# Bridging the Student and Alumni Gap: A Mobile Ecosystem with Technology Acceptance Analysis for Higher Education

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***Abstract*—This research develops and evaluates a centralized mobile ecosystem that addresses the fragmented communication between students and alumni at a private university in Indonesia, where connections are scattered across informal channels. A pre research survey confirmed the communication gap. The application was built using a Waterfall methodology with Flutter for cross platform mobile, ReactJS for the administrative web portal, and Node.js with MySQL for the backend. Evaluation combined unit testing, functionality testing, User Acceptance Testing, the System Usability Scale, and the Technology Acceptance Model validated through Partial Least Squares Structural Equation Modeling. On a deployment of 48 users, the application achieved a combined System Usability Scale score of 90.06, above the industry baseline of 68, and a 98.93 percent task success rate across 13 evaluators. Four of five hypothesized structural paths were supported, with the model explaining 61.3 percent of behavioral intention. The results indicate that a unified mobile ecosystem can bridge institutional communication gaps and sustain professional interaction.**

***Keywords—mobile ecosystem, technology acceptance model, system usability scale, alumni networking, PLS-SEM***

## I. Introduction

Alumni are a strategic resource for higher education institutions, bridging academia and the professional sector through knowledge transfer, mentorship, and career networking [1]. For students, direct alumni connections provide access to the hidden job market, internships, and referrals that campus career services cannot supply alone, building essential social capital [2], [3].

A private university in Indonesia speculates a communication gap between its students and alumni. Reliance on informal platforms such as WhatsApp, LinkedIn, and Instagram makes information sharing fragmented and reduces the network effects that sustain professional relationships [4]. A pre research survey confirmed the gap: 54.2 percent of respondents reported a weak student and alumni network, 70 percent reported that alumni information was limited, and over half of alumni reported never attending institutional events because announcements never reached them.

This research addresses the gap through a centralized mobile ecosystem unifying students, alumni, the alumni association, and the administration into one verified platform for networking, mentoring, employment, events, and news. The study pursues three objectives: whether the application facilitates connections, whether it achieves acceptable usability, and whether it achieves an acceptable task success rate. Validation uses unit testing, functionality testing, User Acceptance Testing (UAT), the System Usability Scale (SUS), and the Technology Acceptance Model (TAM) evaluated through Partial Least Squares Structural Equation Modelling (PLS-SEM).

## II. Related Works

Five prior studies inform this work, compared in Table I. Mulianawati et al. [5] built an Android application for alumni job services and document legalization at a Catholic university, providing an early institutional model but focusing on a single service category. Belali et al. [6] built a web platform for communication and career development between students and alumni, contributing a centralized interaction architecture that remained web only. Anthal et al. [7] measured student and alumni engagement change within a mobile application but concentrated on measurement rather than the delivery of an integrated system. Rubejes Silva [8] developed an alumni ecosystem focused on usability aligned with the ISO and IEC 25010 standard, emphasizing evaluation over a production grade build. Katwale and Fujo [9] designed a job, mentoring, and event system at a cooperative university through iterative prototyping, although the integration between modules remained partial.

TABLE I. Comparison of Related Works

| Study | Focus | Limitation |
|---|---|---|
| Mulianawati et al. [5] | Alumni job and document services | Single service focus |
| Belali et al. [6] | Communication and career platform | Web only, no mobile |
| Anthal et al. [7] | Engagement measurement | Measurement only |
| Rubejes Silva [8] | Usability evaluation | Evaluation only |
| Katwale and Fujo [9] | Job, mentoring, event system | Partial integration |
| This study | Unified ecosystem with adoption analysis | Beta scope |

The four prior application-based works each addressed an isolated portion of the student and alumni relationship, and the one evaluation-focused work delivered no production system. Against this body of work, the novelty of this study rests on four points.

First, it consolidates five functional areas, namely networking, community and mentoring, employment, news and events, and profile management, within one verified ecosystem. As Table I shows, no prior work covered more than two of these areas, which is precisely the fragmentation this study resolves.

