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Exploring Real-Time Feedback Seeking in an Online Learning Task

A Clustering Analysis

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Abstract

This empirical study investigated how students engage with feedback seeking within an online learning environment. Four distinct student profiles emerged based on their feedback-seeking tendencies: Disengaged Learners, Paradoxical Independents, Proactive Feedbackers, and Consistent Seekers. The findings suggest that students' perceived difficulty of tasks and their understanding of the value of feedback significantly impact their likelihood of seeking it. Interestingly, even positive experiences with the online learning platform and reported learning gains did not guarantee active feedback seeking. These results highlight the need for educators to explicitly emphasise the importance of feedback and cultivate a learning environment that encourages its seeking and utilisation. Additionally, the study suggests that interventions may influence student engagement with feedback mechanisms. This study addressed a research gap on the use of learning analytics to uncover feedback practices in elementary education, a field with limited research in feedback literacy and learning analytics integration.

Keywords: e-learning; Feedback Literacy; Feedback Seeking; Real-Time Feedback; Online Learning; Clustering Analysis; Elementary Education; Learning Analytics

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Introduction

Background

Feedback serves as a cornerstone of learning. It allows students to reflect on the goal of their work, identify how to improve, and ultimately guide them where to next in the learning journey (Hattie & Timperley, 2007). This ability to effectively seek out, understand, and utilise feedback is a crucial skillset and mindset known as feedback literacy (Carless & Winstone, 2020). In today's digital learning environments, where online learning platforms are increasingly adopted, feedback literacy becomes paramount due to the transformed nature of student-teacher interactions. These online learning environments, beyond classroom interactions, offer alternative avenues for learning, highlighting the need for a proactive approach to seeking and utilising feedback.

This study particularly focuses on the how students seek for feedback generated by online learning environments. Feedback seeking is an important aspect of feedback literacy. Feedback seeking goes beyond simply receiving feedback; it involves reflection on one's own work and actively ask or seek for comments to improve (Dawson et al., 2023). While frameworks for feedback literacy exist, they often have not been fully adapted to the unique environment of online learning and feedback seeking, especially in school settings. However, online platforms offer distinct advantages: they can collect detailed log data on student activity, enabling personalised feedback through data analysis (Clow, 2012). These advancements are only valuable if students actively engage with the feedback provided. Educators can play a crucial role in fostering this engagement, while learning platform designers should consider features that promote student interaction with feedback. Thus, this research aims to delve into different feedback seeking patterns of students within online environments, and to discuss possible strategies by which educators and online learning platform designers can enhance these essential competencies.

Literature Review

Theory of Feedback and Feedback Literacy

The review article of Hattie & Timperley (2007) serves as a foundation for many feedback studies. Derived from their meta-analyses with earlier articles, a model of feedback to enhancing learning is defined, in which the purpose of feedback is to reduce discrepancies between the understanding or performance of the learners and the desired goal. It suggests that students can achieve this through increased effort or by adjusting their goals, while teachers can help by setting challenging objectives and guiding effective learning strategies. Effective feedback should address three essential questions: "Where am I going?", "How am I going?", and "Where to next?". Each of these questions operates at four distinct levels: Task level, which focuses on performance understanding; Process level, concerning the methods needed to complete tasks; Self-regulation level, involving self-monitoring and directing actions; and Self level, dealing with personal evaluations and feelings about the

learner. While this model provides a useful framework for understanding different functions and levels of feedback, it is essential to conceptualise a more comprehensive view of feedback to account for the multifaceted intricate dynamics within and between students, teachers, and the learning environments that influence the feedback process (Price et al., 2011).

