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Gamified Student Activity Transcript System using MDA Framework

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Abstract−Universities increasingly recognize that employability and civic competencies are formed not only through formal coursework but also through co-curricular and extracurricular engagement. In many campuses, however, activity reporting remains fragmented, highly manual, and submitted late, which results in verification bottlenecks and incomplete student records. This study develops a web-based Student Activity Transcript (SAT) application to support end-to-end submission, verification, and accumulation of student activity points. A gamification approach is embedded to reduce reporting friction and sustain participation. The design follows the Mechanics–Dynamics–Aesthetics (MDA) framework so that each game element is justified from rules to run-time interaction patterns and the intended user experience. The system is implemented using a PHP web framework and a relational database, and it integrates role-based workflows for students, academic advisers, and student affairs administrators. Functional validation is performed through specification-based (black-box) testing to confirm that critical workflows—registration, login, activity submission, verification, and transcript generation—operate as intended. The resulting artifact demonstrates a reusable pattern for universities that need to digitize activity transcripts while ensuring that gamification is applied in a structured, theory-informed manner. This work contributes to TAK governance workflow that preserves institusional verification while adding engagement loops, and an implementation and test blueprint that can be adapted to other campuses adopting transcript or digital badge recognition system.

Keywords: Gamification; Student Activity Transcript; MDA Framework; Co-Curricular Record; Laravel; Black-Box Testing

1. INTRODUCTION

In higher education, co-curricular participation through student organizations and campus units (e.g., UKM) is widely positioned as a mechanism to complement formal learning outcomes by strengthening soft skills, social capital, and work readiness. In Indonesian university contexts, empirical work commonly reports positive associations between organizational participation and readiness indicators such as communication confidence, teamwork ability, leadership exposure, and self-management—particularly when participation is structured and sustained rather than incidental [1]. Complementarily, studies of student perceptions toward UKM emphasize that organizational activities are not only social spaces but also developmental arenas that shape students' sense of competence, belonging, and preparedness for post-campus transitions [2]. In line with broader higher education practice, these developmental outcomes are increasingly documented and recognized through co-curricular records and badge based micro credentials, whitch aim to make particiaption visible, structured, and meaningful for students and institutions [3] [4] [5]. These findings support the idea that universities should not treat co-curricular engagement as "extra," but as an integral development channel that should be recognized, tracked, and supported with appropriate systems.

At Institut Teknologi Telkom Purwokerto, one institutional mechanism for capturing co-curricular achievements is the Student Activity Transcript (Transkrip Aktivitas Kemahasiswaan, commonly called TAK). TAK aggregates points from participation in organizations, committees, competitions, trainings, volunteering, and other activities. Conceptually, TAK serves as a structured portfolio evidencing student development beyond coursework. Operationally, however, TAK reporting can become a late-stage administrative obligation: students often postpone submitting evidence; documentation is dispersed across certificates, posters, screenshots, or informal confirmations; and verification becomes time-consuming for administrators. This type of co-curriculat activity management challenge is alsi reflected in prior platform oriented studies, where the core difficulity is not only recording activities, but sustaining consistent submission and ensuring credible validation over time [6]. When the process is experienced as bureaucratic friction, student participation may become "minimum compliance," and the intended developmental function of TAK is weakened.

A web-based TAK information system can reduce these operational frictions by enabling standardized submission, transparent validation, and centralized documentation. Yet digitization alone does not guarantee sustained student engagement. Students still need a reason to participate consistently: to record activities soon after they occur, to monitor progress toward graduation requirements, and to explore development pathways rather than treating TAK as a one-time checklist. For this reason, the present work positions gamification as an engagement-oriented complement to workflow automation. Gamification is commonly defined as the use of game design elements in non-game contexts to shape behavior and increase engagement [7]. In educational and learning information systems, gamification has been explored as an approach to promote repeated participation, timely task

