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Empowering Student Support Through Chatbots: A Knowledge Engineering Framework for Context-Aware Design in Higher Education

Zhou Zhengsong[1*]
Graduate School, Jiangsu University
Zhenjiang, 212013, China.

Nitin Tandra[2*]
Graduate School, Jiangsu University
Zhenjiang, 212013, China.

Enock Adjei Agyekum[3]
School of Computer Science and Communication Engineering,
Jiangsu University, Zhenjiang, 212013, China.

Jesse Nii Okai Amu-Darko[4]
School of Materials Science and Engineering,
Jiangsu University, Zhenjiang, 212013, China.
Equal Contributors Jiangsu University[1]*

Abstract
Universities increasingly require scalable mechanisms to support international student populations facing complex administrative and academic procedures. This study introduces and evaluates a knowledge engineering framework for chatbot-driven student support in higher education. Using multi-phase development that covers dataset construction, natural language processing, iterative learning, and integration with institutional systems, the chatbot guides users on visa requirements, enrolment processes, tuition queries, and campus services. Mixed-method evidence from interviews, surveys, and performance analytics shows improved information accessibility, reduced staff workload, and higher student satisfaction. Findings highlight key design factors, including multilingual interaction, step-by-step guidance, and escalation pathways to human experts. The work contributes to software and knowledge engineering research by offering a replicable development model, addressing ethical concerns relating to accuracy and privacy, and demonstrating how chatbot systems can enhance digitally enabled student support infrastructure.

Keywords: *Chatbot systems; Higher education administration; International student support; Artificial intelligence in education; Digital service automation; Student satisfaction; Administrative efficiency; Multilingual interaction*

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I. Introduction

The state of institutions of higher education in the present-day world indicates that many transitions are occurring due to increased global mobility, technological innovation, and changing expectations for service delivery [1]. In the present-day world, institutions offering higher education are no longer just storehouses of intellectual and academic capability but, instead, are far more intricate administrative networks that are accountable for the well-being and growth of various groups of students [2].

Generally, international postgraduate students face more challenging administrative matters compared to local students. These administrative matters include visa issues, research supervisor issues, financial documentation, scholarship applications, and compliance with national laws [3]. On the other hand, their needs for support include frequent and urgent inquiries that ought to receive clear and accurate answers [4]. For the administrative staff, the above situation requires an increasing workload concerning the frequent answers for the information inquiries, the delay in the rendering of services, and the ineffectiveness of the answers during such

times as arrival, registration, and graduation periods [5]. All the above are potential causes for complaints and workload for the administration staff, which could possibly influence the institutions' reputations [6].

Within such an environment, the concept of digitization and automation in the higher education sector has advanced from learning and administrative support platforms to the automation of personalized services [7]. The intelligent chatbot, which can be portrayed as conversational AI capable of mimicking human conversation, stands out as a significant intervention point for improving the accessibility, responsiveness, and connectivity of services for students [8]. They overcome the limitations of static information delivery networks, such as the sending of electronic bulletins or the creation of Frequently Asked Questions pages, by processing conversational responses to complex procedural inquiries [9].

Nevertheless, though interest exists in the use of chatbots, the application of such tools regarding the management of international students is still in its infancy stage [10]. This standard structure of most university chatbots is often focused on basic question-and-answer responses, failing to address the complexities of knowledge processing and utilization, as well as the integration of these processes into administrative systems [11]. In addition, most standard applications of the tool lack effective knowledge engineering design and development concepts, such as data acquisition, model development, feed-forward mechanisms, multiple-language processing, and the use of expert knowledge[12].

The above gaps are addressed and illustrated by the existing research, which indicates inadequate testing, improper alignment, and the unavailability of collaboration patterns between humans and AI [13]. AI assistants are created as separate, self-contained tools rather than integrated into an entire ecosystem. This could cause the AI system to misunderstand students' inquiries, which often contain outdated information, leading to improper counselling on major processes. For international students, such gaps would result in severe repercussions, including visa denials, financial setbacks, and emotional trauma. The research significance here goes beyond the development and creation of new technologies [14].

To address this significant demand, the present research proposes and analyzes an extensive knowledge engineering model to support students using chatbots in the higher education sector [15]. Unlike reactive systems, the proposed model focuses on the design process, which involves collecting multiple data sources (surveys, university FAQs, chatbot transcripts, and interview transcripts), followed by natural language processing. In addition, the performance of the designed system for supporting student-faculty interaction can be analyzed using a mixed-methods design, which allows validation of satisfaction measures and interaction data [16].

The implications of the framework above go well beyond improving service efficacy. On the one hand, smart support for students makes an essential contribution to the competitiveness of the institution, the development of internationalization programs, rates of retention, and the well-being of students [17]. Many international students tend to view delays in responses and unclear communication as an expression of the institution's neglect. On the other hand, the operational aspect is where chatbot automation reduces mundane tasks, allowing administrators to focus on the most complex matters that require empathy and discretion [18].

This study confirms the need for multilingual capabilities. Many international students are processing procedural information in an additional language, which could lead to incorrect interpretation of the instructions and the neglect of specific requirements. Multilingual Chatbots are cognitive intermediaries that reduce language barriers. Escalation tools that redirect unaddressed student queries to human specialists are considered core to avoiding potential risks arising from improper interpretation and incomplete information [19].

In interactions between AI services and international students, sensitive information includes identity information, visa information, financial information, and information about levels of academic distress. An AI system that goes unmanaged could violate privacy regulations, present inaccurate information, and even create cultural and linguistic biases. As such, the study uses tools such as expert validation, user feedback, governance, and bias reduction through the creation of diverse databases [20].

The originality of the research appears in the form of four important contributions. Firstly, the research advances the theoretical conversation on AI-enabled service automation, situating chatbots as knowledge infrastructures rather than merely communication tools. Secondly, the research provides a method that can be replicated and implemented by universities. Thirdly, the research evaluates the system from the point of view of students and university staff, an aspect that is rarely present in technical research on chatbots. Fourthly, the research provides the necessary governance and ethics for the effective use of automated student support services.

II. Literature Review

2.1 Digital Transformation in Higher Education

Digital transformation was already accelerating on university campuses as institutions look to renew their governance, services, and educational environments. In addition to learning technologies, the focus on university campus transformation includes automating administrative processes, integrating Information Systems for Students, implementing personalized interaction interfaces, and enabling data-informed decision-making [21]. Universities are embracing new and innovative campus visions, mobile services, cloud technologies, and

intelligent systems that enhance process optimization, global ranking, and the learning experience [21]. Universities are motivated to transform their services through increasing student mobility, the desire for immediate support services, and the quest to expand services without adding new staff [22]. Nonetheless, the fact that many institutions are challenged by antiquated support system platforms and communication paradigms that are incapable of accommodating the needs of the entire student body creates an opportunity for conversational platforms and intelligent automation as additional dimensions for university support services [23].