Second, it delivers a production grade implementation across both a Flutter mobile application and a paired ReactJS administrative web portal served by a single Node.js backend. None of the reviewed works delivered both a user facing mobile interface and an institutional governance interface within one architecture.

Third, it validates user adoption through a dual instrument approach combining the System Usability Scale with the Technology Acceptance Model evaluated through PLS-SEM. Four of the five reviewed works applied at most one evaluation instrument, and none reported a structural equation analysis of the adoption mechanism itself.

Fourth, the evaluation is grounded in an authentic institutional context using a sample size calculated from the actual student and alumni population through the Slovin formula, rather than convenience sampling, producing a deployment that exceeds the calculated minimum.

Taken together, these points position the work as a consolidated and empirically validated contribution that advances beyond the isolated, feature-specific contributions of the prior literature.

## III. METHODOLOGY

### A. Development Methodology

The application was developed using the Waterfall methodology, where each phase is completed and validated before the next begins [10], within a fixed sixteen week timeline. The approach was selected over agile alternatives because the project operated with clearly defined institutional stakeholders, where scope clarity and traceability were more valuable than iterative pivoting.

### B. System Architecture

The ecosystem operates on a client server architecture shown in Fig. 1. A cross platform mobile application built with Flutter compiles natively to both Android and iOS from a single Dart codebase and serves students and alumni. A web based administrative portal built with ReactJS serves institutional staff responsible for content moderation and member management. Both communicate with a centralized Node.js backend through REST API services secured with JSON Web Token authentication, and processed data is stored in a MySQL relational database. The separation of concerns allows each layer to scale independently.

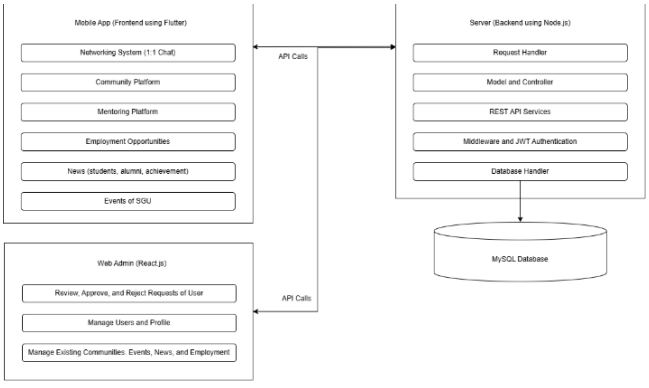



Fig. 1. System architecture of the mobile ecosystem.

### C. Sample Size Determination

The required sample size was determined using the Slovin formula in (1), where n is the required sample size, N is the total population, and e is the margin of error.

$$n = N / (1 + N \cdot e^2) \quad (1)$$

The population comprised 819 recent graduates and 751 active students, producing a total of 1,570. A 15 percent margin of error, appropriate for early-stage beta testing where qualitative feedback takes precedence over exhaustive population representation, yielded a minimum sample of 44. This was segmented into 10 pilot participants for questionnaire validation and a planned 34 for the main analysis. In practice, the application was deployed to 48 participants, providing 38 valid main responses and exceeding both the minimum requirement and the planned allocation.

### D. Data Collection Procedure

The data collection followed a sequenced procedure aligned with the development lifecycle. After the application reached a stable beta release, the User Acceptance Testing phase was initiated with the 13 stakeholder participants. Each participant received a personalized credentials package and a structured task script derived directly from the functional requirements. Participants performed each task independently in their natural device environment, marking each task as successful or unsuccessful. Immediately after the task script, each participant completed the ten item System Usability Scale questionnaire through a structured online form.

Following the User Acceptance Testing phase, the application was opened to a broader population for the Technology Acceptance Model evaluation. The twelve item TAM questionnaire was distributed to the 48 participants who downloaded and used the application during the deployment window. The first ten respondents formed the pilot subset reserved for instrument validation, while the remaining 38 respondents constituted the main analysis sample. All responses were collected on a five-point Likert scale ranging from strongly disagree to strongly agree [14]. Participation was voluntary, and no identifying information was retained beyond the institutional role label of student or alumnus.