The concept of feedback literacy emerged around 2010, with a notable surge in the number of studies from 2017 onward to further conceptualise and refine it. As of the time of writing, there are over 300 articles in Scopus with "feedback literacy" in the title and abstract. One of the earliest is Sutton (2012), emphasising the role of feedback literacy in the higher education context. He underscored that feedback literacy is not just about knowledge and skills, but also has its social aspects, based on the academic literacy approach (Lea & Street, 1998; Street, 2003). He identified three dimensions to understanding feedback: the epistemological, focusing on the knowledge about feedback; ontological, relating to the personal and social being in the feedback process; and practical, concerning the application of feedback. In subsequent research, scholars have sought to broaden the scope and deepen the understanding of feedback literacy in different domains, which can be broadly divided into three categories: teacher feedback literacy, such as discussing how to develop (Lee, 2021) and different levels of responsibility for teachers in the feedback process (Boud & Dawson, 2023); student feedback literacy, exemplified by analysing its development by peer review (Hoo et al., 2021) and in the academic writing context (Yu & Liu, 2021); and the social dimensions of feedback practices, including their interactions (Carless & Winstone, 2020) and the discourse on shared responsibility between teachers and students (Chen & Liu, 2024).

Two relevant research approaches on student feedback literacy particularly related to this study. Carless & Boud (2018) have proposed a framework, emphasising the importance of "appreciating feedback" as a fundamental aspect and suggesting that students must value feedback to fully engage with it. Additionally, "making judgments" about feedback content is essential for students to discern what is useful for their learning process. They also highlighted the "managing affect," pointing out the emotional dimension of receiving feedback. The interrelation between the above three areas is critical, as it can either facilitate or hinder the ability to act upon feedback. They argued that integrating these components can enhance students' capacity to effectively use feedback for their academic development. Meanwhile, Nash & Winstone (2017) have concluded four types of psychological barriers to engaging with feedback. The first is awareness, where students simply do not understand the feedback itself, its purpose, or even realise they received it. The second is cognisance, meaning students lack knowledge on how to implement the feedback or what strategies to use. The third barrier is agency, where students feel unequipped or that acting on feedback is pointless. This can stem from believing their weaknesses are fixed or a history of unsuccessful attempts at improvement. Finally, volition refers to a lack of motivation or enthusiasm. Students might prioritise grades over understanding their performance, avoid negative emotions associated with feedback, or simply be unwilling to invest the time and effort (Nash & Winstone, 2017).

The above describes the multifaceted nature of students engagement with feedback, but leaves out another important aspect of student feedback literacy: feedback seeking, which is a relatively untapped area of current research (Carless & Young, 2024).

Feedback Seeking and Feedback Seeking Behaviour

In this study, the dynamics of feedback seeking within an educational context is examined, distinguishing it from "Feedback Seeking Behaviour" (FSB), a concept predominantly investigated in workplace environments within academic discourse (Ashford & Cummings, 1983). FSB refers to the proactive measures individuals take to obtain feedback on their work performance, roles, or objectives, instead of relying on indirect information from observing or inferring (Anseel et al., 2015). This direct feedback can come from peers, supervisors, or external sources, demonstrating an individual's eagerness to learn and enhance their capabilities. In contrast, feedback seeking within the educational environment aligns more closely with the feedback literacy framework from Carless & Boud (2018), particularly the aspect of appreciating feedback. The premise is that if students perceive themselves as consumers and rely on the teacher's guidance, they will not be able to take responsibility for their own learning (Bunce et al., 2017). In contrast, if students value feedback, they are more inclined to actively pursue it and make individual judgements in improving their work (Tai et al., 2017; Pitt & Winstone, 2022). This proactive approach to feedback seeking is crucial for educational development, facilitating a deeper engagement with learning processes and fostering an environment conducive to continuous improvement (Winstone & Nash, 2019).

Two main directions for recent research on feedback seeking can be identified. First, although FSB in workplace contexts and learning settings stem from distinct origins, researchers are increasingly drawing insights from organizational practices to enhance feedback seeking in higher education (Joughin et al., 2020; Leenknecht & Carless, 2023). These cross-domain studies aims to translate the findings into better understand of feedback literacy within academic settings. Second, a more detailed model of feedback literacy can be designed. For instance, a recent study by Dawson et al. (2023) has refined the concept of feedback seeking by distinguishing it from the broader framework of feedback literacy. They developed a scale to quantify students' feedback-related behaviours, emphasising the distinction between seeking and utilising feedback. Their study highlights the close correlation between these actions, arguing that acquiring feedback is a prerequisite for its effective interpretation and application. This sequential understanding underscores the importance of feedback seeking as a foundational step in the educational process, enabling students to fully leverage feedback for their learning and growth.