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completion, and stronger persistence by giving users clearer goals, feedback, and a sense of progression [8]. Reviews and syntheses of gamification research also show that positive effects are possible, but strongly dependent on context, implementation quality, and how elements are matched to user characteristics and system goals [9], [10]. At the same time, the literature clarifies why "points and badges" are not a universal solution. Poorly aligned rewards can encourage superficial actions (e.g., logging activities without meaningful participation), demotivate students who feel left behind on leaderboards, or produce short-lived novelty effects that fade once the system becomes familiar. Therefore, meaningful gamification requires alignment between what students value, what the institution needs them to do, and what the system reinforces through feedback and incentives. Nicholson's "RECIPE for meaningful gamification" emphasizes that gamification should support user autonomy, meaningful choices, and context-appropriate value, rather than relying primarily on extrinsic rewards [11]. Practical design frameworks provide additional guidance: Werbach & Hunter emphasize "game thinking" as designing engagement loops and feedback cycles around clear behaviors [12]; Chou's Octalysis helps map motivational drivers (e.g., achievement, ownership, social influence, meaning) to specific design features [13]; and Zichermann & Cunningham provide a structured perspective on mechanics such as points, badges, levels, and challenges—while also warning that mechanics must be tied to the intended user journey and business/organizational outcomes [14].

To operationalize this alignment for TAK, this study adopts the Mechanics–Dynamics–Aesthetics (MDA) framework as a core design lens. MDA separates concrete rule elements (mechanics), their run-time interactions (dynamics), and the user-experienced outcomes (aesthetics) [15]. In education-focused analyses, MDA is frequently used to justify how mechanics—missions, levels, points, progress bars, leaderboards, and rewards—create dynamics such as routine formation, exploration, competition/cooperation, and timely submission habits, culminating in target experiences such as achievement, clarity, and belonging. Kusuma et al. further demonstrate the usefulness of MDA as an analytical frame for comparing and selecting gamification models in educational contexts, reinforcing that design should be reasoned from mechanics to experience rather than added ad hoc [16].

In addition, the motivational logic of the gamification layer is grounded in Self-Determination Theory (SDT), which explains sustained motivation through satisfaction of psychological needs commonly described as autonomy, competence, and relatedness [17]. Applied to TAK, SDT implies that students will engage more consistently when they experience autonomy, through meaningful choices of activities aligned with interests; competence, through clear requirements and visible progress; and relatedness, through recognition and a sense of belonging in campus communities. This motivational framing is consistent with the intent of TAK as a developmental transcript rather than a mere administrative record.

Based on this rationale, the objective of this work is to design and develop a web-based TAK information system that digitizes reporting and verification while embedding a gamification layer grounded in MDA and SDT principles. The system is intended to: First, record and validate student activity evidence. Second, compute and visualize TAK points transparently. Third, provide structured activity missions and progress feedback, and Fourth, encourage sustained participation through well-aligned game elements. In doing so, the system aims to support students' co-curricular development while reducing administrative overhead and improving the integrity and timeliness of TAK documentation.

This study contributes to a governance preserving TAK workflow that formalizes multi actor responsibilities while reducing reporting friction through feedback, implements gamification using MDA bu mapping each mechanic to intended dynamics and aesthetics, minimizing "point and badges only" implementations and ligning incentives with institusional requirements. This study also provides an implmeneted web artifact and specification based testing protocol that can be reused as a reference architecture for campuses developing transcript or badge based recognition system.

2. RESEARCH METHODOLOGY

This study applies a Research and Development (R&D) methodology to produce an implemented and evaluable TAK web information system with embedded gamification. The method combines iterative needs identification, product design, development, validation, and refinement, so the output is not only a conceptual model but a functioning artifact that can be tested and assessed by users. As summarized in Figure 1, the workflow proceeds from problem identification and requirement elicitation, to collection of institutional inputs (TAK rules and evidence), system design using UML modeling and MDA-based gamification mapping, implementation using the selected web stack, functional verification via black-box testing, and user evaluation for improvement.

a. Research Design
   This study uses a Research and Development (R&D) approach to produce an implemented and evaluable software artifact, a TAK web information system with embedded gamification. In Indonesian applied research, R&D is commonly used to combine needs identification, product design, development, validation, and iterative improvement in a structured cycle [18]. The output is therefore not only a conceptual model but a functioning system that can be tested and assessed by users.
b. Problem Identification and Requirement Elicitation

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The process begins with identifying operational problems in the existing TAK workflow and clarifying stakeholder needs (students, student-affairs administrators, and activity validators). Key requirement themes include: evidence submission and storage, point calculation rules, verification workflows, user roles and access control, progress visualization, and gamification elements that encourage timely participation. The elicitation stage is conducted through observation of current procedures and structured interviews/discussions with stakeholders, producing an initial requirement specification and a prioritized backlog of features.