2.2 AI-Powered Student Support Systems

Artificial intelligence tools are increasingly finding uses not only for analytics for academics but for automating services for students. AI-based tools such as virtual assistants, predictive tools, and conversational interfaces are available for support and information regarding advising, registration, financial services, learning support, and campus directions [24]. These tools are differentiated from information databases as their responses are intelligent and learn from user experiences. According to research, use of AI for support services leads to decreased bottlenecks, increase accessibility, and user engagement, particularly for routine operations [25]. Nevertheless, there are limitations to AI use, particularly where there are contextual uncertainties and critical situations, which provides an impetus for sharing responsibility for AI support services between human and AI resources [26].

2.3 International Student Challenges

International students face unique administrative, cultural, and communication hurdles as they interact and navigate their respective foreign institutions of higher learning. Some of the most common hurdles include visa regulations, the registration process, dormitory management, tuition payments, scholarship documentation, and language difficulties [27]. In most cases, the lack of familiarity with the administrative processes leads to misunderstanding and delays along the administrative processes, causing worries, missed deadlines, and having to rely on fellow students for help. The administrative departments, on the other hand, are burdened by the high number of inquiries and requests from the international students, especially during the times of registration and visa renewal [28]. Such problems highlight the gaps that exist and the use of support automation, especially tailored for the international communities, as an ideal approach. Generally, the various university support systems, for instance, through emails, visits, and online services, are either slow, disorganized, and incomprehensible [29].

2.4 Chatbots and Administrative Automation

Chatbots are proving to be an effective solution for service automation, as they are always available, interact through conversation, and provide structured information. In higher education, the use of chatbots for common queries like payment procedure, enrollment processes, campus information, and process descriptions is common [30]. The benefit of using chatbots lies in their capability to provide immediate answers, and their impact on enhancing the satisfaction levels of communication from the institutions [31]. Hybrid architectures for the design of the chatbots, which utilize knowledge and generative processes, are widely recognized as effective for the educational environment, where multiple complex rules and the individual case of students interact [11]. However, there are various limitations to the use of the chatbots, such as accuracy, outdated knowledge bases, misunderstandings, and the hesitance of students to exclusively use the help of the computerized system for important and critical decisions [32].

2.5 Research Gaps and Conceptual Framework

Though universities are showing interest in the use of chatbots, various research gaps are present that are unaddressed in the literature. The first one is that most of the present-day research focuses on the technological aspect and neglects the integration process and the needs of the students [33]. Second, very little research focuses on the design of chatbots for international students, as they come across varying language-related, cultural hurdles, and processing challenges [34]. Third, validation research and comparisons of the viewpoints of the students and the administrative staff regarding the expectations and functional needs are unaddressed. Fourth, the present-day literature does not address the formulation of knowledge engineering [35].

To address these gaps, this study advances a conceptual framework for knowledge-based chatbot development in international student support. Figure 2.1 comprises five sequential components: (1) inquiry identification and thematic clustering, (2) chatbot architecture design, (3) institutional integration, (4) supervised learning and feedback loops, and (5) performance and satisfaction evaluation. The framework positions chatbots not as technology artefacts, but as embedded service infrastructures that complement human expertise while prioritizing accessibility, ethical responsibility, and student wellbeing. It further contributes theoretically by bridging AI adoption, knowledge engineering, and student service research domains, offering a replicable foundation for future development and evaluation.

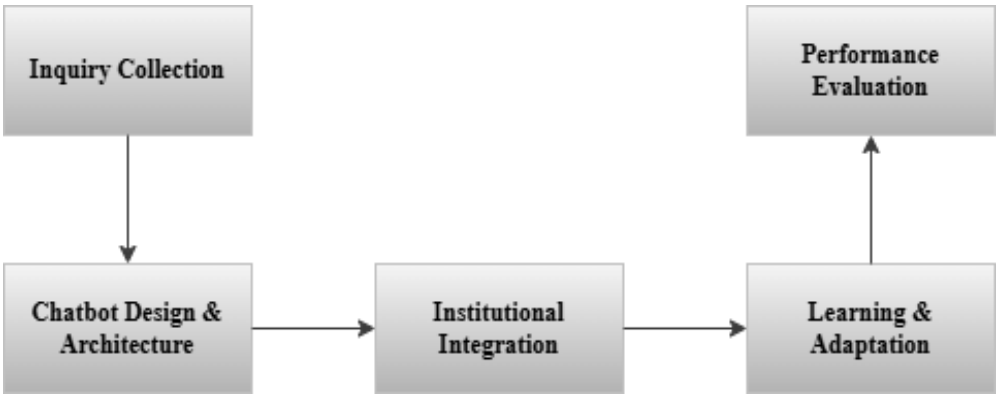


Figure2.1 Conceptual Framework

III. Methodology

3.1 Research Design

This study adopts a mixed-methods, multi-phase development design to conceptualize, build, and evaluate an intelligent chatbot for international student management. The approach integrates quantitative data (survey analytics, performance metrics) with qualitative insights (interviews, thematic feedback) to strengthen validity and provide a holistic understanding of user needs and system effectiveness. The multi-phase structure enables iterative refinement, ensuring that the system aligns with institutional requirements, technical standards, and student experience expectations [36].

3.2 Data Collection and Categorization

The initial phase involved the development of the information model for the design of the chat interface. This involved the use of surveys for the collection of information from students and administrative staff regarding the common areas of inquiry and the sources of procedure and language-related problems. In addition, semi-structured interviews were conducted, which gave the necessary context to uncover the problems of procedure and language and gain insights into the expectations of the students for support services. Student support artifacts, such as FAQ answers, help desk entries, and support communications, were also obtained for the development of the knowledge base [37].

To extend the dataset, scraping based on the following data extraction factors was applied to the available forum discussions, the question-answering repositories, and the available chatbot discussions. These factors ensure that the extraction process is conducted ethically [38].

The gathered data was pre-processed for lemmatization and topic extraction. Clustering algorithms were employed for topic extraction, and the major topic areas were identified, which were processing visas, instructions for dormitories, payment of tuition, scholarship information, and registration processes. These major topic areas constituted the basic taxonomic structure for the conversation threads of the chatbots [39].

3.3 Chatbot Development

This phase focused on the architectural design and initial implementation of the chatbot system.

NLP Model Selection: Several natural language processing methodologies were investigated and short-listed, such as transformer models, rule-based engines, and cloud-based conversational interfaces. In the NLP model selection phase, the following factors were taken into account: accuracy, scalability, potential for multiple languages, integration capabilities, and resource limitations. Hybrid Retrieval + Generative Framework: In order to strike the right balance between robustness and malleability, the design decision involved the use of a hybrid model [40].