Learning Analytics and Feedback Generation

Research in the field of learning analytics and feedback generation is evolving rapidly, focusing on improving educational outcomes through proper consideration on the types of data, analytic methods, objectives and stakeholders (Banihashem et al., 2022). A key theme in this research is the role of personalised and actionable feedback, highlighting the critical importance of providing individualised, timely, and relevant feedback within learning environments. Tools and dashboards for learning analytics are being developed to support self-regulated learning by offering learners personalised insights and feedback based on their behaviours and performance (Sedrakyan et al., 2020). These tools assist in identifying learning patterns, emotions, and strategies that have a significant impact on outcomes.

Examples of research in learning analytics and feedback include Clow's (2012) paper, which introduces a cycle for learning analytics aimed at personalising the learning experience through effective data use to close the feedback loop between learners and educators. Ali et al. (2012) explore a tool designed to provide educators with personalised insights into student learning to enable more tailored feedback mechanisms. Fyfe & Rittle-Johnson (2016) discovered that computer-generated feedback, when coupled with guidelines, enhances problem-solving tactics in mathematics, with immediate feedback leading to improved learning outcomes.

However, it is noted that a small proportion of current learning analytics research directly addresses providing effective feedback to teachers and students, with a major focus on content customization (Chatti et al., 2012). This indicates a need for more research in the specific area of learning analytics and feedback.

Research Questions and Contributions

Question 1: What kind of student profiles emerge from clustering analysis based on feedback seeking actions, group attributes, and responses from the survey form?

This question investigates the profiles that emerge from clustering analysis, that uses feedback seeking actions, group attributes, and responses from the survey form in an online learning context to create distinct student profiles. These profiles will be further examined in the next research question.

Question 2: What can the unique features of each student profile reveal about the factors influencing feedback seeking actions in online learning tasks?

This question focuses on the insights derived from student profiles, specifically regarding the factors that influence feedback seeking. It aims to explain the underlying reasons for the observed profiles. By pinpointing specific characteristics and behaviours that differentiate learners, educators or learning platform designers can develop more personalised feedback mechanisms and learning interventions, potentially enhancing student engagement and academic achievement in digital environments.

In addressing these questions, this study contributes to the field of feedback literacy in elementary education, where research on feedback seeking actions is still in its infancy. Although feedback literacy is an emerging field in higher education contexts (Nieminen & Carless, 2023), there is a significant gap in understanding how it applies to younger students. By integrating learning analytics with feedback mechanisms, this study enhances our understanding of these intersections and provides valuable insights that can inform the development of more effective feedback practices and educational technologies tailored to primary school learners.

METHODOLOGY

Instrument and Participants

This study is embedded within the KidNET project (Erdmann & Mikkilä-Erdmann, 2023). KidNET project targets enhancing digital literacy of elementary school students, with a special focus on science content. The initiative strives to develop a comprehensive set of skills and competencies that enable students to navigate and conduct research effectively in the diverse digital learning environment.

This study, conducted in autumn 2023, engaged a diverse group of elementary school students from 4 schools located in southwest Finland. The participant pool consisted of 169 grade 5 to 6 students, aged from 10 to 12. Due to not all students participating in both pre-test and post-test, the final sample size comprised 89 students in the intervention group and 46 students in the control group who completed the entire experiment. The grouping procedure will be explained in detail in the next section on the experimental framework. In Finland, schools have some autonomy in implementing the Finnish National Core Curriculum. While there is no standardised Information and Communication Technology (ICT) subject at the elementary school level, ICT skills are emphasised as transversal skills throughout the core curriculum (Opetushallitus, 2014). As a result, all Finnish schools have internet access and computers for student learning purposes, which enables students to develop their ICT skills in various subjects. This diversity of participants and settings provides a robust foundation for examining the nuances of feedback seeking in an increasingly digital learning landscape.

