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# A PILOT STUDY USING ACADEMAGOGY TO PERSONALIZE ADULT LEARNER EXPERIENCES IN BLENDED LEARNING

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# A PILOT STUDY USING ACADEMAGOGY TO PERSONALIZE ADULT LEARNER EXPERIENCES IN BLENDED LEARNING

*Completed Research Paper*

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## Abstract

*Academagogy is a learner-centred teaching model that offers flexibility for an educator to choose the most appropriate teaching style, evaluation, and learning experience based on learners' needs. However, previous applications of academagogy have shown limitations such as workload and time commitments. In this research in progress paper, we present a pilot study using academagogy supported by artificial intelligence. Our objective was to personalize the learning experiences of adult learners in a 13-week semester of an information technology course at a regional Australian university. The mixed method analysis of learner reflections and semi-structured interviews showed an increased cognitive ability to learn independently. The learners reported feeling more positive emotions than negative ones during the semester. In addition, the learners felt a sense of belonging and connection in blended learning. These findings have implications for creating sustainable online learning environments to promote quality adult education.*

*Keywords: Personalization, Adult learners, Online education, Academagogy, Artificial intelligence.*

## 1 Motivation

Academagogy is defined as a *scholarly leading* that can be used to facilitate learners of diverse cultural, generational, and disciplinary backgrounds and previous knowledge (Winter et al., 2008).This paper focuses on adult learners in the context of online learning at the tertiary educational level. Adult learners (also known as non-traditional learners or mature-aged learners) are usually 25 years old and above and pursue higher education alongside family or work responsibilities. These learners are the largest group of online learners in higher education (Chen, 2017; Moore and Shemberger, 2019). However, studies report that adult learners often show a higher drop-out rate than other cohorts in online learning (Chen, 2017; Kahu et al., 2013; Kara et al., 2019). The adult learner's high attrition is potentially due to low learner engagement, among other causes, that could result from the limited opportunity for interaction with educators and peers, family or work responsibilities, previous knowledge, feelings of isolation, and the one-size-fits-all teaching model (Kahu et al., 2013; Kara et al., 2019).

Personalization has a crucial role in engaging adult learners in distance education. It is defined as the systematic design of the learning process, which focuses on tailoring instruction according to individual learners' needs, strengths, preferences, and goals (Walkington and Bernacki, 2020). Online learning studies have shown that personalization can improve learning experiences, engagement, satisfaction, performance, and retention (Kara et al., 2019; Mikić et al., 2022). Though personalization of instruction

seems advantageous, its implementation was found to be complex—possibly due to limited integration of automation tools such as learning analytics (LA), sentiment analysis (SA), artificial intelligence (AI), and intelligent tutoring systems (ITS) with current teaching models in online and blended education (Bartolomé, Castañeda and Adell, 2018; Mikić et al., 2022). The knowledge gap provides complex challenges for educators in deciding when, where and how various tools can be best utilised for personalization in a learning management system (LMS). Consequently, we focused on integrating LA and SA with *academagogy* for personalization in an LMS.

The notion of academagogy is one-size-fits does not fit all, where an educator can apply appropriate teaching methods and or technologies in their context for achieving better learning outcomes in a given cohort of learners (Winter et al., 2008). Academagogy has been studied in different disciplines for face-to-face education, such as Entrepreneurship (Jones et al., 2014; Kennedy, 2018), Engineering (McAuliffe and Winter, 2013; Winter et al., 2009), Nursing (Raymond and Dahlke, 2022), Theology (Oliver, 2015), and corporate organisations (Murthy and Pattanayak, 2019). However, academagogy is not well-recognized in online education. Based on the knowledge gaps, we focus on the research question:

*How can academagogy be used to personalize adult learner experiences in an online Information Technology course?*

# 2 Related work

The objective of the study was to personalize adult online learner experiences in an LMS using academagogy. In an LMS, learners interact (i.e., reactively communicate) in three modes: (1) learner-content interaction, (2) learner-learner interaction, and (3) learner-educator interaction (Moore, 1989). Personalization can be applied in all three of these modes of interaction using different techniques, models, or theories (FitzGerald et al., 2018; Shearer et al., 2020). The study described in this paper concentrated on personalizing the learner-educator interaction since adult online learners value learner-educator interactions more than learner-learner and learner-content interactions (Knowles, Holton III and Swanson, 2015; Martin and Bolliger, 2018). In this study, we used academagogy theory as a framework to personalize learner-educator interactions.