c. Data Collection and System Inputs
Data collection focuses on TAK policy rules (point categories, validation requirements, minimum totals), student activity evidence types (certificates, letters, screenshots), and user feedback needs (what progress information students and administrators require). These inputs define the database entities, validation constraints, and gamification mapping (e.g., which activities count as "missions," how levels are computed, and what feedback is presented).

d. System Design: UML Modeling and Gamification Design (MDA)
Software design is produced using standard software engineering practices for web applications, including separation of concerns, modularity, and traceability from requirements to implementation [19], [20]. Unified Modeling Language (UML) artifacts are used to formalize and communicate the system architecture and behavior, including use-case diagrams (actor interactions), activity diagrams (workflow logic), and class diagrams (data structures and relationships), referencing the UML specification for notation and consistency [21]. Gamification design is developed explicitly through the MDA framework. Mechanics include point rules, levels, mission lists, progress bars, and achievement markers; dynamics include routine submissions, competition/cooperation signals, and exploration of activity categories; aesthetics target clarity of progress, sense of achievement, and belonging [15], [16]. This step also includes adopting design lessons from prior Indonesian gamification web systems and educational gamification implementations to avoid purely superficial incentives and to ensure alignment with learning/developmental goals [22], [23].

e. Implementation Technology and Development
Implementation follows a web-application development life cycle, translating UML artifacts and requirements into database schemas, back-end logic, and user interfaces. The system is implemented using the Laravel PHP framework for application structure (routing, controllers, ORM, authentication scaffolding) [24] and MySQL for relational database storage and query support [25]. Core modules typically include: authentication and role management; activity submission; evidence upload and storage; validation workflow (approve/reject with notes); point computation; dashboards and progress visualization; and gamification UI components (levels, missions, achievements).

f. Functional Testing
Functional verification is conducted using black-box testing to ensure that each feature satisfies its functional requirements without relying on internal code structure. Black-box test cases are derived from the requirement specification and use-case flows, covering normal paths and edge cases (invalid inputs, missing evidence, unauthorized actions) [26]. Outputs of this stage include a test case matrix, pass/fail logs, and defect notes, which are used for corrective iterations.

g. User Evaluation and Feedback Analysis
User evaluation assesses usability, perceived usefulness, and perceived motivational impact of the gamification layer. The questionnaire design is informed by the idea that specific game elements can influence psychological need satisfaction and engagement when aligned with SDT constructs [17], and by empirical work showing that particular design elements can differentially affect perceived competence, autonomy, and relatedness [27]. Evaluation results are summarized descriptively and used to refine interface clarity, mission framing, feedback pacing, and validation transparency.

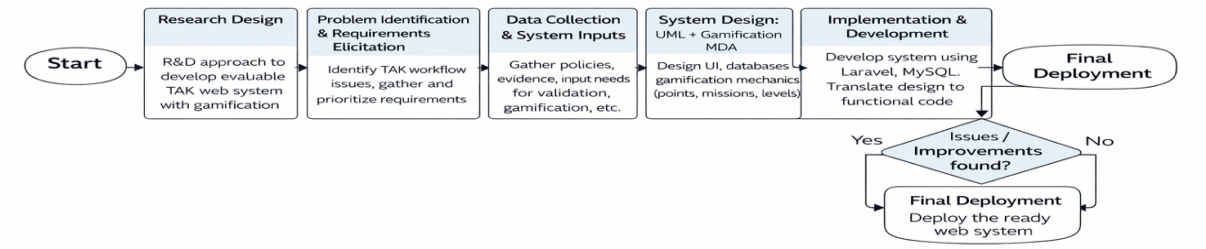

Figure 1. Research Methodology

3. RESULT AND DISCUSSION

3.1 Problem identification and analysis

The first stage focuses on clarifying the operational problem that motivated the system development. Based on interviews with the Student Affairs unit at Institut Teknologi Telkom Purwokerto, the existing TAK reporting

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process caused many students to submit TAK points only at the final moment—often close to graduation—rather than reporting regularly each semester. This situation was further linked to limited socialization of the TAK process, which reduced student awareness and routine compliance. In practice, the TAK workflow already existed through the IGRACIAS academic information system: students upload TAK, then wait for validation from the academic adviser; after the minimum score is met, the adviser reports to Student Affairs for approval. The challenge was not the absence of a process, but rather weak engagement: students tended to delay reporting because the process felt administrative (not motivating) and because reporting was not embedded into a routine cycle. This research frames gamification as a strategic response to this motivational gap by integrating game elements into a non-game system to encourage desired behavior and make the process more engaging. Therefore, the "problem identification" result is the explicit formulation of a behavioral/operational target: increasing student motivation and regularity in reporting TAK, while preserving the existing institutional validation structure (student → adviser → student affairs).