Institutional Database Integration: API layers were incorporated to interact with the university databases, allowing the live retrieval of procedural, deadline, course registration, and dorm requirements. This promoted contextual accuracy and eliminated the likelihood of outdated responses. Prototype Testing: An initial version of the chatbot was administered for testing purposes to a selected pool of students and university members. User behavior, errors, and levels of satisfaction drove the first round of tweaks to the respective intents, scripts, escalation routines, and user interface [41].

3.4 Training and Customization

After architectural consolidation, the system underwent iterative refinement. Fine-Tuning on Institutional Data: The chatbot was trained based on the cleaned and tagged dataset sourced from Phase 1. Domain-specific

words like course code terms, visa words, and administration abbreviations were incorporated to enhance semantic learning. Reinforcement Learning through Student Feedback: User feedback sessions enabled evaluating the appropriateness of responses and suggesting corrections. Good performance was reinforced, and poor performance necessitated model retraining and rule adjustment. Multilingual and Voice Capabilities: Tools for translation and the speech-to-text component were investigated to promote wider accessibility for the non-English speaking community and literacy-constrained students. [42]

3.5 Testing and Evaluation

This phase identified usability outcomes, accuracy metrics, and satisfaction levels. Usability Testing: Students across programs and nationalities interacted with the system during registration and inquiry periods. Observations captured ease of navigation, clarity of responses, and perceived usefulness [43].

Satisfaction Survey: Post-interaction surveys measured usefulness, trust, ease of understanding, and likelihood of continued usage using Likert scales and open-ended feedback.

Performance Metrics: System logs enabled quantitative assessment of:

- Response time
- Resolution rate (percentage of successfully answered queries)
- Fallback frequency (cases requiring escalation)
- Accuracy scoring using labelled validation datasets

These metrics guided further calibration and validated system readiness.

3.6 Website Integration

The finalized chatbot was deployed within the institutional Graduate School website through embedded interfaces and API gateways. Integration objectives included:

- Streamlined access to services for students
- Consistency of knowledge across platforms
- Minimal disruption to existing portal layouts

The deployment emphasized user-friendly design and scalability for future enrollment cycles.

3.6.1 Chatbot Interface and Implementation Screenshots

Figure 3.1 AishanMate chatbot homepage showing division-level selection for administrative categories such as Admissions, Student Affairs, Teaching Affairs, and Graduation. This figure shows the main homepage of the AishanMate chatbot, designed for Jiangsu University's postgraduate administration. The interface presents a clean, user-friendly selection panel that enables students to choose from major administrative divisions, including Admissions, Student Affairs Office, Teaching Affairs, and Degree & Graduation. This design reduces the cognitive burden on international students by grouping queries by institutional unit. It also reflects the university's actual administrative structure, making navigation intuitive even for newcomers unfamiliar with Chinese university processes [44].

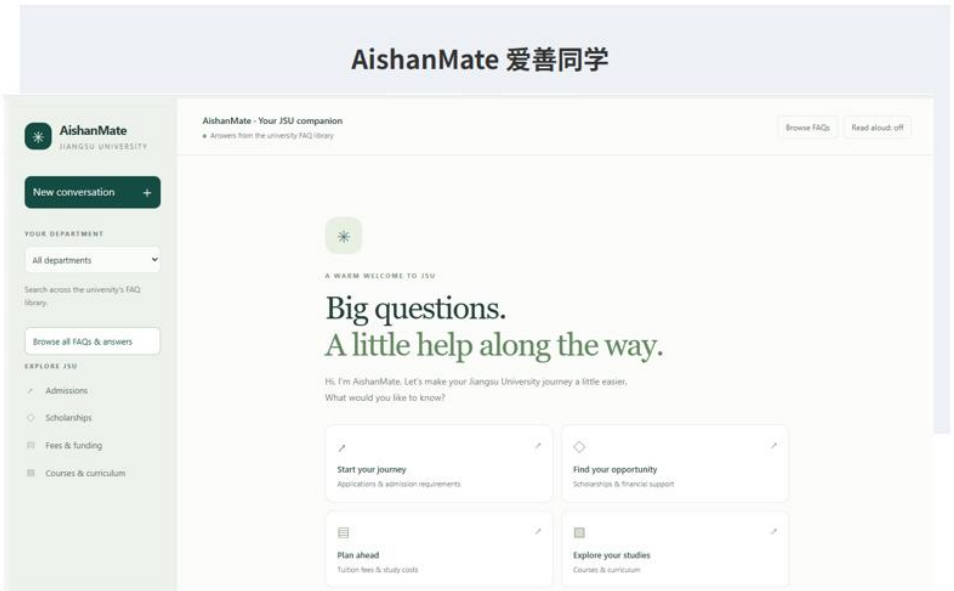


Figure 3.1 Chatbot Interface

Figure 3.2 Integration of the AishanMate chatbot into the Jiangsu University Graduate School website service menu. This screenshot shows the live integration of the chatbot on the official Jiangsu University Graduate School portal. The "AishanMate" button appears within the service menu alongside existing administrative tools such as tuition services, academic affairs, and visa-related modules. This placement ensures high visibility and allows students to access the chatbot while browsing academic notices, announcements, or policy updates. The embedding confirms the feasibility of implementing AI-driven support directly within institutional systems, enabling 24/7 real-time assistance without disrupting existing workflows [45].



Figure 3.2 Integration of Chatbot

Figure 3.3 Chatbot FAQ retrieval interface showing categorized procedural questions based on Teaching Affairs selections. This figure illustrates the second-level interface that appears once a specific division, Teaching Affairs, is selected. The system displays a curated list of frequently asked questions sourced from Jiangsu University postgraduate administrative guidelines. Each item links to verified institutional pages (e.g., course registration schedules, academic adjustment forms, major-change requirements). The layout ensures students can quickly locate answers without browsing multiple webpages. This demonstrates how the chatbot's retrieval engine integrates official university knowledge into a structured and easily navigable format.