## 2.1 Academagogy theory

Academagogy is defined as a meshed model of pedagogy, andragogy, and heutagogy (Winter et al., 2008). Pedagogy is an educator-centred model where the learners are dependent on the educator for learning resources (Knowles, 1980). Andragogy is a learner-centred model that encourages independence and self-directed learning (Knowles, 1980). In andragogy, learners and educators share responsibility for learning resources and decision-making. Heutagogy is a learner-driven model where the learners autonomously decide what and how they want to learn (Hase, 2016). In heutagogy, educators facilitate but maintain an appropriate distance to help learners become interdependent (Winter et al., 2008), similar to doctoral studies. The pedagogy-andragogy-heutagogy (PAH) continuum is described as a cumulative cognition development process in the learners (Luckin et al., 2011), with differences shown in Table 1.

| | **Pedagogy** | **Andragogy** | **Heutagogy** |
|---|---|---|---|
| Control | Educator | Learner | Learner |
| Cognition levels | Cognitive | Metacognitive | Epistemic |
| Dependence | Dependent | Independent | Interdependent |

*Table 1. The Pedagogy-Andragogy-Heutagogy Continuum.*

Earlier studies of academagogy showed enhancement in learning and teaching outcomes. The first case study on implementing academagogy in face-to-face learning mode showed a reduction in failure rates and positive comments from learners (Winter et al., 2009). Another study revealed that academagogy

enabled learners to achieve higher grades compared to grades achieved by earlier teaching processes (McAuliffe and Winter, 2014). In addition, research on a business management program framed by academagogy theory found that the program was appealing to educators by 90%, and learners had an 85% acceptance rate (Kennedy, 2018). The use of academagogy for training recruits in a corporate setting revealed a positive impact on the behavioral skills of the trainees (Murthy and Pattanayak, 2019). Nevertheless, there are limited applications of academagogy in online education, which may be because of scalability issues such as additional time commitment and workload for educators. The scalability issues are because of the amount of work required to understand learner needs in larger classes (Murthy, Furness and Wardle, 2012) and the time needed to tailor the teaching strategies based on learner needs (Winter et al., 2009). We conducted a multi-phased research project based on a design-based research method to study the use of academagogy in online and blended learning environments.

### 2.2 Design-based research

Design-based research (DBR) is defined as a series of approaches to produce new theories, artifacts and practices that can imply learning and teaching in natural settings (Barab and Squire, 2004). DBR has been increasingly used as a research model for studies on the development of technology-enhanced online learning environments. Based on real-world educational context, DBR seeks to explain how and why an educational innovation works (Anderson and Shattuck, 2012). DBR uses both qualitative and quantitative methods to support rigor in research analysis and reporting (Anderson and Shattuck, 2012). Our DBR project consisted of five phases (Addanki et al., 2022):

- Phase 0: A literature review was conducted on improving adult learner engagement in online education and posited academagogy as a framework for personalization (Addanki et al., 2020).
- Phase 1: A preliminary study of adult learners' experiences in an online information technology (IT) course using academagogy showed its potential for personalization but identified scalability issues (Addanki et al., 2022).
- Phase 2: Based on the preliminary study outcomes in Phase 1, a lightweight mock prototype of an AI system was developed using the wizard of oz (WOz) method. In a WOZ experiment, a human (i.e., wizard or researcher) simulates the system's intelligence and interacts with the users through a real or mock computer interface (Maulsby, Greenberg and Mander, 1993). WOz is a human-centred design method that avoids extensive resources used for developing AI systems that do not meet user needs by testing ideas early in the process. The WOz method has been extensively used for prototyping, designing, and testing AI systems in the educational context (Stipancic et al., 2021). The aim of designing the AI system (known as the WOz system) is to build a potential system that helps educators apply academagogy.
- Phase 3: The WOz system was used in the pilot study to personalize adult online learner experiences based on academagogy as described in Sections 3 and 4.
- Phase 4: Phase 4 will reflect the project results, which could advance academagogy theory and broad real-world applications.

## 3 Methods

Following the DBR approach, we used mixed methods involving quantitative and qualitative methods to maximize the understanding of the use of academagogy for personalization on adult online learner engagement.

### 3.1 Participant recruitment

Nine adult learners (seven males and two females) were recruited from a regional Australian university following Human Research Ethics Committee approval. All participants were aged 25 years or older. This course had enrolments from diverse backgrounds of adult learners with different educational and family backgrounds and work experience. The diversity of the participants is given in Table 2. Participants were recruited from learners who were enrolled in the IT courses "Advanced Mobile

Technologies" (a master's level course) and "Mobile Computing" (a bachelor's level course) using a purposive sampling technique. The participants were recruited based on the criteria of voluntary interest in improving their general self-learning skills and knowledge about the course (programming, research, and presentation skills of Mobile Technologies). The IT courses ran for 13 weeks, from February to May 2022.

| | **Gender** | **Previous education** | **Job/ Family responsibilities** | **Workload** |
|---|---|---|---|---|
| P1 | M | Secondary | Full-time work in the retail industry and study | 40 hrs/week |
| P2 | M | Secondary | No work, only study | 0 hrs/week |
| P3 | M | Secondary | Part-time tutoring and study | 2 hrs/week |
| P4 | M | Secondary | No work, only study | 0 hrs/week |
| P5 | F | Tertiary, Medicine | Part-time work, study, and family responsibilities (primary carer) | 12 hrs/week |
| P6 | M | Tertiary, science | Part-time work in the hospitality industry and study | 20 hrs/week |
| P7 | M | Tertiary, vocational | Full-time work in the telecommunications industry for the last two years and study | 30 hrs/week |
| P8 | M | Tertiary, science | No work, only study | 0 hrs/week |
| P9 | F | Tertiary, medicine | Ten years in business process outsourcing and IT industry, full-time work, and study | 40 hrs/week |
| P1 | M | Secondary | Full-time work in the retail industry and study | 40 hrs/week |