3.2 Data collection

The second stage concerns the evidence base used to design the system requirements. Data collection combined field research and library research. Field research consisted of interview data, while library research drew from scientific journals and books relevant to the theme; in addition, the Rector's Decree on TAK was used as the formal basis for application design.

A key operational constraint is that TAK minimum scores vary by cohort year and study program, and these minimum thresholds are treated as graduation requirements. This collected "rule base" (minimum score policy and validation path) is essential because it directly shapes the application logic:

(1) the system must track student progress relative to required minimums,
(2) advisers must be able to confirm and escalate qualifying students to Student Affairs, and
(3) students must be able to monitor progress and receive system feedback (notifications, progress indicators, and badge changes).

Accordingly, the output of the data collection stage is not a numerical dataset in the machine-learning sense, but a structured operational understanding: institutional rules (TAK requirements), reporting workflow, role responsibilities, and user pain points that inform the functional scope.

3.3 Data collection

This stage corresponds to the system design outcomes, implemented using UML artifacts and functional specifications. explicitly states that UML was used to design the system based on prior data collection and to model use cases and diagrams, while also analyzing existing TAK features in IGRACIAS.

3.3.1 Actor definition and functional requirements

The system design result begins with actor identification. Admin, Academic Adviser, Student Affairs, and Students, each with distinct functional requirements. The functional requirements can be summarized as follows:

Table 1. Actor and roles

Actor	Key Functional Requiremetns
Admin	Manage master data: students, advisers, student affairs, TAK data, program study, badge data, school year (add/edit/delete where applicable).
Academic Advisor	Manage and confirm student TAK submissions (view/edit/delete/confirm, download evidence), see notifications, and report students who meet minimum scores to Student Affairs.
Student Affairs	Manage/confirm TAK submissions, see TAK and adviser report notifications, and validate adviser reports.
Students	Input TAK, view tutorials, view leaderboard, print pass letter/certificate, receive confirmations and badge notifications, and manage TAK progress (edit/delete unconfirmed items, view/download evidence).

This mapping matters because it preserves institutional governance: students do not "award themselves" points; instead, points are linked to confirmed TAK actions through adviser/student affairs validation, aligning motivational design with administrative accountability.

3.3.2 Use Case Modeling

Use case diagram (Fig. 1) is decomposed into a use-case definition table that enumerates the major functions: login, registration, data management, TAK input, progress management, leaderboard view, printing the pass letter, notifications, tutorial interactions, profile editing, adviser reporting, and student affairs validation.

