of students, lecturers, and administrators. In this test, black-box testing is used so that

errors can be detected in the program. The inputted data can be in accordance with the functional requirements to produce the desired output.

```
<?php

use yii\helpers\Html;

/* @var $this yii\web\View */
/* @var $model app\models\TTPenplusPenilaianAktif */

$this->title = Yii::t('app', 'Update {modelClass}: ', [
    'modelClass' => 'Ttpenplus Penilaian Aktif',
]) . ' ' . $model->KodePenilaian;
$this->params['breadcrumbs'][] = ['label' => Yii::t('app', 'Ttpenplus Penilaian Aktifs'), 'url' => ['index']];
$this->params['breadcrumbs'][] = ['label' => $model->KodePenilaian, 'url' => ['view', 'id' => $model->KodePenilaian]];
$this->params['breadcrumbs'][] = Yii::t('app', 'Update');
?>
<div class="ttpenplus-penilaian-aktif-update">

    <h1>Update Periode Aktif</h1>

    <?= $this->render('_form', [
        'model' => $model,
    ]) ?>

</div>
```

Figure 6: Listing of score input programs

The program listing above is coding so that lecturers can input scores starting from independent assignments, midterm, and a final exam by the code of courses being taught. Below is the result of black-box testing from 6 (six) activities.

Table 1: Black-box Testing

Activities	Test Case	Output	Result Test Case
User login (Teacher, student, Lecture administration)	Login SSO	Go to the page with different access levels according to the needs.	Valid
Lecturer input grades	Input score assignment, mid test and final exam.	Access score input, submit scores, display score results.	Valid
Admin can update, delete, or add data	Update class, student and courses.	Shown student data, lecturers updated.	Valid
Lecture administration access	Upload exam schedule	Display exam schedule for inputted scores by lecturers.	Valid
Student access	View viewboard	Students see the score	Valid
Rector access	View activity	Report on the score by the lecturer	Valid

4.4 *Evaluation System*

At this stage, the evaluation of the Smart Student Assessment system begins with finding a sample of lecturers and students using the Slovin Formula [37].

$$n = \frac{N}{1 + Ne^2}$$

Where n is the number of samples, N is for the total population, and e is the error tolerance limit [38]. With a total active lecturer population N = 134 and an error tolerance limit of 1%, the required number of lecturer samples is:

$$n = \frac{134}{1 + 134.(0,01)^2}$$

$$n = \frac{134}{2,34}$$

$$n = 57,26 \rightarrow 57$$

Moreover, with a student population of N = 1743 and an error tolerance limit of 1%, the number of student samples needed is:

$$n = \frac{1743}{1 + 1743.(0,01)^2}$$

$$n = \frac{1743}{18,43}$$

$$n = 94,57 \rightarrow 95$$

The next evaluation stage uses the System Usability Scale to find out how well the system is implemented. System Usability Scale (SUS) is a questionnaire that can be used to measure computer system usability according to the user's subjective viewpoint [39]. Where X is the total score of SUS, and N is the number of respondents, while R1 through R10 is the respondent's statement variable.

$$X = \frac{(((R1) + (R2) + (R3) + (R4) + (R5) + (R6) + (R7) + (R8) + (R9) + (R10)) * 2,5) * N}{N}$$

In this study, the SUS Questionnaire used a 5-point Likert scale. The respondents namely lecturers and

students were asked to assess the system starting from "Strongly disagree", "Disagree", "Neutral", "Agree", and "Strongly agree" on 10 question items where each one item statement is a variable R1 up to R10 according to its subjective assessment. The questionnaire was distributed to all active lecturers and active students via email. The overall SUS score is obtained from the average individual SUS score. The following is the formula for calculating SUS average scores for lecturers:

$$X = \frac{((3)+(3)+(4)+(3)+(3)+(3)+(2)+(5)+(4)+(4))*2,5)*}{57}$$

$$X = \frac{4,987,5}{57} = 87,5$$

The SUS average score calculation formula for students:

$$X = \frac{((3)+(3)+(2)+(3)+(4)+(3)+(3)+(4)+(4)+(4))*2,5)*}{95}$$

$$X = \frac{7,837}{95} = 82,5$$

From 10 responses of lecturer respondents and 95 responses of students, respondents were then calculated using the SUS Score formula to produce an overall SUS Score. After calculating, it was found that the average assessment of the SUS score for lecturers reached 87.5, and for students reached 82.5, in the next stage, a reliability test using Cronbach's Alpha would be considered reliable if the value was more significant than 0.721 [40]. SUS is a subjective global assessment of aspects of usability (effectiveness, efficiency, and satisfaction) felt by system users.

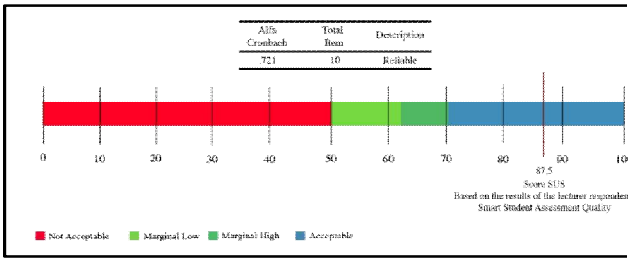

Figure 7: The results are based on the lecturer SUS.Respondents' scores on the Smart Student Assessment system

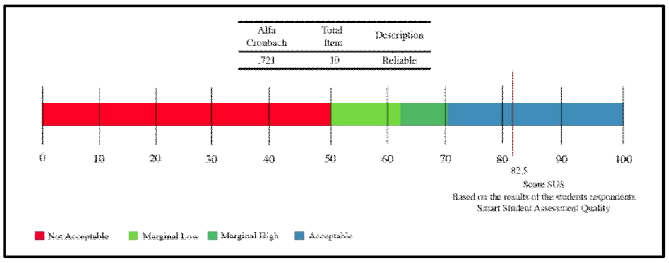

Figure 8: The results are based on the students SUS.Respondents' scores on the Smart Student Assessment system

The SUS score can indicate the level of user acceptance for the system created. SUS scores are required to reach more than 70 in order to be included in the Acceptable [41] category. Furthermore, the results obtained by the Smart Student Assessment are 87.5 of the results of the lecturer respondents, and for the results of students, respondents get 82.5 so that it can be declared included in the Acceptable category. SUS scores can also indicate a tendency to become a Net Promoter. A SUS score of 82 or more indicates that a user can potentially become a Promoter that causes users to continue to increase, while a SUS score of 67 or less indicates that users can potentially become a detractor, which can lead to a continued decline in system users [42][43][44][45]. The SUS Smart Student Assessment Quality Score of 87.5 and 82.5, indicates that the user has the potential to become a Promoter. This has a positive impact on the system created due to the future number of system users will increase. The results obtained from usability measurement can be the primary step of system evaluation, which shows that the system is usable. The SUS Smart Student Assessment Score illustrates the user's subjective assessment that the system is effective, efficient, and satisfying to the user. The survey data is used as a measure of motivation for students towards the implementation of an assessment system in higher education [46][47][48].

5. CONCLUSION

Overall, this research contributes to the transformation of digitizing lecture assessment systems in higher education. It was evidenced by the use of a system that serves lecturers and students on assessment information that is said to be effective and efficient. Input results of student scores can also be seen in real-time after the lecturer scores input into the Pen + system. The use of the SDLC waterfall method helps build a Pen + system with a blend of

gamification based on the framework. In the SUS score X results, it is known that the lecturer score reached 87.5> 82, and the student score 82.5> 82, which means the research instrument was declared as a promoter. This shows that digitalization in the rating system can significantly improve the quality of assessment, and the number of users can increase[49]-[52]. Where the gamification mechanism also participates in the smart assessment system to motivate students towards their personal values. It is proven that the assessment of this lecture is digitalized in tertiary education so that it provides a research reference for the future. The next suggestion for researchers is public gamification, which can be seen widely with the application of the blockchain, and this system can be used at all levels of education.

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