*Table 2. Participant demographics.*

The teaching format used for this course was blended learning, which included lectures and practicals. The lectures were delivered through online synchronous sessions and asynchronous recorded lecturettes. The practicals were conducted as face-to-face learning sessions in a computer lab. During each practical, learners worked on hands-on Java programming activities to develop mobile applications in Android Studio software, facilitated by a teaching staff member other than the course educator.

## 3.2 Data collection

The first author, who was the primary researcher of the project, collected the following learner data:

- Learner self-reflections: At the end of each practical, the learners wrote a self-reflection text (100 to 200 words long) as a regular weekly assessment piece during the semester. There were nine practicals and three assignments for which the learners had written self-reflections. Assignment.1 and Assignment.2 were developing mobile applications adhering to guidelines of the Android mobile platform for utility and education use cases, respectively). Assignment.3 was a code review presentation activity (evaluating and discussing the technical aspects of mobile computing applications). In total, 65 self-reflection texts (12, 531 words) were collected from the participants. These self-reflections provided lived and in-depth experiences of learners while working on each practical and assignment activity.
- Learning Analytics: Learners' interaction data with the LMS, such as the number of user accesses, submission activities, and time spent within the course site during the semester, were collected.
- Technical icebreaker: A reflection activity consisting of open-ended questions about learners' previous programming experiences related to the subject and general questions related to learners' motivation to enroll in the subject.
- Semi-structured interviews: Midway and at the end of the semester, the participants were interviewed via the Zoom meeting platform. All learner participants consented to the audio

recording of their interviews, which were anonymized and transcribed into text documents. These interview transcripts provided additional data on the overall experiences of the learners in the course.

## 3.3 Data analysis

We used both qualitative and quantitative methods to analyze the research data following the DBR approach. In this pilot study, learner data were analyzed using Reflexive thematic and Sentiment analysis methods.

### 3.3.1 Reflexive thematic analysis

Reflexive thematic analysis is a traditional qualitative method used to identify, analyze, and report essential research data references (themes/categories/codes) based on the researcher's subjective skills (Braun and Clarke, 2020). In the reflexive thematic analysis, data (self-reflections, technical icebreaker responses, and interview transcripts) were analyzed through the lens of academagogy. The primary aim of academagogy is to shift the capabilities of learners towards heutagogy on the PAH continuum as the learner engages in the learning process (Winter et al., 2008).

During the reflexive thematic analysis process, the Content analysis method was used. Content analysis is a research method for analyzing written, verbal, or visual communication messages (Cole, 1988). NVivo version-12, a Computer-Aided Qualitative Data Analysis Software, was used to quantify the output (references) while maintaining rigor and internal validity during the content analysis. Two cycles of coding (First cycle and Second cycle) were used in the content analysis process.

First cycle coding (also called Open coding) closely examines pieces of qualitative data and compares them for similarities and differences (Saldaña, 2013). In the first-cycle coding, the data were coded using Emotion coding and In Vivo coding separately, inspired by the Grounded theory approach (Saldaña, 2013). Also, learner self-reflections were open-coded to identify any references related to the cognitive domain of Bloom's taxonomy (remember, understand, apply, analyze, evaluate, and create) (Krathwohl, 2002). These references are mapped to cognitive differences among pedagogy, andragogy, and heutagogy, as described in Table 1. The first cycle coding resulted in identifying the position of a learner on the PAH continuum at any point in time. For further analysis to identify the shifts in the capabilities of learners on the PAH continuum over a period, we used second cycle coding methods, Axial coding, and Longitudinal coding methods (Saldaña, 2013). The second cycle analysis resulted in major themes, as shown in Table 3.

| Theme (frequency) | Description | Subthemes (frequency) | Examples derived from participant data |
|---|---|---|---|
| PAH (187) | Any piece of text that shows evidence of pedagogy or andragogy, or heutagogy characteristics | Pedagogy (47) | Memorizing, reading, perceiving, and acquiring knowledge |
| | | Andragogy (98) | Analyzing learning goals, identifying learning resources, and applying strategies |
| | | Heutagogy (42) | Exploring, experimenting, creating own mobile applications, and lateral thinking |
| Emotions (207) | Any reference related to emotions or feelings | Positive (122) | Very easy, enjoyable, and succeeded |
| | | Negative (77) | Hard, difficult, frustrated, and upset |
| | | Mixed (8) | Did not seem to have many issues, worked out well until I got |

*Table 3. Sample themes derived from the content analysis on learner self-reflections.*

### 3.3.2 Sentiment analysis

Learners' self-reflections were analyzed to determine their emotional engagement. Sentiments or emotions are essential to their academic achievement (Henrie, Halverson and Graham, 2015). SA provides a viable solution to analyze large volumes of learner-generated data, such as self-reflections, journals, blog posts, end-of-subject learner feedback, and discussion forums. In online learning environments, analysis of the learner data is beneficial for determining the overall sentiment of the class and analyzing individual learner data provides personalised interventions.