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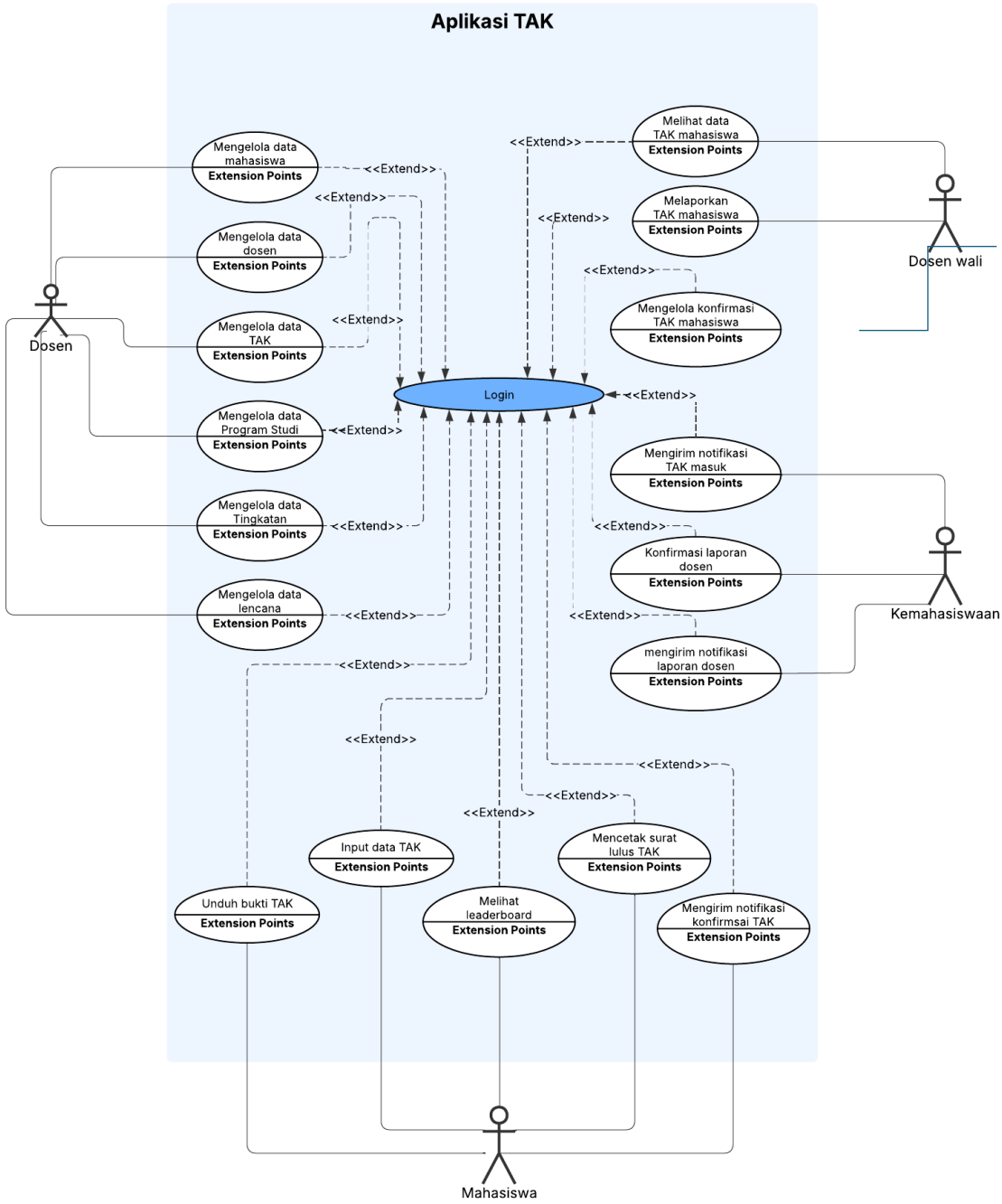

Figure 2. Use Case Diagram

From a design perspective, the use-case list demonstrates two deliberate design properties. First, Role separation: the same "incoming TAK data management" capability is available to advisers and student affairs, but it is applied under different authority scopes. Second, Motivation embedded into workflow: tutorials/tooltips guide first-time users; leaderboards and badge notifications reinforce progress after validated actions.

3.3.3 Class Diagram Modeling

The class diagram result is described as modeling classes and attributes used in system design. class diagram at this stage indicates a structured object/data model supporting the workflows identified above (accounts/roles, TAK entries, evidence files, program-study grouping, school year grouping, and gamification artifacts such as badges/points).

3.4 Gamification Design

Gamification is designed using the MDA framework (Mechanics, Dynamics, Aesthetics), with explicit mapping of game elements into each component.

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3.4.1 Mechanics

This research conducted five mechanic elements: points, leaderboards, badges, tutorials, and tooltips. Points are awarded when an academic adviser or student affairs confirms a student's TAK submission, and the value corresponds to the activities reported. Leaderboards are grouped by school year and program study and display student identity, badge, and total points. Badges represent milestone achievements and are defined by progress thresholds and tutorial completion. Tutorials are specifically for newly registered students as simulations before inputting TAK. Tooltips support students during TAK entry, providing micro-guidance in context.

Table 2. Badge requirements summary

Badge	Requirements	Representation
Tutorial	Students complete the available tutorials	
Bronze	Students managed to get more than 1/3 of the available cumulative TAK points.	
Silver	Students managed to get more than 1/2 of the available cumulative TAK points.	
Gold	Students managed to get more points than the cumulative TAK points available.	

3.4.2 Dynemics

The expected dynamics are explicitly stated: students gain points after validated inputs and can observe competitive standing through the leaderboard. This creates a controlled motivational loop: action (submit TAK) → institutional validation → points awarded → ranking visibility.

3.4.3 Aesthetics

The aesthetic targets are described as sensation and challenge: students experience satisfaction when gaining points and ranking, and they face a structured challenge to complete progress and satisfy graduation requirements. The application supports this with a visible TAK progress feature (Figure 3).