### E. System Scope and Functional Requirements

The system implements five functional areas summarized in Table II, modeled through twenty-two use cases across student, alumni, and administrator actors. User generated content created across the networking, community, employment, and news areas flows through a moderation pipeline managed in the administrative portal, where each submission carries a pending, approved, or declined status until reviewed.

TABLE II. FUNCTIONAL REQUIREMENTS MAPPING

| Functional Area | Implemented Capability |
|---|---|
| Networking System | One to one secure messaging |
| Community and Mentoring | Community creation, joining, mentoring |
| Employment | Job posting, browsing, external apply |
| News and Events | Content browsing, registration links |
| Profile | Profile editing, resume, social links |

### F. Evaluation Instruments and Hypotheses

Five instruments were used in combination. Unit testing verified individual components in isolation. Functionality testing exercised end to end workflows. User Acceptance Testing confirmed real world task completion. The System Usability Scale provided a standardized usability score after UAT. The Technology Acceptance Model, administered during deployment, measured behavioral adoption and was validated through PLS-SEM. The five hypothesized structural paths are: H1, Perceived Ease of Use (PEOU) affects Perceived Usefulness (PU); H2, PEOU affects Attitude Toward Use (ATU); H3, PU affects ATU; H4, PU affects Behavioral Intention (BI); and H5, ATU affects BI. A hypothesis is supported when its bootstrapped t statistic is at least 1.96 at p less than 0.05 [11].

## IV. Results and Discussion

### A. System Implementation

The system was implemented across the three architectural layers. The administrative web portal exposes a unified dashboard giving administrators centralized control over members, content submissions, communities, employment listings, events, and news. Pending content is rendered in a review queue supporting approve and decline actions, with status changes propagated to the corresponding mobile views through the shared backend. The member management module supports import, edit, and export operations, with the import workflow accepting batched member records derived from the institution's authoritative rosters. The mobile application delivers an identical experience on Android and iOS, surfacing four primary modules through a bottom navigation pattern: a Home Dashboard aggregating news, events, jobs, and communities; a one to one Networking interface; a Requests dashboard tracking submissions across the moderation lifecycle; and a Profile module covering personal information, resume upload, and professional links. Representative mobile interfaces are shown in Fig. 2.

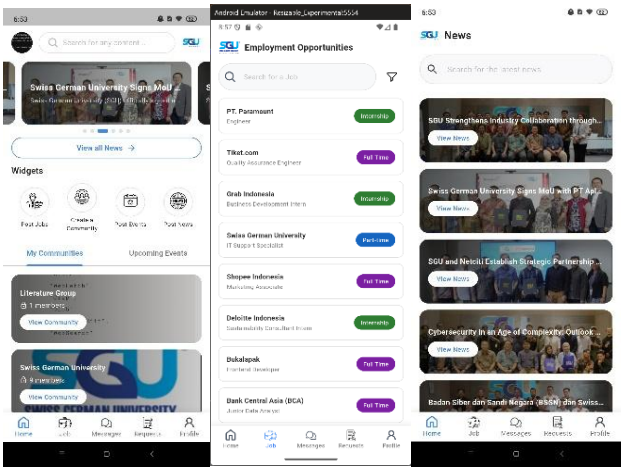



Fig. 2. Mobile application interfaces.

### B. Unit and Functionality Testing

Testing was conducted in two layers and the results are summarized in Table III. The web portal passed all 30 backend unit tests and all 59 end to end functionality tests, while the mobile application passed all 86 unit tests and all 95 end to end functionality tests. The complete pass rate indicates that both platforms operate as designed from the unit level through the workflow level, with no regression defects observed after the testing phase.