Valence-aware dictionary for sentiment reasoning (VADER) was used to do instant sentiment analysis on learner self-reflections. VADER is a simple rule-based natural language processing (NLP) tool that takes input from a text and outputs the feelings of the writer in the form of positive, negative, and neutral emotional percentages (Hutto and Gilbert, 2014). Though emotion analysis based on NVivo could be used for SA, we also used VADER to quickly analyze self-reflections and provide just-in-time personalized support to learners.

## 4 Personalization Procedure

The WOz system (refer to Section 2.2) was used to conduct the personalization process with the following sequence of actions during the pilot study, as illustrated in Figure 1:

1. The wizard (also known as the researcher) looks at and analyzes learner data.
2. The wizard generates a report (called the WOz report, as shown in Figure 1) containing visualizations from the learner data.
3. The educator looks at the report.
4. The educator provides general support and advice to all the learners.
5. The wizard sends personalized support to individual participants.

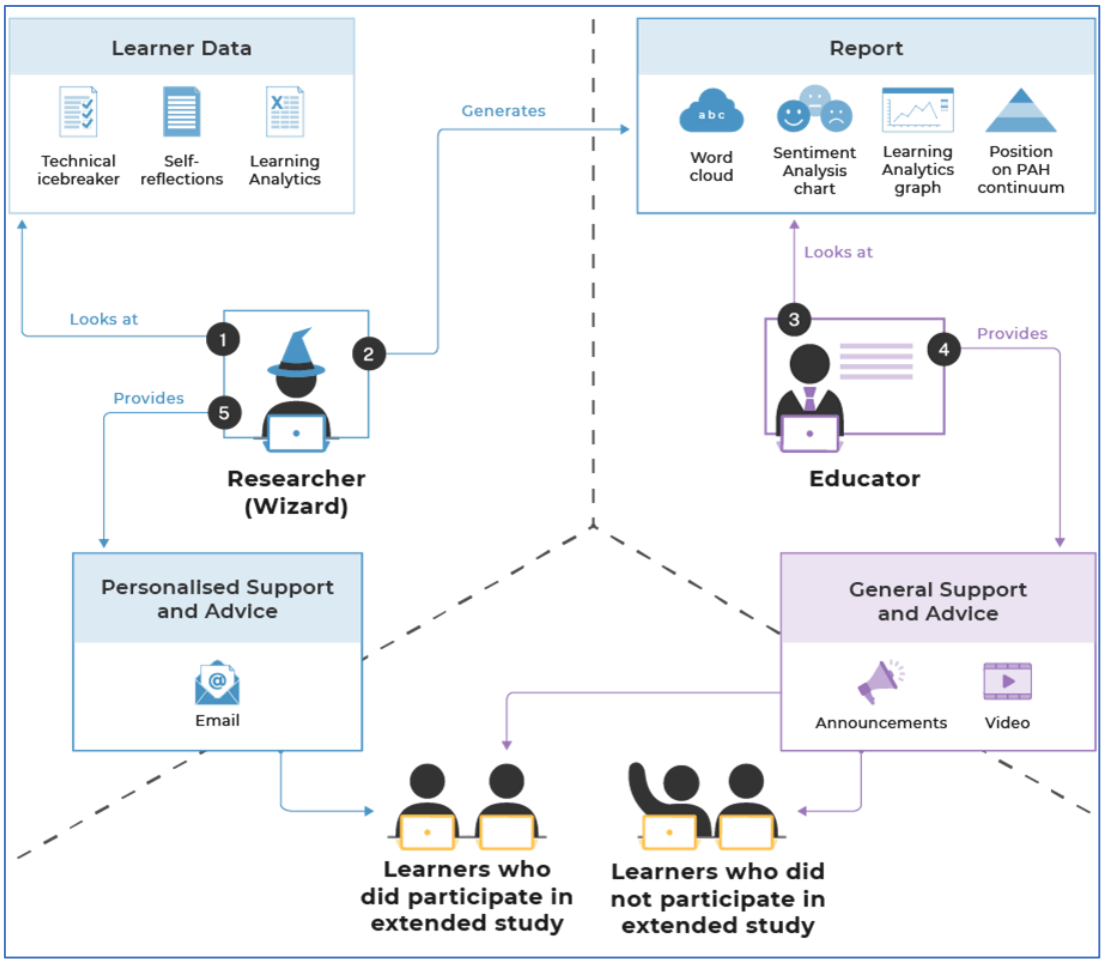


*Figure 1. Personalization process diagram.*

The actions were carried out in two stages during the 13-week pilot study using the WOz system, namely diagnosis and continuous tracking, which is described in Table 4.