The KidNET digital learning platform (**Figure 1**), the primary tool of our study, is intricately designed to support the project's objectives. It simulates an interactive, closed online environment where students are presented with a task that mirrors real-life online research scenarios within a science context. To complete a task, students must engage in a series of processes: searching for sources of information via a search engine like in the internet, evaluating the reliability and relevance of sources, identifying key ideas within a science text related to the task, and synthesising those ideas into paragraphs that address the task's questions. Log data is gathered automatically with actions and timestamps.

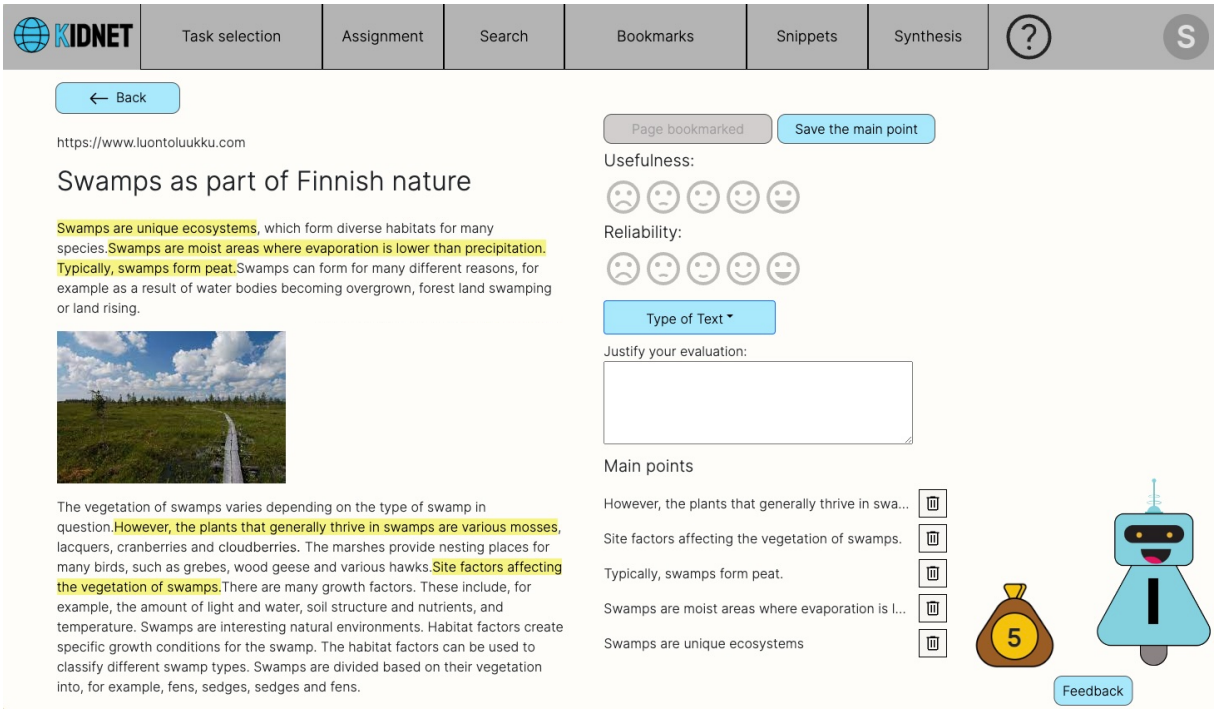

Figure 1: The KidNET digital learning platform, machine translated from Finnish to English. (© 2024 KidNET)

Experimental Framework

The parent study adopted a quasi-experimental design (**Figure 2**), in which two measurements, a pre-test and a post-test, were utilised to assess skill improvement and changes in feedback seeking actions. Each test included a task, centred on the science topics of forests and swamps. Articles related to these topics were carefully selected and modified to ensure consistency in content and complexity, facilitating the tracking of learning outcomes. The task topics were swapped in the post-test.

Classes of students were assigned to either a control or intervention group. Students in both groups were introduced to the KidNET learning platform and its real-time feedback feature through a demonstration video just before the pre-test. The intervention group received five 90-minute learning sessions before the post-test, focusing on enhancing skills in three key areas: internet searching and evaluating, identifying key ideas within science texts, and synthesising information. They are designed specifically for science literacy, mentioned in the Finnish National Core Curriculum for Basic Education (Opetushallitus, 2014). However, these intervention sessions did not specifically address feedback literacy. In contrast, the control group continued with their regular lessons as usual.