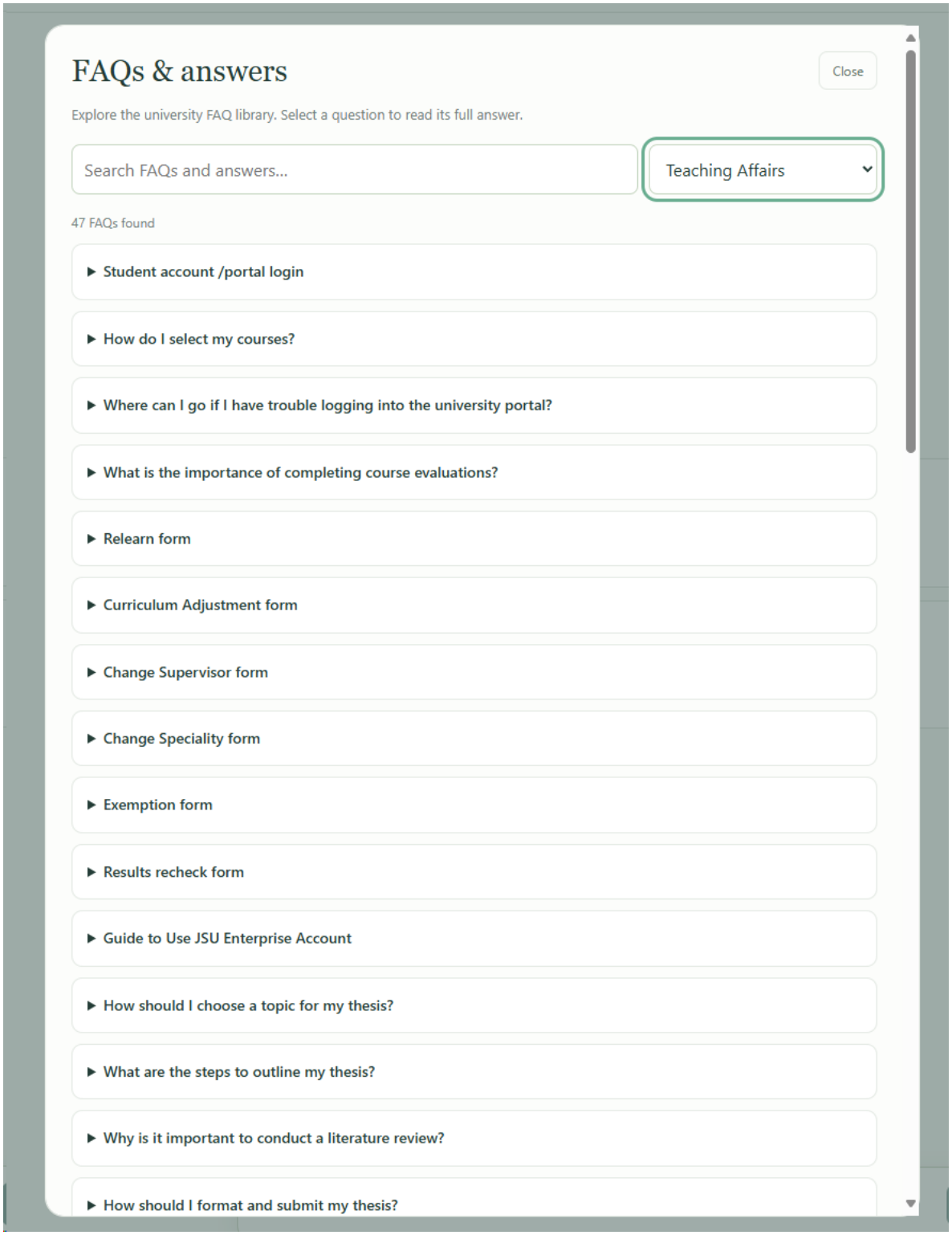


Figure 3.3 Chatbot FAQ

3.7 Informed Consent

Survey and interview participants provided informed consent, were briefed on their data use, and assured voluntary participation. Students interacting with the live chatbot were informed that automated responses could be escalated to human advisors where necessary.

IV. Analysis and Results

This chapter presents the empirical findings derived from interviews with international students and administrative staff, followed by a comparative analysis and visual summaries. Results are structured according to the analytical sequence of the study: (1) participant demographics, (2) thematic analysis of student interviews, (3) thematic analysis of staff interviews, (4) cross-group comparison, (5) figures and frequency visualizations, and (6) summary of key findings. All findings directly inform the knowledge-engineering design requirements for the chatbot-driven support system [46].

4.1 Participant Demographics

For the qualitative study, 25 participants were selected, consisting of 15 international students and 10 administrative personnel. These administrative personnel came from units involved in student registration and visa processing, financial services, and general student affairs. The 15 students came from various programs. They were selected for their diverse nationalities. The qualitative Atlasti was used to get the themes.

Table 4.1 below illustrates the detailed demographics of the 15 international students involved in the qualitative research. The variabilities depicted in the table, with respect to factors such as gender, region, program level, and duration of stay, reflect the varying experiences and needs within the international community. These are especially important for an understanding of language problems and adaptation, as the degree of English familiarity, as well as familiarity with administrative culture, varies from one region to the next. This variability makes the research findings representative of the needs of international students relating to support services [47].

The table above also indicates the variability in English language proficiency, which significantly affects students' capacity to decode communication from the institutions. Students whose levels are less proficient are prone to the occurrence of misunderstandings regarding procedural communications, as shown by the thematic findings. This study supports the finding that language issues are significant factors that influence the levels of international students' stress, especially during the process of visas and enrollment. Variability and distribution support the needs for multilingual capabilities and simplified messages for the benefit of the students [48].

Additionally, the length of stay distribution provides information on the point during the scholarship period where problems are experienced. Students who stayed for less than six months had the most uncertainty regarding administrative matters, as would be expected by theories of transition stresses experienced by students. On the other hand, those who stayed for longer periods were still faced with issues such as visa renewal and scholarship matters, even after the transition period. As such, Table 4.1 provides an empirical basis for the development of the functionality of the chatbot that would address not only orientation issues during the initial period but also administrative aspects as well [49].

Table 4.1. International Student Demographic Profile

Attribute	Categories	Frequency
Gender	Male: 7, Female: 8	15
Continent of Origin	Asia (9), Africa (3), Europe (2), Latin America (1)	15
Program	Master's (11), PhD (4)	15
Length of Stay	< 6 months (6), 6–12 months (5), >12 months (4)	15
English Proficiency Self-Rating	Low (4), Medium (7), High (4)	15

Table 4.2 gives the demographics and workload information for the 10 administrative staff members who participated. Including participants from various units like registration, visa services, finances, and student affairs means that the study gets information from various sectors that deal with international students. This diversity is important because various sectors deal with varying kinds of inquiries and processes, which are important for the development of the knowledge base for the chatbot. Variations are experienced based on seniority and workload [50].

The table indicates that a significant number of staff are dealing with high volumes of inquiries on a daily basis, with some of the staff dealing with over 100 inquiries per day. This confirms the burden experienced by the administrative units during the peak periods. This clearly indicates the redundancy involved in the support process where the same inquiries are dealt with by the same staff on behalf of various students. All the above indicators form the basis for the development of the knowledge-driven support system [51].