| Stage | Time period | Data collection | Data visualization |
|---|---|---|---|
| Diagnosis | Weeks 1 and 2 | Technical ice breaker | Word clouds |
| Continuous tracking | Weeks 3 to 13 | Learning analytics | Learning analytics graph |
| | | Learner self-reflections | Sentiment analysis chart |
| | | | Thematic analysis showing the learners' position on the PAH continuum |

*Table 4. Using the wizard of oz system in the two stages for personalization.*

## 4.1 Stage 1: Diagnosing learners' needs

Diagnosis of learners' needs is essential to providing a clear sense of their initial skills for educators to personalize (Mikić et al., 2022). Hence, at the start of the semester, the learners were given a technical icebreaker as a self-reflection activity. During week 5, the WOz system reported the technical icebreaker results in the form of word clouds based on thematic analysis, identifying major themes (see Table 3) for the educator.

## 4.2 Stage 2: Continuous tracking

Continuous tracking of learners' experiences is another important aspect of providing timely and personalized support (Shearer et al., 2020). The WOz system tracked learners' experiences learner data every week from weeks 3 to 13, as explained in Table 4, in three dimensions and created the WOz reports:

1. Behavioral: LA data was used to determine the behavioral dimension and visualized like an LA graph.
2. Emotional: The VADER tool was used to determine the affective dimension from the analysis of self-reflections, giving an SA chart.
3. Cognitive: Thematic analysis of learner self-reflections was used to track cognitive dimensions, which were visualized as the learner's position on the PAH spectrum.

Based on the WOz reports, the educator created personalized support (LMS announcements and videos) to meet the learners' needs. The educator uploaded the personalized support into the LMS as an announcement called course participation review (CPR). The CPRs contained textual messages describing the progress of the whole class. The text message included overall behavioral interactions, emotions, self-learning strategies, appreciating the learners who made progress, and action plans for those who were behind. The educator uploaded three CPRs during weeks 5, 9, and 13 during the semester. Also, the educator simultaneously uploaded a short video recording explaining the CPRs to give synchronous and asynchronous support for the benefit of online learners.

LMS announcements and videos that the educator uploaded can be considered essentially one-to-many communications. Since the educator was one of the supervisors for this research project, the educator was restricted from knowing the identity of the individual participants based on human research ethics. Also, the purpose of the study was to provide individualized support for each participant; the WOz system customized the educator's announcements and sent them to individual participants via their university emails, as shown in Figure 2. Additionally, this step was carried out to avoid any coercion effect on the research participants (*National Statement on Ethical Conduct in Human Research 2007 (Updated 2018)*) and to provide one-to-one level support.