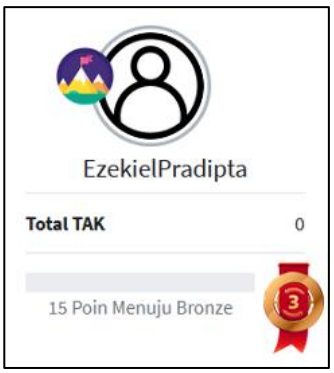

Figure 3. Progress display TAK gamification app

3.5 Product Testing

Product testing uses black-box testing to verify whether each system function works correctly across roles. The tests participants are: one academic adviser, one student affairs user, and 15 student respondents. The black-box test results are reported by role. First, academic adviser functions tested include login, managing student data, incoming TAK data handling, profile change, notifications, and logout. Second, student affairs functions tested include login, incoming TAK data, validation, profile change, notifications, and logout. Third, students were tested on end-to-end flows including registration, login, tutorials and tutorial notifications, TAK input, progress management (proof viewing/downloading/modifying, edit/delete), leaderboard viewing, TAK confirmation notifications, badge change notifications, printing pass letter, profile change, and logout. From these results that all functions operated as expected without visible errors, indicating the system is ready for general use under the tested roles.

3.6 Deployment

The final stage operationalizes the design into a working web application. The implementation is using PHP (version 7.3), MySQL, and the Laravel framework.

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3.6.1 Admin: manage student data

Admin can add/edit/delete student records through a management page as shown in Figure 4, with similar interfaces for managing advisers and student affairs. This supports master-data integrity, which is required for role-based access and accurate grouping (e.g., leaderboards by program and year).

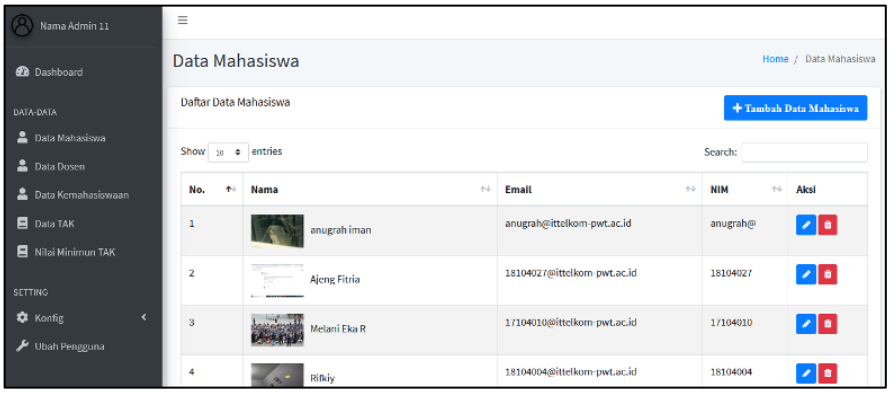

Figure 4. Manage student data (admin) page

3.6.2 Academic adviser: manage student list and confirmed TAK

Advisers can view taught students and their confirmed TAK as shown in Figure 5, and can report students who meet minimum points to student affairs. This implementation detail is critical because it formalizes the institutional validation pathway and prevents the gamification loop from bypassing academic oversight.

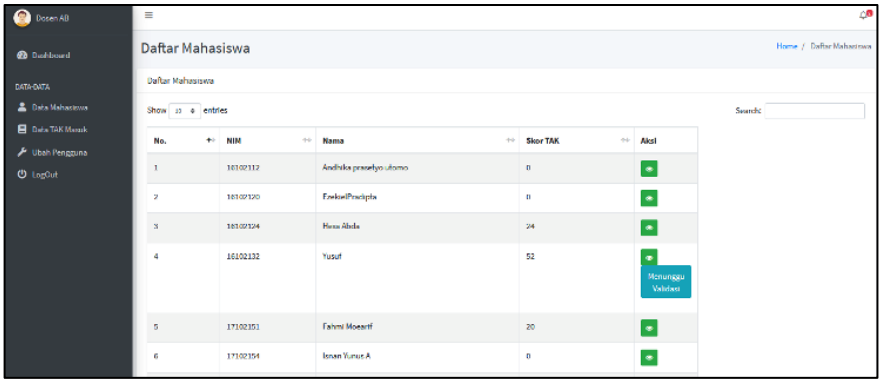

Figure 5. Manage student data (admin) page

3.6.3 Incoming TAK data management (adviser / student affairs)

Both adviser and student affairs can manage incoming TAK as shown in Figure 6: edit/delete/confirm submissions and handle evidence (including downloading). his is the operational “verification gateway” that triggers points awarding (mechanic) and subsequently leaderboard/badge updates (dynamic outcomes).