TABLE III. Software Testing Summary

| Test Type | Platform | Cases | Pass |
|---|---|---|---|
| Unit | Web | 30 | 100% |
| Unit | Mobile | 86 | 100% |
| Functionality | Web | 59 | 100% |
| Functionality | Mobile | 95 | 100% |

### C. User Acceptance Testing

User Acceptance Testing involved 13 stakeholders, comprising 11 students and alumni evaluating the mobile application and two administrators evaluating the web portal. The results are presented in Table IV. The web portal reached 100 percent across 55 tasks. The mobile application reached 98.93 percent across 51 tasks, with eight of eleven users completing every task and three registering isolated failures in editing a prior submission, locating a user to message, and uploading a resume. Both results exceed the 80 percent threshold defined for the third objective.

TABLE IV. User Acceptance Testing Results

| Platform | Participants | Cases | Success |
|---|---|---|---|
| Web Portal | 2 | 55 | 100% |
| Mobile | 11 | 51 | 98.93% |

### D. System Usability Scale

The System Usability Scale was administered to the same 13 stakeholders. The results are presented in Table V. The web portal scored 91.25 and the mobile application scored 88.86, both within the A grade tier. The combined score of 90.06 exceeds the industry baseline of 68 [12] by 22.06 points and satisfies the second objective requiring a minimum score of 70.

TABLE V. System Usability Scale Results

| Platform | Evaluators | SUS | Grade |
|---|---|---|---|
| Web Portal | 2 | 91.25 | A |
| Mobile | 11 | 88.86 | A |
| Combined | 13 | 90.06 | A |

### E. Technology Acceptance Model Analysis

The application was deployed to 48 participants, yielding 38 valid main responses. The analysis used the pingouin [13] library for reliability and validity and the plspm library for the measurement and structural models, with every statistic independently recomputed in a spreadsheet to confirm correctness.

Reliability was assessed through Cronbach's Alpha, computed in (2), where k is the number of items, the numerator sums item variances, and the denominator is the total score variance.

$$\alpha = \left(\frac{k}{k-1}\right) \cdot \left(1 - \frac{\Sigma \sigma^2_i}{\sigma^2_t}\right) \quad (2)$$

All four constructs met the 0.70 threshold, as shown in Table VI. Validity was assessed through Pearson item total

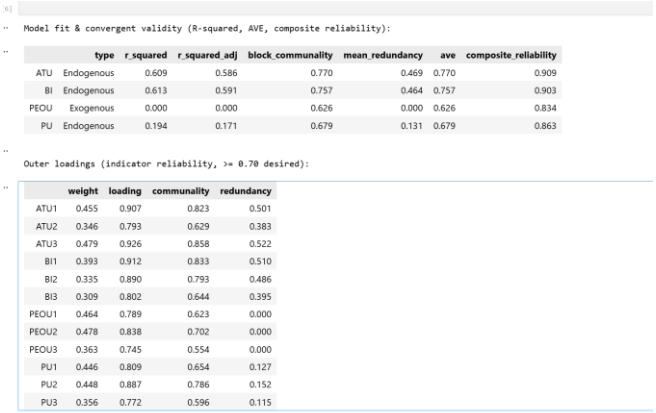
correlation, computed in (3), where n is the number of responses, x is the item score, and y is the total construct score.

$$r = \frac{(n\Sigma xy - \Sigma x\Sigma y)}{\sqrt{([n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2])}} \quad (3)$$

All twelve items scored between 0.507 and 0.779, exceeding the 0.30 threshold, so no items were removed. The measurement model was then assessed through outer loadings, Average Variance Extracted (AVE) computed in (4), and Composite Reliability (CR).

$$AVE = \frac{\Sigma\lambda^2_i}{n} \quad (4)$$

All outer loadings ranged between 0.745 and 0.926, all AVE values between 0.626 and 0.770, and all CR values between 0.834 and 0.909. The consolidated reliability and validity results appear in Table VI. The Python statistical output is shown in Fig. 3.