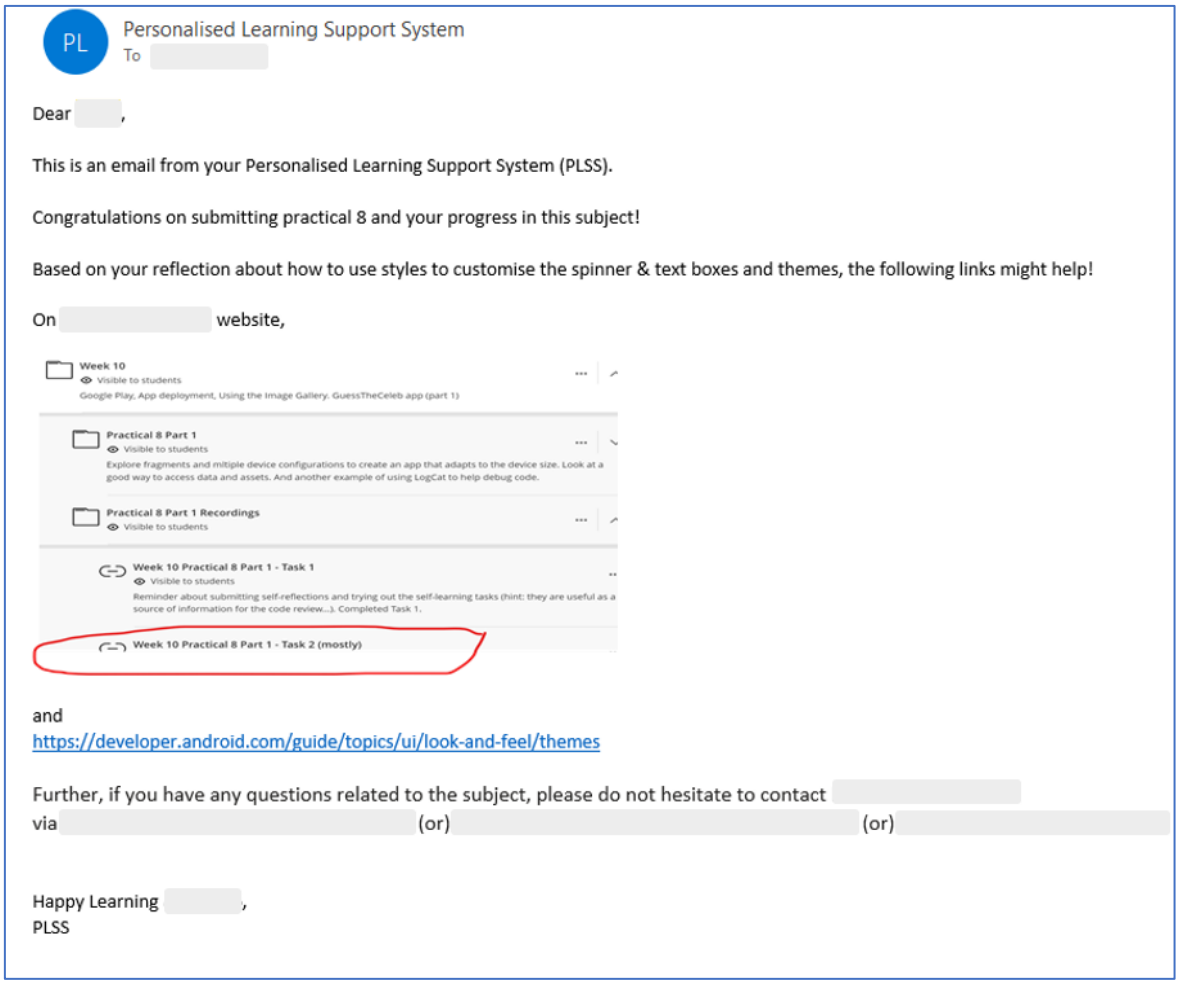


*Figure 2.* *Sample of Email Sent by the Mock Artificial Intelligence Prototype to a Participant. Note. The WOz System was named the "Personalised Learning Support System" for the convenience of participants.*

# 5 Findings and Discussion

In this section, we discuss the findings from the thematic and sentiment analyses. The thematic analysis shows that the learners felt increased cognitive abilities for self-directed learning and that they felt positive and socially connected during the study.

## 5.1 Encouraging learner agency

We identified that learners were orientated more towards andragogy on the PAH continuum according to the thematic content analysis on learner self-reflections. The references for themes pedagogy, andragogy, and heutagogy were analyzed using the matrix coding technique in NVivo. Out of the total 187 references for the theme PAH (refer to Table 3), the learners reflected 47 references (25%) for pedagogy, 98 references (52%) for andragogy, and 42 references (23%) for heutagogy, as shown in Figure 3.

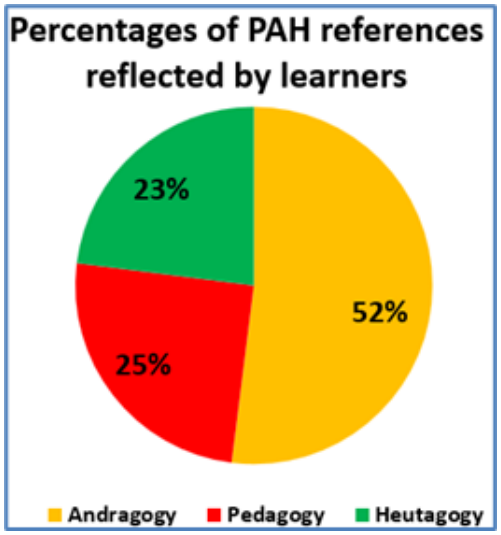


*Figure 3. Learners' orientation on the PAH continuum.*

The orientation of learners on the PAH continuum infers a positive outcome since the learners reflected on working independently rather than solely dependent on the educator during the semester. Other studies also implied that shifting learner capabilities from pedagogy towards andragogy and heutagogy is essential to designing successfully personalized blended learning support (Narayan, Herrington and Cochrane, 2019; Raymond and Dahlke, 2022). We used Bloom's taxonomy to assess learners' cognitive skills, like other studies that developed personalized and adaptive learning systems (Aeiad and Meziane, 2018; Bartolomé, Castañeda and Adell, 2018). Moreover, the paper presents a novel cognitive skills analysis method that analyzes self-reflections written by IT learners following Bloom's taxonomy and academagogy theory.

## 5.2 Learners' emotional engagement

The use of the VADER sentiment analysis tool on the learner's weekly self-reflections revealed that learners felt more positive than negative emotions throughout the semester, as shown in Figure 4. However, in the VADER analysis, neutral emotions seemed to dominate compared to positive and negative emotions that hindered in-depth observation. Another study identified similar limitations in VADER analysis (Hixson, 2020).