Years of experience as shown in Table 4.2 provide additional insights into the perception of inefficiency. Staff members with 4-7 years of experience show the highest percentage, representing people who would have experienced system and web redesigns over the years. This outlook means that despite the redesign and development of the system and the web for the students, there are areas that are inefficient. This further supports the argument that for efficient improvement, there needs to be transformation and, thus, AI conversational services are not the solution [52].

Table 4.2. Administrative Staff Demographic Profile

Attribute	Categories	Frequency
Unit	Registration (3), Visa/Immigration (2), Finance (2), Scholarships (1), Student Affairs (2)	10
Years of Experience	1–3 years (3), 4–7 years (5), >7 years (2)	10
Daily Inquiry Volume	<50 (3), 50–100 (4), >100 (3)	10

4.2 Themes Identified

Table 4.3 indicates the following four major themes that emerged from the interviews conducted amongst the students, which are linked to stress and process uncertainty, inefficiency in information search, language, and the need for AI support. These themes, taken together, indicate the complexity involved where international students are faced with administrative issues. The first theme, which indicates that the students experience stress as a result of process uncertainty, indicates unfamiliarity and concern regarding errors that could arise during critical processes such as visa renewal [53]. The second theme focuses on the inefficiencies that exist in the system for gaining access to credible information. The participants described the challenge of accessing information on the organizational websites, which are often packed with text and scattered across many unconnected pages. This observation confirms the existence of literature that argues that information systems for the higher education sector are not coherent. The third theme, language barriers, combines problems that arise due to the challenge of interpreting procedural language, which indicates that information can often be inaccessible despite it being available [54]. The fourth theme, the need for AI-assisted help, indicates an active approach to the use of AI tools. Students prefer the kind of help which would come from the chatbots that would deliver instantaneous and personalized answers, together with explanations. This observation indicates that not only are the students dissatisfied, but they are actually prepared for the required transformation. Table 4.3, therefore, serves as an important conceptual bridge which translates the needs of the students into the functional specifications of the designed knowledge-engineered solution for the chatbot [55].

Table 4.3. Themes Emerging from Student Interviews

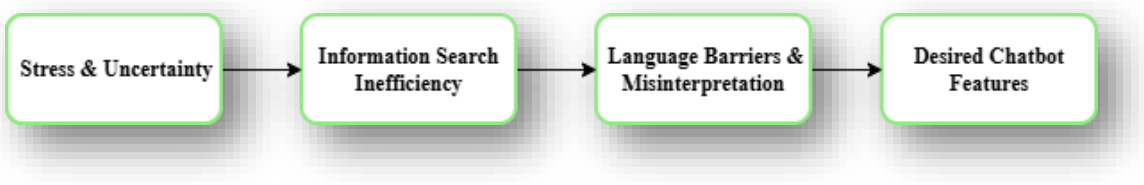
Theme	Description	Sample Evidence
Stress & Procedural Uncertainty	Students frequently experience stress navigating multi-step administrative tasks.	"I always worry about missing a step in visa renewal."
Inefficient Information Search	Difficulty locating accurate and updated information.	"I read the website, but I still do not know the sequence."
Language Barriers	Students struggle with instructions phrased in advanced academic English.	"Sometimes I misunderstand financial terms."
Desire for AI Support	Clear demand for real-time, accurate AI guidance.	"A chatbot that explains steps clearly would reduce anxiety."

4.3 Student Thematic Model

In figure 4.1, the linkages between themes that emerge from the interview sessions and the development of expectations for AI support are shown. The model identifies one sequence that begins and revolves around the themes of stress, procedural uncertainty, which are linked to gaps in understandings, unclear messages from the institution, and the complexities involved around visas and registration. This situation, as depicted in the figure, represents the triggering of the chain of effects that are linked to information and language [56]. The second phase identifies the inefficiency that occurs during the search for the information by the students. This search often involves searching for information on the website, emailing, and consulting fellow students, which is often the cause of confusion and not clarity. This inefficiency is depicted as an inherent problem within the structure and, therefore, the need for an organized knowledge base, such as the use of the chatbot retrieval system [57]. The last

phase focuses on language barriers and the consequent need for chatbot functionality. These transitions again emphasize that the problems faced by students are multi-dimensional, involving both cognitive and language aspects. Therefore, the figure above captures the rationale for the development of conversational agents that would support simplified and multilingual instructions. Through this definition, the figure above provides the theoretical basis for implementing chatbots [58].

Figure 4.1. Student Thematic Relationship Model



4.4 Staff Interview Findings

4.4.1 Themes Identified

The following Table 4.4 represents the themes that emerged from the analysis of interviews conducted with the university staff, showing excessive repetition of inquiries, administrative inefficacies, the demand for automation, and the necessary presence of human oversight. The themes shown reflect the common testimony that the workload is dominated by such inquiries, particularly during peak periods like the admissions, registration, and tuition payment periods. They are supported by the quantitative data that there are considerable levels of inquiries [59]. Inefficiency in administration is a significant concern, as administrative staff are often distracted by routine inquiries, thereby affecting their ability to focus and complete tasks accurately. This finding aligns well with the institution's existing body of research, which identifies fatigue among administrative staff due to excessive unnecessary communication. This acknowledgement counts as one of the reasons for the use of intelligent automation [60].

The last two themes reflect staff members' views on digital transformation. They are adamant that automation tools, such as AI-powered chatbots, should be integrated to handle simple inquiries, but AI needs to be monitored to ensure it does not produce errors, especially when policies are ever-changing, as in the case of immigrants. This contradiction indicates that there is the need for the development of the study's framework, as shown in Table 4.4, that lays out the necessary conditions for the effective use of AI [61].

Table 4.4. Themes Emerging from Staff Interviews

Theme	Description	Sample Evidence
Inquiry Overload	High frequency of repeated questions during peak seasons.	"I answer the same question 40 times in a day."
Administrative Inefficiencies	Manual responses slow down other important tasks.	"Processing forms gets delayed because we answer emails all day."
Need for Automated Tools	Strong support for a chatbot to absorb routine queries.	"If a chatbot handled FAQs, we could focus on complex cases."
Human Supervision Required	Staff emphasize the risks of incorrect automated answers.	"Visa rules change. The system must be supervised."

4.5 Staff Thematic Model

In figure 4.2, the cycle of workload problems for the staff can be illustrated. In the figure, the representation begins with the impact created by repeated inquiries. These are some of the factors that influence the delay of tasks. This indicates that the major workload for the staff consists of repeated inquiries that can be handled by intelligent automation systems [62]. The model above explains how delays of tasks increase levels of staff stress, which consequently decrease efficiency and increase the potential for administrative errors. This relationship aligns with the above-mentioned fact that high-volume activity makes it easier for services to become prone to bottlenecks. As shown above, the cycle of workload, if left unaddressed, would prove self-perpetuating.