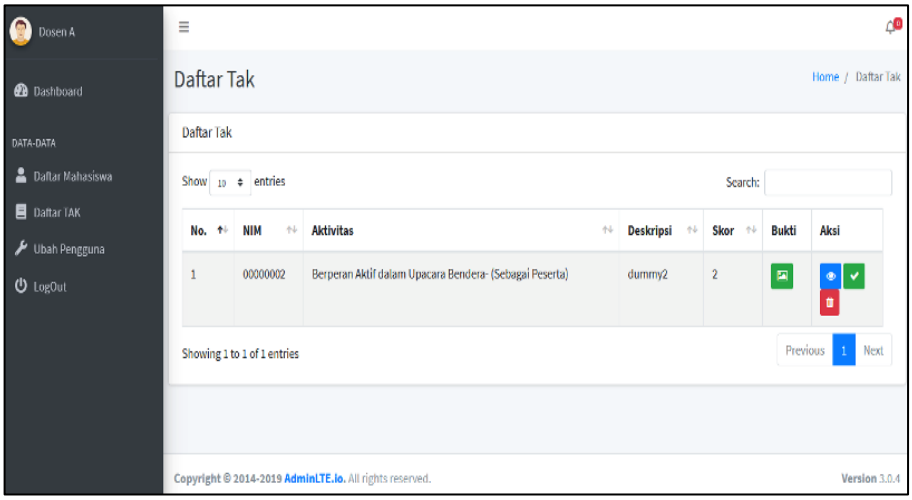

Figure 6. Incoming TAK Page

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3.6.4 Students: manage TAK progress

Students can manage their entered TAK—editing, deleting, and editing evidence—especially for unconfirmed entries, which matches the requirement to manage progress while preserving validation control.

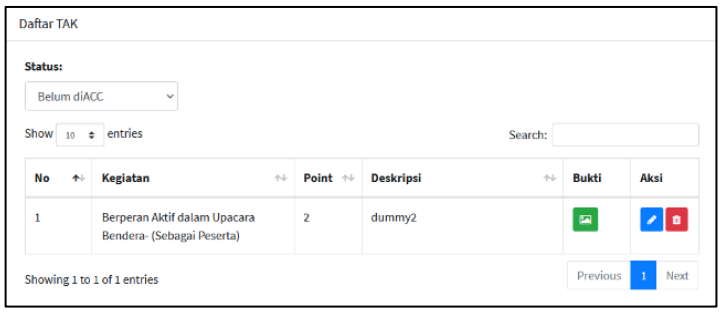

Figure 7. Manage TAK for student

3.6.5 Students: input TAK and tutorial-driven onboarding

The input TAK page supports students entering activities, and it shares features/appearance with the tutorial input page, reinforcing onboarding consistency for newly registered users. This directly supports the "tutorial" mechanic and the need to guide first-time usage.

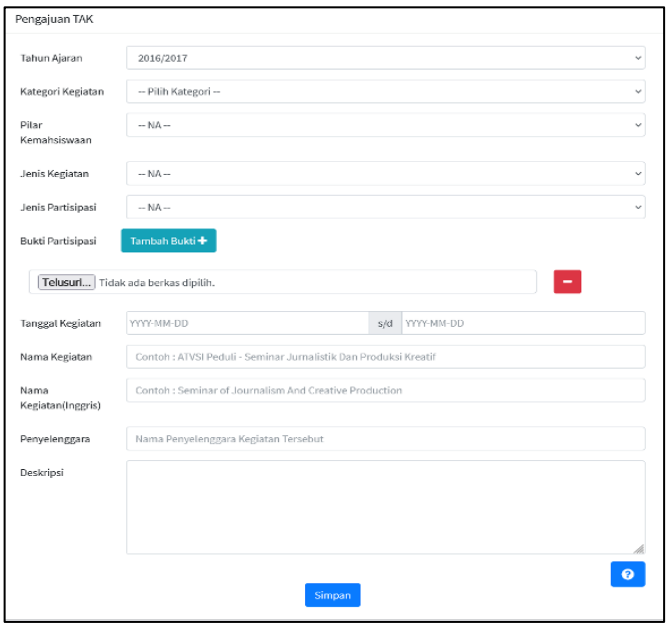

Figure 8. Input TAK for student

3.6.6 Leaderboard display

The leaderboard page provides the visibility layer of competitive feedback and status comparison described in the gamification mechanic/dynamic design.