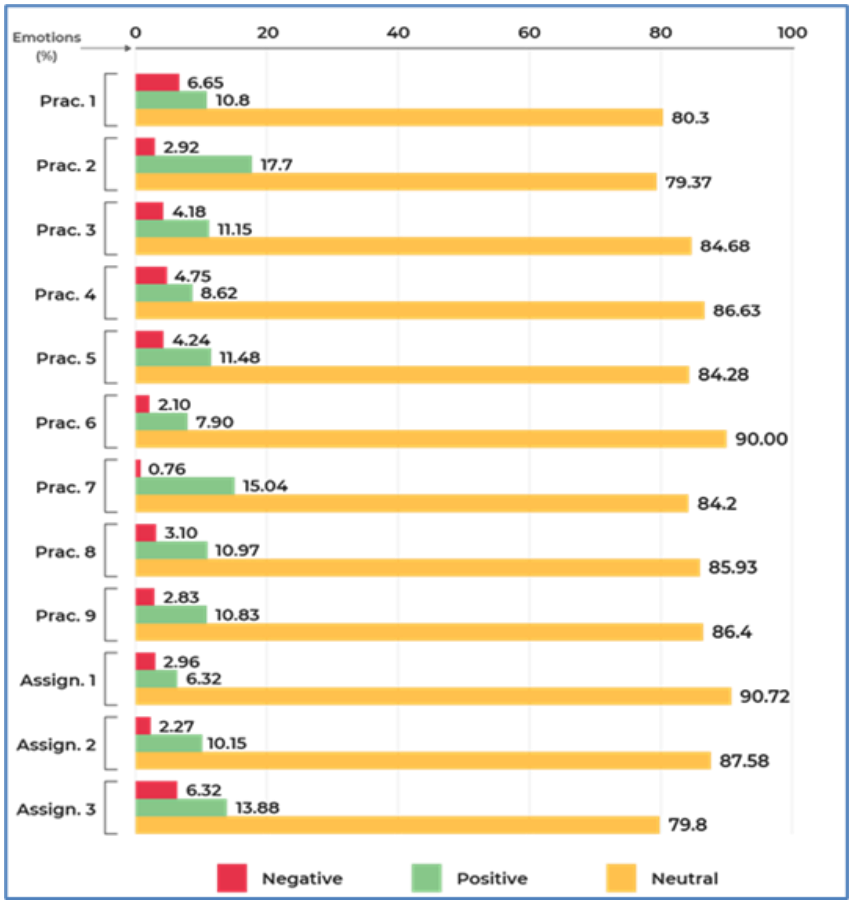


*Figure 4. Learners' emotions analyzed by VADER. Note. Practicals are termed "Prac." and Assignments are termed "Assign.".*

The limitation may be because VADER has primarily been used for business domain-related texts such as social media interactions, New York Times editorials, movie reviews, and product reviews such as cameras, mobile phones, and laptops (Hutto and Gilbert, 2014). Hence, the emotion analysis provided by the VADER tool is not accurate, as the research participants were university learners enrolled in a computer science subject who might have used domain-dependent words related to computer science, not the domain words that VADER was trained for. These domain-dependent words might have had different polarities (positive, negative, and neutral) compared to the words VADER. For example, the word "fast" for a laptop business review, like "this laptop's processing speed is fast", might have a positive sentiment; however, the word "fast" in a classroom review, such as "the teacher is fast and difficult to understand", has a negative sentiment. This study agrees with the notion that sentiment tools used for analyzing learner emotions need to be retrained for the educational domain words (Hixson, 2020).

Hence, the researcher analyzed self-reflections using the thematic emotional coding method. The references to the Emotions theme were quantified using the matrix coding technique in NVivo software. Out of the total 207 references for the theme of Emotions (refer to Table 3), the learners reflected 122 references (59%) for positive emotion, 77 references (37%) for negative emotion and 8 references (4%) for mixed emotions, shown in Figure 5. The emotional engagement pattern indicating when the learners felt more positive than negative is linked to high academic performance (Pekrun et al., 2011). This finding demonstrates the use of academagogy in online learning and teaching.

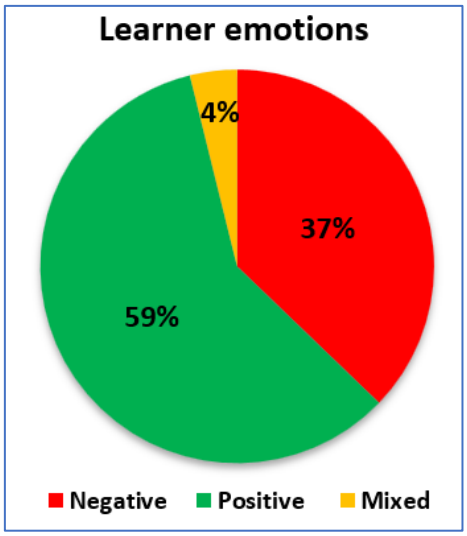


Figure 5. Learners' emotions analyzed by thematic analysis.