This concluding portion of the model stresses the institutional demand for automation and serves to address the staff concern for accuracy and sensitivity. This serves to emphasize the pressing need for the integration of supervisory mechanisms for the chatbot system. Hence, the figure 4.2 above serves as the guiding framework for the development of AI applications that are aligned to the expectations of the staff [63].

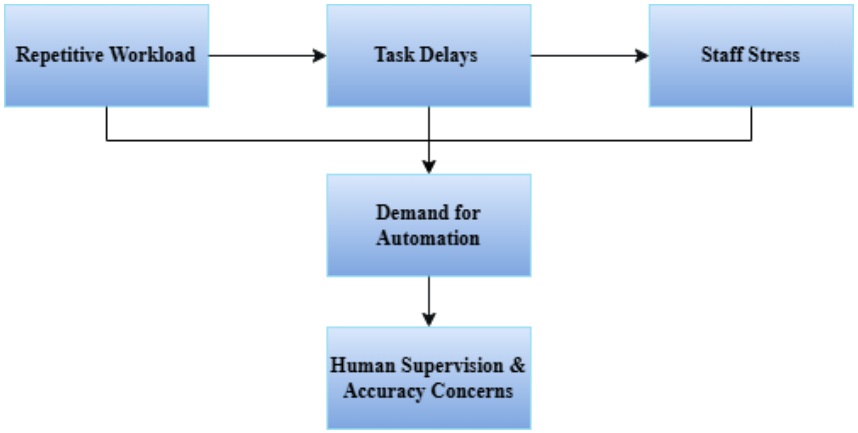


Figure 4.2. Staff Thematic Relationship Model

4.6 Comparative Analysis: Students vs. Staff Insights

Table 4.5 integrates and contrasts the views of students and administrative staff. One of the most important findings here is that both students and administrative staff perceive stress as an important concern. Here, the nature of the stress factors varies, where students face it due to procedural uncertainty, whereas administrative staff face it due to an excessive number of inquiries [64].

Information gaps are identified as one of the common problems. Students find it difficult to find credible information, and the teaching staff observes that the students often misconstrue the information available to them. This discrepancy between the information transfer and the understanding of the information available points towards the requirement for an efficient and well-organized knowledge repository, which is satisfactorily addressed by the presence of the chatbot that focuses on knowledge engineering [65].

The table indicates considerable support for automation. Students demand immediate feedback and procedural instructions, but staff would like to be freed from mundane tasks. Nevertheless, both groups recognize the importance of dependability and impose the proviso that human oversight is necessary. This unanimity maintains the legitimacy of the hybrid system, whereby routine work is computerized and complex decisions are guided by human authority. Table 4.5, therefore, offers the necessary strategic basis for the development of AI-driven support services for students in institutions of higher learning [66].

Table 4.5. Comparative Summary of Insights

Dimension	Student Perspective	Staff Perspective	Convergence
Stress Factors	Confusing procedures	Overload from repeated inquiries	Both experience stress from inefficient processes
Information Gaps	Hard to find accurate info	Students frequently misunderstand info	Need for clearer information delivery
Language Challenges	Difficulty understanding terms	Staff spend time re-explaining simple terms	Multilingual AI essential
Automation Need	Desire for instant guidance	Desire to reduce routine workload	Strong mutual support for chatbot
AI Reliability	Need accurate and updated responses	Need human oversight	Hybrid human–AI model required

4.7 Figures and Visual Presentations

Figure 4.3 depicts the distribution of international students' types and inquiries. Visa and immigration inquiries are the most common, followed by registration and general inquiries. This trend confirms the significance of addressing the bureaucracy students are subjected to and the need to prioritize the development of the respective modules, such as immigration and registration. In addition, the graph shows that inquiries about finances and housing/dormitories are also popular, thereby reiterating the need to integrate knowledge across departments and to use the chatbot. This finding aligns well with the information categories that were previously designed during the development of the dataset[67].

This indicates that the kinds of inquiries are varied and that there are multiple domains of needs for international students as opposed to the needs lying strictly in the domain of an administrative body. This means that the kind of functionality that the chatbot requires incorporates the learning of multiple domains [68].

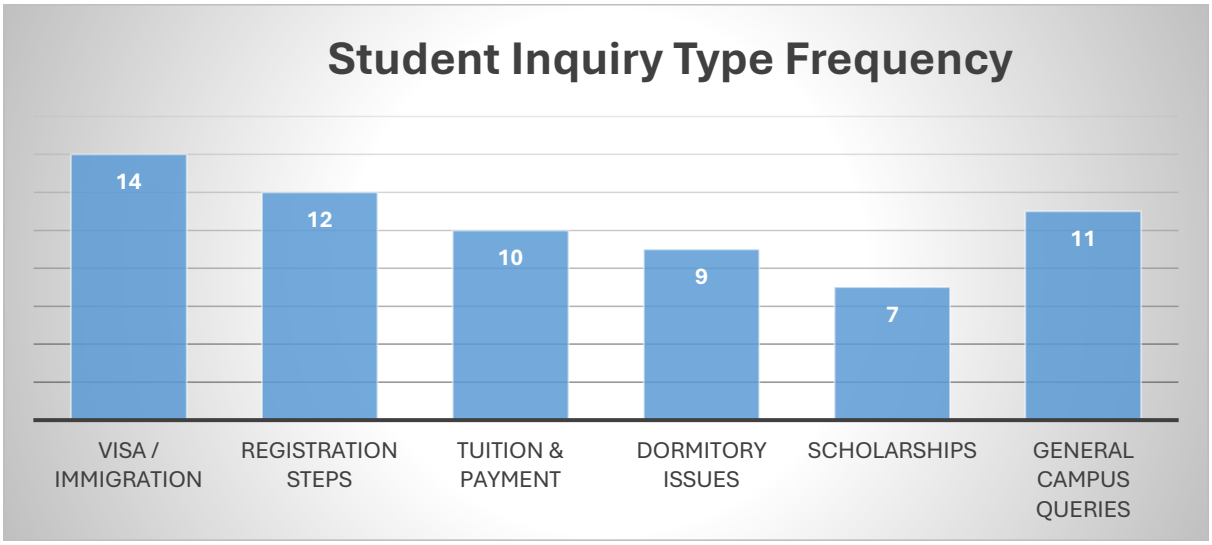


Figure 4.3. Frequency of Student Inquiry Types

4.8 Staff Workload Distribution

In figure 4.4, the allocation of staff time for the various administrative tasks can be observed. The most common administrative activity occupied by staff, amounting to 35%, comprises responses to emails. This implies that the major part of the office hour goes into the process of replying to common inquiries. Also, counter services and processing of documents account for an important allocation of administrative staff time, thus adding to the burden. The figure indicates that the allocation of staff time for activities involving less expert-level analysis, like case escalation, ranks much lower. This creates an imbalance, pointing towards the misuse of expert-level administrative manpower, which gets constrained by the continuous nature of the frontline activity [69]. From the perspective of knowledge engineering, the figure above shows the aspects of administrative tasks that are easily automatable. This includes situations where people use their emails and the counter services, which often entail making repeated inquiries that the chatbot can easily address. Therefore, Figure 4.4 offers quantitative reasons for the development of the chatbot that can undertake most of the administrative staff work [70].