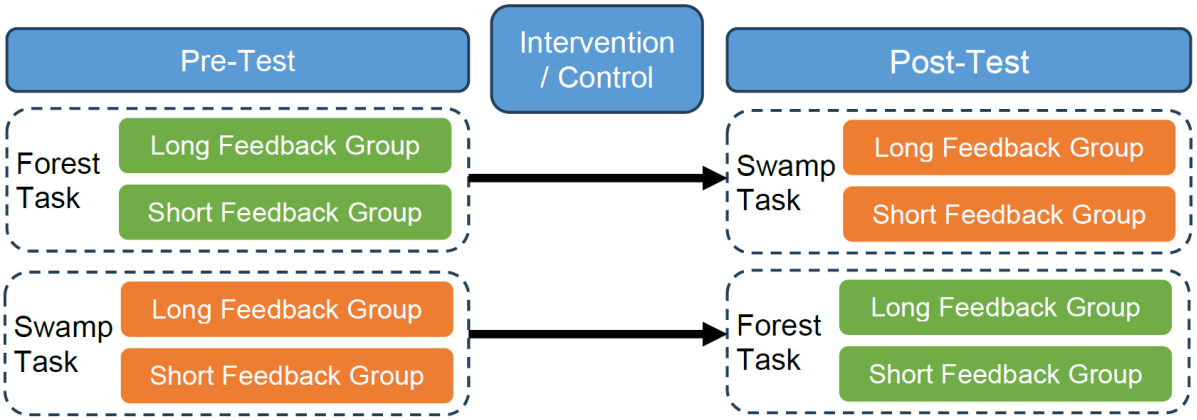

Figure 2: The quasi-experimental design in this study.

Learning Analytics on Feedback

On top of the general experimental framework, the focus of this article places a particular emphasis on the dynamics of feedback seeking among students. Therefore, the design of the real-time feedback mechanism and its integration into student groups should be carefully crafted to align with the investigative goals.

A robot is introduced to give students real-time feedback (**Figure 3**). Students can seek feedback voluntarily by clicking the feedback button, limited by 15 tokens. To explore the impact of feedback depth, students were randomly assigned to receive either short or long feedback, regardless of their initial group. Short feedback included basic data on task performance based on the real-time analysis on log data, while long feedback, as suggested by Hattie & Timperley (2007), also offered more detailed actions for improvement.