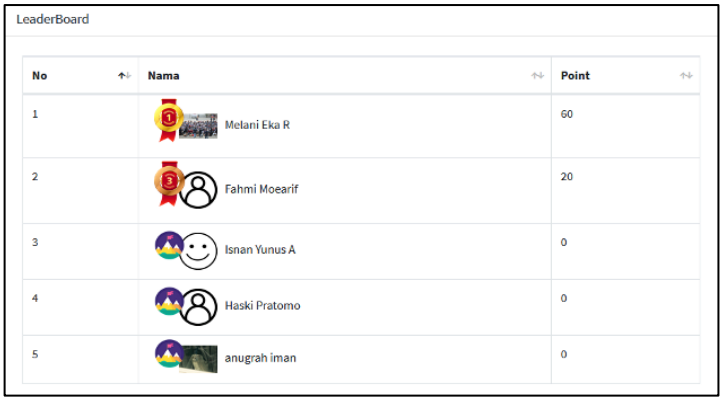

Figure 9. Leaderboard

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3.6.7 Notifications: TAK confirmation and badge change

Two separate notification implementations are described: TAK confirmation notifications and badge change notifications, each readable by students and presented as specific displays. This implementation is materially important for gamification alignment, because notifications operationalize feedback loops: students are informed when their submission has been validated (enabling points) and when their badge status changes (reinforcing achievement milestones).

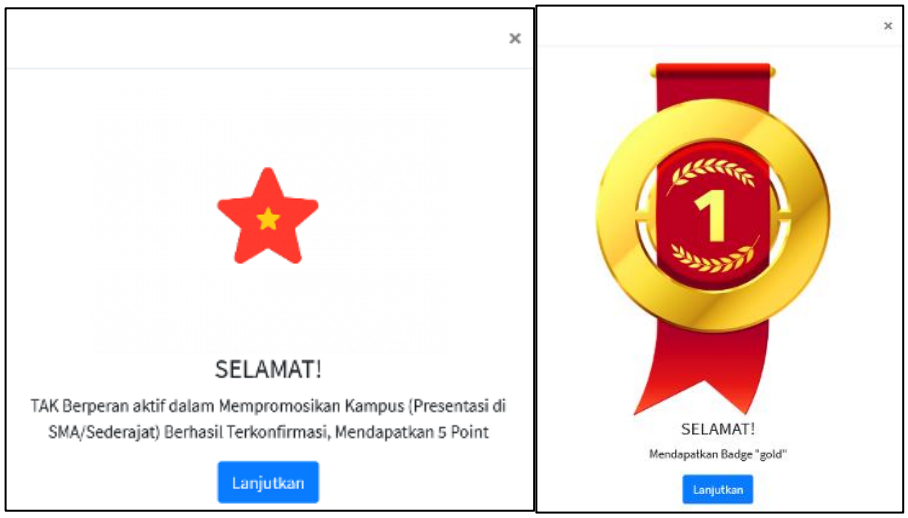

Figure 10. Changing Badge Notification

4. CONCLUSION

This study developed a web-based Student Activity Transcript (TAK) information system with a gamification layer to address low student engagement and delayed TAK reporting. Using an R&D approach, the work began by identifying operational issues in the existing TAK workflow, then collecting institutional rules and stakeholder needs to define system requirements. The product was designed using UML artifacts to ensure clear role separation between students, academic advisers, student affairs staff, and administrators, thereby preserving institutional accountability in TAK verification. Gamification was implemented using the MDA framework by embedding mechanics such as points, badges, leaderboards, tutorials, and tooltips directly within the TAK submission and validation process. These mechanics were structured to produce dynamics of routine reporting and progress-driven participation, while supporting aesthetic goals such as satisfaction, challenge, and clarity of achievement. Functional validation through black-box testing indicated that all core features operated correctly for each actor role, including submission, verification, notifications, progress tracking, and reporting. Overall, the implemented system demonstrates that combining a structured administrative workflow with carefully aligned gamification elements can improve the usability and engagement potential of TAK reporting, while maintaining the integrity of validation and institutional requirements. From research standpoint, the main contribution is a reuseable design and implementation pattern for merging co-curriculat transcript (TAK) workflows with structured gamification (MDA), extending prior activity transcript system and badge based recognition. Future studies can extend this work with eeffectiveness evaluation beyond functional metrics validation.

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