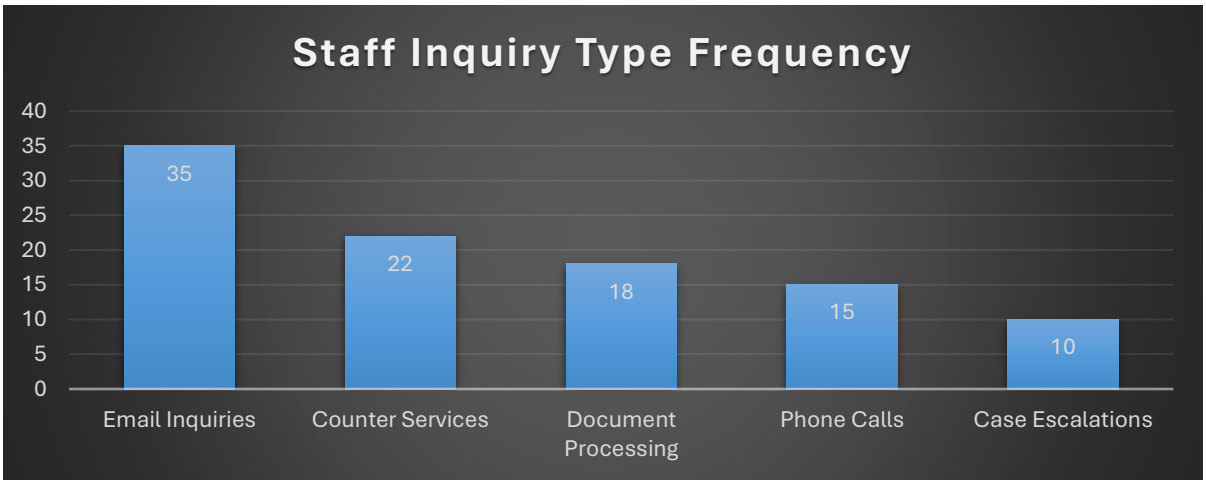


Figure 4.4 Desired Chatbot Features

4.9 Desired Chatbot Values

Figure 4.5 illustrates the characteristics that are most desired by the international students. Multilingual support ranks highest, indicating that language accessibility is no longer a preference but an essential requirement. Students prefer step-by-step support, which indicates that it reflects their procedural requirements. These characteristics reflect the larger problem many face with the use of various educational and administrative processes that are often conducted despite language barriers. In fact, the preferences reinforced that the selected

modes of communication, such as instructions for help available on the website and answers available by mail, do not support the learning process and the responses somehow delay the process [71]. Although it ranks lower, the factor of human escalation remains important, showing the desire for the hybrid model. Students prefer the use of automation for some tasks but understand the need for human knowledge on other, more complex problems. As such, the design principle for the combination of automation and the oversight of humans, as presented in Figure 4.5, is confirmed [72].

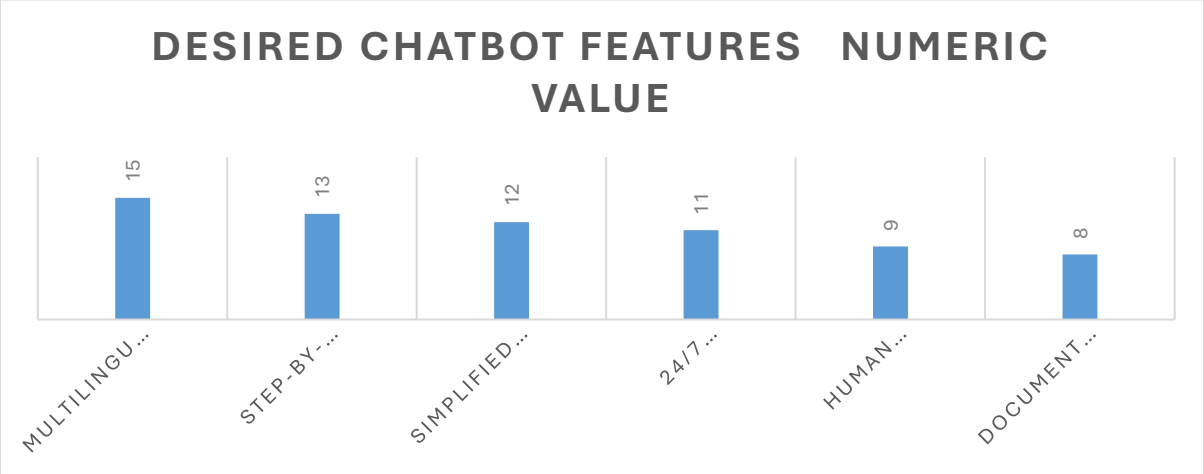


Figure 4.5. Desired Chatbot

4.6 Summary of Key Findings

Results reveal that international students face many problems concerning administrative matters, specifically focusing on visas, university registration, fee submission, and university processes. Ambiguity, anxiety, and uncertainty are common problems that arise due to unclear administrative process information, non-integrated university information services, and the utilization of university-specific jargon. Language issues worsen the situation, leading to potential misunderstandings and making people depend on fellow students and administrative staff for answers. Simultaneously, administrative personnel are overworked and inundated with repeated communications that utilize considerable time, particularly during the peak periods of the academic calendar. These repeated communications consequently prolong the administrative process and increase the burden on administrative staff, leading to reduced administrative efficacy [73]. Although the nature and types of problems faced differ between the two groups, there appear to be common expectations regarding the new support system. The students are looking for immediate, precise, and multilingual support to help them overcome their anxieties, accelerate problem-solving, and complete necessary processes independently. On the other hand, the staff members are again pointing to the potential of automation, which would help them focus on difficult cases that require human intervention. At the same time, there would be an increasing emphasis on the need for human oversight for accuracy, especially for processes that are governed by ever-changing policies, such as immigration and financial processes. Interestingly, there appears to be support for the integration of an AI-driven chat support system [74].