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Model fit & convergent validity (R-squared, AVE, composite reliability):
```

| | type | r_squared | r_squared_adj | block_communality | mean_redundancy | ave | composite_reliability |
|---|---|---|---|---|---|---|---|
| ATU | Endogenous | 0.609 | 0.586 | 0.770 | 0.469 | 0.770 | 0.909 |
| BI | Endogenous | 0.613 | 0.591 | 0.757 | 0.464 | 0.757 | 0.903 |
| PEOU | Exogenous | 0.000 | 0.000 | 0.626 | 0.000 | 0.626 | 0.834 |
| PU | Endogenous | 0.194 | 0.171 | 0.679 | 0.131 | 0.679 | 0.863 |

```
Outer loadings (indicator reliability, >= 0.70 desired):
```

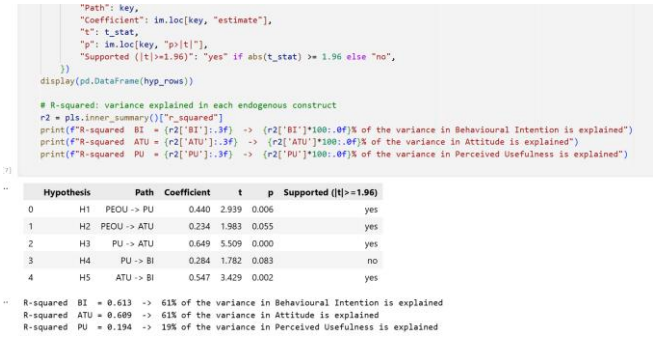
| | weight | loading | communality | redundancy |
|---|---|---|---|---|
| ATU1 | 0.455 | 0.907 | 0.823 | 0.501 |
| ATU2 | 0.346 | 0.793 | 0.629 | 0.383 |
| ATU3 | 0.479 | 0.926 | 0.858 | 0.522 |
| BI1 | 0.393 | 0.912 | 0.833 | 0.510 |
| BI2 | 0.335 | 0.890 | 0.793 | 0.486 |
| BI3 | 0.309 | 0.802 | 0.644 | 0.395 |
| PEOU1 | 0.464 | 0.789 | 0.623 | 0.000 |
| PEOU2 | 0.478 | 0.838 | 0.702 | 0.000 |
| PEOU3 | 0.363 | 0.745 | 0.554 | 0.000 |
| PU1 | 0.446 | 0.809 | 0.654 | 0.127 |
| PU2 | 0.448 | 0.887 | 0.786 | 0.152 |
| PU3 | 0.356 | 0.772 | 0.596 | 0.115 |

Fig. 3. Python statistical output for the measurement model.

TABLE VI. RELIABILITY AND VALIDITY RESULTS

| Construct | Cronbach α | AVE | CR |
|---|---|---|---|
| PEOU | 0.700 | 0.626 | 0.834 |
| PU | 0.762 | 0.679 | 0.863 |
| ATU | 0.848 | 0.770 | 0.909 |
| BI | 0.835 | 0.756 | 0.903 |

The structural model tested the five hypothesized paths. The results are presented in Table VII, and the Python output for the path coefficients, t statistics, and $R^2$ values is shown in Fig. 4.



```
        "Path": key,
        "Coefficient": im.loc[key, "estimate"],
        "t": t_stat,
        "p": im.loc[key, "p>|t|"],
        "Supported (|t|>=1.96)": "yes" if abs(t_stat) >= 1.96 else "no",
    })
display(pd.DataFrame(hyp_rows))

# R-squared: variance explained in each endogenous construct
r2 = pls.inner_summary()["r_squared"]
print(f"R-squared  BI  = {r2['BI']:.3f}  ->  {r2['BI']*100:.0f}% of the variance in Behavioural Intention is explained")
print(f"R-squared  ATU = {r2['ATU']:.3f}  ->  {r2['ATU']*100:.0f}% of the variance in Attitude is explained")
print(f"R-squared  PU  = {r2['PU']:.3f}  ->  {r2['PU']*100:.0f}% of the variance in Perceived Usefulness is explained")
```

| | Hypothesis | Path | Coefficient | t | p | Supported (\|t\|>=1.96) |
|---|---|---|---|---|---|---|
| 0 | H1 | PEOU -> PU | 0.440 | 2.939 | 0.006 | yes |
| 1 | H2 | PEOU -> ATU | 0.234 | 1.983 | 0.055 | yes |
| 2 | H3 | PU -> ATU | 0.649 | 5.509 | 0.000 | yes |
| 3 | H4 | PU -> BI | 0.284 | 1.782 | 0.083 | no |
| 4 | H5 | ATU -> BI | 0.547 | 3.429 | 0.002 | yes |