### 5.3 Learners' perception towards personalization

Thematic analysis of learner interviews reveals that all the participants felt the educator was interactive. "It feels like you are actually being interacted with by a real person, yep, who is actually trying to help you" (P3, Interview). Also, the participants felt more connected with the educator, implying a sense of belonging. A sense of belonging is essential for adult learners as it can promote communication with educators and peers in online education (Kara et al., 2019).

> *In the external sense, where you are not obligated to go in, or anything like that still having contact. Even if it is that one way contact where they chuck an announcement up, it still feels as though you know they care. Yeah. And that you are a part of this subject. (P7, Interview)*

Further, the regular and timely personalized feedback made learners feel that the educator was keeping track of their learning journey. Also, participants felt that they were being cared for based on the personalized emails:

> *But for some learners that are lagging behind or you know they miss a practical or two or even three. It definitely helps to have that email there was like this, some resources, you can maybe look through. (P1, Interview)*

The learners' experience with personalization using academagogy indicated enhanced communication between them and their educator. Learner-educator communication plays a vital role in engaging adult online learners (Martin and Bolliger, 2018; Moore, 1989). Thus, the use of academagogy to personalize instruction for adult online learners is a promising avenue.

## 6 Insights and Implications

The efficient personalization process depends on creating an ideal balance between support and learner-directed learning activities (McAuliffe and Winter, 2014; McLoughlin and Lee, 2010). Because some learners are highly self-directed, more personalised support may not be effective for them. In contrast, some learners prefer structured guiding; in that case, more self-directed activities could overwhelm these learners (Winter et al., 2009).

In this pilot study, we used academagogy as a balanced theoretical model for personalization, giving appropriate value to each of the models' pedagogy, andragogy and heutagogy according to learner needs.

Learners at the pedagogy level may not have control over the learning materials (Luckin et al., 2011). Since educators have complete responsibility for the learning materials and how to deliver these materials (Winter et al., 2008), this study assumed the pedagogy level as a starting point in personalizing the learning experience for all learners. The role of andragogy in helping to personalize the learning experience is to allow learners to collaborate with their educator. This collaboration focuses on what and how learners can reach their learning goals. As heutagogy enables learners to work on their goals, thus making them self-determined learners, the role of heutagogy is to help learners personalize their learning experience by allowing critical self-evaluation of their learning process.

To our knowledge, this pilot study is the first application of academagogy in the IT discipline. The findings indicate that academagogy could be used to enhance adult online learner engagement in IT courses. These findings align with previous applications of academagogy, showing its potential to encourage life-long learning and cognitive skills (Kennedy, 2018; McAuliffe and Winter, 2013; Murthy and Pattanayak, 2019; Winter et al., 2009). In addition, this pilot study identified positive emotional engagement and social connection with the educator and peers in a blended learning class. Further, this study adds to the literature by presenting a lightweight mock prototype of an AI system addressing the scalability issues in applying academagogy. Based on the research findings, we believe that academagogy could facilitate wider adoption of AI in education with the following implications:

- Encouraging learners to write self-reflections could enhance their agency and critical thinking.
- Self-reflections provide a rich data source to track emotional and cognitive learning patterns using NLP methods to improve online educational experiences.
- Academagogy could be potentially used for personalization in LMSs at a large scale when integrated with data-driven automation tools like LA and SA.
- Learner-educator interactions in an LMS can be personalized based on academagogy theory; however, there is a need to develop robust AI systems to support educators.

# 7 Limitations and Future Directions

This study has few limitations and directions for future work. Firstly, the participant sample is small to generalize the findings to other contexts. Though the participants' sample size was limited, they were observed in multiple dimensions simultaneously. For instance, LMS behavioral interactions, emotions, and cognitive skills were analyzed. Grounded in mixed methods analyses based on the DBR, we believe this study contributes to further research. Future work could rigorously investigate the application with larger cohorts of learners.

Secondly, the study was highly reliant on the weekly self-reflections written by the learners. These self-reflections provided qualitative insights into the learner's lived experiences, which complemented the quantitative LA and SA data for the nuanced observation of participants. Also, the researcher analyzed the self-reflections to find out the position of learners on the PAH continuum. Any biases in the manual thematic analysis can be reduced by training a machine learning model using NLP methods like Topic modelling algorithms (Bakharia et al., 2016). Hence, in the future, the WOz system could possibly be developed into an interactive pedagogical agent that is deployable in LMSs for personalization at scale.

# 8 Conclusion

Personalization is a reiterating theme to support the diverse learning needs of adult learners. The prevalence of AI in education has leveraged the automation of the personalization process in online and blended education facilitated by LMSs. However, personalization literature highlights the limited theoretical frameworks to guide the design of AI systems in education. In this paper, we discussed the integration of academagogy theory with LA and SA tools for designing a human-centred AI system in future. We found that the integration has encouraging outcomes in the cognitive and emotional engagement of adult online learners. The research implications provide a foundation for developing AI-assisted tutoring systems based on learner-centred educational theories.

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