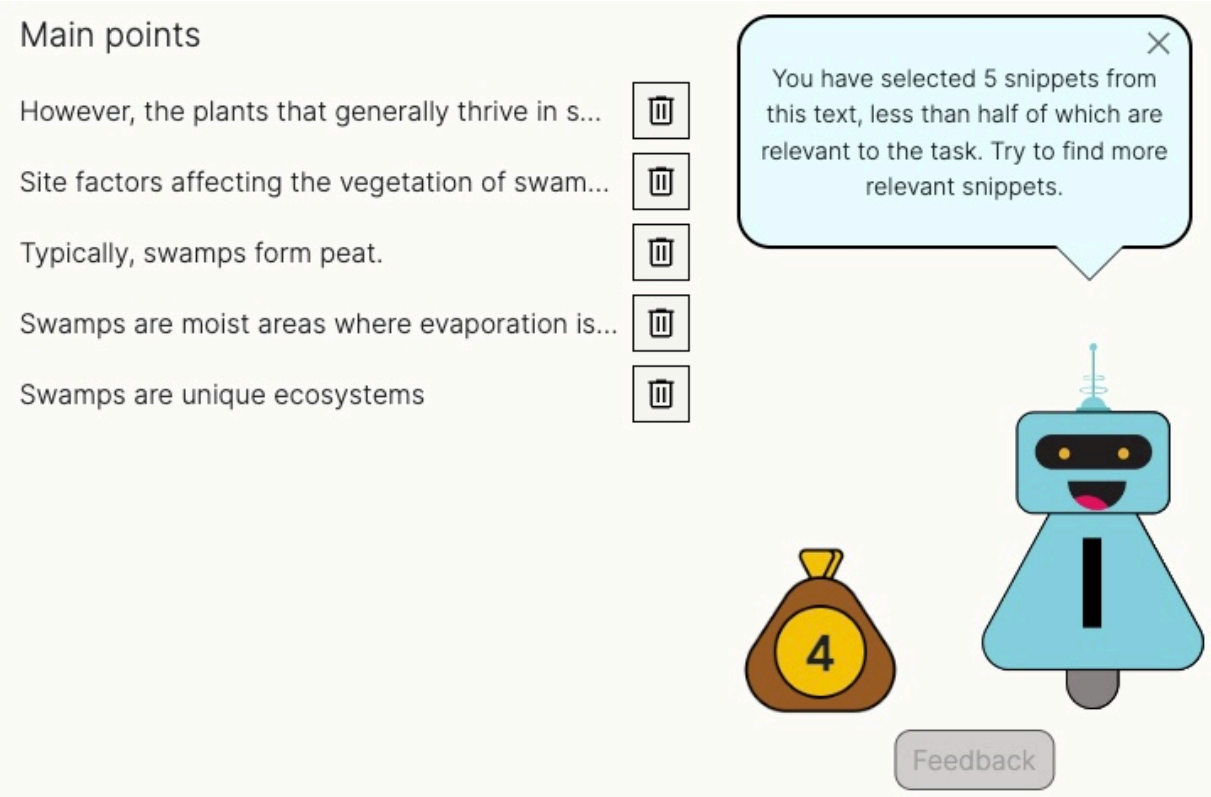

Figure 3: The robot is providing feedback to a student. (© 2024 KidNET)

Data Collection and Preparation

The study adhered to ethical standards by obtaining informed consent from all participants and undergoing ethical pre-evaluation. Data was anonymised and securely stored in compliance with GDPR regulations, ensuring that individual participants could not be identified, maintaining confidentiality and adhering to data protection laws. Specifically for this study, variables extracted include whether participants were in the intervention or control group, the topic of the task, and whether they received long or short feedback. Additionally, the number of feedback requests was tallied. To facilitate the analysis of the impact of whether or not students requested feedback, a binary variable 'no feedback' was created. These variables are listed in **Table 1**.

The responses from the survey form also provided valuable insights. They were collected immediately after the pre-test and post-test. There are 7 items in the survey form rated on a 3-option Likert scale, as shown in **Table 2**. They covered various aspects of the task and the KidNET platform, such as task interest, ease, usefulness, platform usability, and learning outcomes. Regarding questions 5 and 6, the Octopus logo on the top-right corner of the platform provides tutorial information on how to use each page, while the Robot, accessible on the bottom-right corner during search or reading tasks, enables feedback requests, as described in the previous section.

Variables	Description	Variable Type
'group'	Intervention group (1) or control group (0)	Binary
'task'	Topic of the task, forests (1) or swamps (0)	Binary
'type'	Long feedback (1) or short feedback (0)	Binary
'feedback count'	Number of feedback requested	Discrete
'no feedback'	Indicates whether no feedback was requested (1 for zero feedback, 0 for one or more)	Binary
'q1' … 'q7'	Responses to 7 survey form items rated on a 3-option Likert scale (1 = Agree, 2 = Neutral, 3 = Disagree)	Ordinal

Table 1: Variables to be analysed.

Item	Question
q1	The task was interesting.
q2	The task was easy.
q3	The task was useful.
q4	KidNET was easy to use.
q5	The Octopus provided enough help and support.
q6	The Robot provided enough help and support.
q7	I learned internet reading in KidNET.

Table 2: Items in the survey form.

DATA ANALYSIS

Overview

The data analysis adopted a three-step approach: clustering analysis, within-profile difference analysis, and between-profile comparison. The initial clustering analysis addresses the first research question, with the subsequent steps corresponding to the second research question. This structured approach allows for a flexible selection of models, enhancing the robustness and accuracy of the analysis.

In the first step, the k-medoids clustering algorithm is utilised, employing the Gower distance metric due to its capability with mixed-type variables such as binary, ordinal, and discrete. By calculating similarities across diverse variables without requiring data transformation, k-medoids clustering with the Gower distance metric adeptly handles datasets of various variable types, thereby ensuring an accurate measure of similarity between data points.