```
R-squared  BI  = 0.613  ->  61% of the variance in Behavioural Intention is explained
R-squared  ATU = 0.609  ->  61% of the variance in Attitude is explained
R-squared  PU  = 0.194  ->  19% of the variance in Perceived Usefulness is explained
```

Fig. 4. Python output for hypothesis testing and $R^2$ values.

TABLE VII. HYPOTHESIS TESTING RESULTS

| Hyp. | Path | β | t | Decision |
|---|---|---|---|---|
| H1 | PEOU→PU | 0.440 | 2.939 | Supported |
| H2 | PEOU→ATU | 0.234 | 1.983 | Supported |
| H3 | PU→ATU | 0.649 | 5.509 | Supported |
| H4 | PU→BI | 0.285 | 1.787 | Not Supported |
| H5 | ATU→BI | 0.546 | 3.431 | Supported |

Four of the five paths were supported. The strongest relationship is H3 (PU to ATU) with a coefficient of 0.649 and a t statistic of 5.509, indicating that Perceived Usefulness is the primary antecedent of Attitude Toward Use. The second strongest is H5 (ATU to BI) with a coefficient of 0.546. The model explains 61.3 percent of the variance in Behavioral Intention ($R^2 = 0.613$), 60.9 percent of Attitude Toward Use ($R^2 = 0.609$), and 19.4 percent of Perceived Usefulness ($R^2 = 0.194$). The two outcome constructs each exceed the moderate threshold of 0.50 referenced in PLS-SEM literature [11].

### F. Discussion

The structural model produces a finding that diverges from the typical TAM pattern. Perceived Usefulness does not drive Behavioral Intention directly, as H4 was the sole unsupported path. Instead, usefulness shapes attitude through the strongest path H3, and attitude drives intention through H5. The validated adoption pathway therefore flows from Perceived Ease of Use through Perceived Usefulness and Attitude Toward Use to Behavioral Intention. This pattern aligns with the subset of TAM literature where the direct PU to BI path weakens in voluntary, non-workplace contexts. For a university platform, a positive attitude is the mediator through which usefulness translates into continued use, which implies that engagement and community building efforts carry as much weight as the underlying utility of the features.

### G. Limitations

The study is bounded by four limitations. First, the evaluation was conducted within a beta scope before formal institutional release. Second, the sample was drawn from a single institution, which restricts generalizability to other contexts. Third, the deployment captured early adopters rather than the full user population. Fourth, the SUS evaluation involved 13 stakeholders, a small focus group that follows standard UAT practice but limits the precision of the usability estimates.

## V. CONCLUSION AND FUTURE WORK

This research developed and evaluated a centralized mobile ecosystem that addresses the communication gap between students and alumni at a private university in Indonesia. The application achieved a combined System Usability Scale score of 90.06, a task success rate of 98.93 percent, and a validated Technology Acceptance Model explaining 61.3 percent of behavioral intention, satisfying all three objectives. The validated adoption pathway flows from Perceived Ease of Use through Perceived Usefulness and Attitude Toward Use to Behavioral Intention.

The deployed ecosystem establishes a unified networking infrastructure that supports post-graduation employment access, centralizes institutional content, and sustains professional interaction. Future work should address sustained institutional engagement after handover through integration with orientation programs and alumni association events, expansion of artificial intelligence assisted features beyond

profile description generation toward job matching and mentor recommendation, and automated member verification through direct integration with the institution's academic information system.

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