These themes are supported by visual evidence. Primarily, inquiries concern administrative and procedural matters, as would be expected, and the distribution of workload indicates the level of input into standard communication. Students state that multilingual capabilities, step-by-step processes, simplified answers, and 24/7 accessibility are the most important aspects of the chatbot, as expected, and support the assertion that the available communication channels are suboptimal. Cumulatively, the above findings and their alignment reveal an unambiguous interest and demand for an AI-based solution that is empowered to close information gaps and improve the quality of the service. As such, the above findings provide an empirically sound basis for the introduction of the knowledge-engineered, hybrid human-AI-based system that can transform the global support services available for international students [75].

4.7 Discussion

The study's findings indicate a serious mismatch between the information-delivery process available to the university and the needs of international students when dealing with administrative matters. The students express uncertainty and anxiety as they navigate the processes of visa renewal, enrollment, payment, and scholarship applications. This appears to be the case not only for the students as they deal with the processes involved, but also due to the use of texts as the university communicates the information. The students express concern that, despite following the instructions on the website, they remain confused about the process involved

[76]. Simultaneously, the views of administrative staff show the inherent limitations of the existing service delivery system. Staff are dealing with many queries that can actually be easily handled automatically by the system, which is consuming much of their resources. This calls for an examination of the nature of the cycle that students and administrative staff are experiencing, which negatively impacts the entire process. The linkage between the situation of confused students and the workload experienced by administrative staff indicates that both parts of the administrative system are negatively affected by the existing limitations of the information system. One obvious area of similarity between the students and the staff regarding the needs of the university community is the interest shown for the use of automated support solutions. The students would prefer to use a support system that is able to provide an immediate and clear answer, especially if the question referred to some sort of procedure, and preferably if it were multilingual. The staff confirms the feeling that having such an AI support system would decrease the workload and increase the responsiveness of their services. However, the pressing need for accuracy and oversight, especially regarding ever-changing regulations, indicates that the AI support system needs to be incorporated into such an environment [77].

The larger implication here would be that the emergence of the knowledge-engineered chatbot would bring about a revolution in the administrative experience for both students and university staff. This would be achieved as the structured responses for the conversation would ensure that the administrative process for the students becomes simplified, thereby ensuring that the students remain completely independent and self-reliant as far as university regulations are concerned. On the other hand, having routine information inquiries handled by the chatbot would ensure that the administrative staff remained focused on issues that warranted their specialized attention and sensitivity. This would therefore imply that the emergence of AI-driven support tools would play the most crucial role in ensuring that they are not auxiliary tools but an integral support infrastructure. Lastly, the findings above reveal that the effective implementation of the new system would involve sensitivity towards the integration of the new system into the pre-existing system. This would ensure that the new system remains updated, and there would be integration of new feedback to ensure the accuracy and appropriateness of the AI system and alignment with the new university policies and regulations. The combination of the two, therefore, provides an attractive scenario for the implication of the hybrid AI and human model of delivering services, which seeks to position the AI system as an addition, and not an alternative, to the support service framework for international students [78].

V. Conclusion

This study provides evidence of the significant transformative potential of AI-operated chatbots for supporting international students and improving the management of higher education. By offering precise, multilingual, and accessible information, chatbot platforms provide an equitable infrastructure that assists any learner, regardless of their language or familiarity with administrative processes, in managing complex administrative tasks. At the same time, the research highlights the importance of paying attention to the system design AI requires for practical use, which can be achieved through knowledge engineering. This clears up any misconceptions about AI's operations, stating that it enhances human judgment.

5.2 Implications

The findings of this research have important implications, both practical and theoretical. In fact, the integration of the knowledge-engineered chatbot system into university operations not only optimizes communication but also transforms the way that information, administrative tasks, and the adjustment process of internationals are handled. These aspects are associated with processes, usability, and theoretical formulations regarding the delivery of AI services.

5.3 Practical Implications

One major implication of using the proposed system is a reduction in the workload for administrative staff. In light of the research findings, it is clear that the administrative staff involved in the research dedicate considerable time to processing inquiries such as registration, visas, and tuition payments. This aspect is important because the system can process inquiries answered by the chatbot, which serves as the first point of contact.

Furthermore, the integration of chatbots improves the institution's workflow efficiency by stabilizing services during peak periods. The employees are no longer overwhelmed by the high volume of emails and inquiries, and they always have the chatbot to process the necessary information dissemination. This offers an additional advantage to the institution, such as preventing employee burnout, reducing interpersonal conflict, and improving the accuracy of administrative processing. From a management perspective, the system improves the effective use of human resources.

For international students, the advantages are vast and immediate. The major benefit of the chatbot, for international students, lies in the immediacy and tone of the responses, which do not require the student to wait

for office hours and, therefore, are not delayed by the timeframe that mail communications take. The use of the chatbot reduces the levels of stress that are derived from procedural uncertainty..

5.4 Theoretical Implications

The research provides additional insights into the theory of AI adoption, especially from the perspective of organizational contexts, such as the world of higher education. Classic AI and organizational adjustment theory, such as TAM and UTAUT, focus on the dimensions of utilization and ease of use. Nevertheless, for AI-infused administration, it can be inferred, based on the research, that the dimensions of trust, accuracy, and human oversight and control are important factors as well. The complementing nature of the human-AI combination, as shown by the research study, provides new depth and insights not previously addressed, such as that of the concept of collaborative automation.

In addition, the study makes theoretical contributions to the transition and support for international students. While the support for international students focuses on cultural, language, and socio-emotional factors, administrative literacy remains an understudied theoretical component. From the study, administrative complexity, particularly involving visas, registration, and payment, impacts students significantly as it influences their levels of stress. This introduces administrative accessibility as an important foundation for the theoretical study of support services for international students. The theoretical development of the potential for AI as an agent that alleviates procedural confusion adds to the theoretical study of the interventions that institutions can influence regarding student performance and well-being through the use of technology.

5.5 Future Directions

These results point out some potential future directions for enhancing the use of chatbots for supporting students in knowledge engineering and higher education. As AI-based solutions are increasingly leveraged by universities, the next generation of systems must move from reactive information services to intelligent, predictive, and highly integrated services. In the future, new technologies could implement machine learning algorithms that forecast administrative risks for students, such as visa renewal, payment deadlines, enrollment, and disengagement. Student behavioral patterns and system usage would provide the necessary information for the chatbot to automatically alert the students of future needs and problems. This strategy would align with the global trend toward early warning systems and would certainly optimize student retention and compliance. This would need an effective governance framework regarding privacy and data use.

Considering the diversity of languages spoken by international students, voice-based conversational interfaces would form the obvious next step for enhancing accessibility. Integration of the tool with popular platforms, especially WeChat, would help increase accessibility and user-friendliness. This would enable students to conveniently avail themselves of administrative support using the popular mobile interface. This would be most helpful for students who face literacy challenges and people with disabilities.

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