To focus the analysis effectively, variables crucial to the research questions, especially the number of feedback requested, are given priority in the clustering process. This selective approach is vital for the clarity and utility of the clusters. Subsequently, various combinations of variables are evaluated, with silhouette scores calculated to assess clustering quality. Higher scores denote greater dissimilarity between clusters and increased homogeneity within clusters, indicating a more meaningful grouping. Although silhouette scores can vary, those closer to 1 are generally preferred, serving as a benchmark for the ideal clustering configuration (Rousseeuw, 1987).

In the second step, which delve into the assessment of within-profile differences between pre-test and post-test outcomes, McNemar's mid-p test is employed for binary variables and the Wilcoxon signed-rank test is utilised for ordinal and discrete variables. These statistical tests are selected for their appropriateness in handling specific data types, ensuring a precise evaluation of changes over time within the same profile.

In the final step, the Mann-Whitney U Test is chosen for between-profile comparisons. This non-parametric test is favoured for its ability to compare distributions between two independent groups without requiring the assumption of normal distribution, making it particularly suitable for analysing differences in feedback seeking actions and other pivotal variables across various profiles. Through this method, we gain a comprehensive understanding of the distinct characteristics and behaviours of each profile, shedding light on factors that could significantly enhance learning experiences.

Clustering

Given the focus on feedback seeking in our research question, the number of feedback instances is an important variable. Thus, 'Pre feedback count' and 'Post feedback count' were selected as primary features for the initial clustering phase, where the prefixes 'Pre' and 'Post' denote pre-test and post-test data, respectively. The first iteration tested combinations of these two variables with one of the other variables in **Table 1**, and the one with the highest silhouette score was chosen as the foundation for the next phase, detailed in **Table 3**. The process continued up to the fourth iteration, where a significant decline in the silhouette score was observed, indicating that no further iterations would be beneficial.

Variables combination	**k***	**Silhouette**
First iteration		
'Pre feedback count', 'Post feedback count', 'Post no feedback'	2	0.795
'Pre feedback count', 'Post feedback count', 'Pre no feedback'	3	0.759
'Pre feedback count', 'Post feedback count', 'Pre type'	2	0.739
Second iteration		
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback'	4	0.824
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre type'	4	0.783
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre task'	4	0.781
Third iteration		

'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Post type'	4	0.736
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'group'	5	0.679
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Pre type'	5	0.671
Fourth iteration		
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Post type', 'group'	5	0.607
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Post type', 'Pre task'	5	0.592
'Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Post type', 'Post task'	5	0.592

Table 3: Progressive iterations of clustering analysis showing the top three combinations per iteration.

In classical clustering problems, the well-structured Iris dataset typically yields silhouette scores ranging from 0.5 to 0.7 for optimal cluster sizes k (Shahapure & Nicholas, 2020). Considering that social science datasets often exhibit greater variability and complexity compared to those in natural sciences, a silhouette score above 0.5 is deemed quite satisfactory.

The profiles, created by labelling the clusters, were identified based on one selected combination for in-depth analysis. The selection between the top results of the second and third iterations, which scored 0.824 and 0.736 respectively, goes beyond silhouette scores alone. The inclusion of 'Post type' in the third iteration enriches the analysis by providing insights into how feedback seeking varies with different feedback types. This addition introduces more diversity, considering both 'feedback count' and 'no feedback' originate from the quantity of feedback, and aligns with the study's objectives. It also indicates a deliberate balance between statistical integrity and the relevance of variables to research aims, ensuring the clusters are meaningful and pertinent for further examination. **Table 4** illustrates the four profiles derived from the combination ['Pre feedback count', 'Post feedback count', 'Post no feedback', 'Pre no feedback', 'Post type'], along with the descriptive statistics for all variables. The naming of each profile will be explained at the end of Within-Profile Differences section.

		Profile			
Variable		**1 (N = 29)**	**2 (N = 22)**	**3 (N = 17)**	**4 (N = 67)**
		Disen-gaged Learners	**Paradoxi-cal Inde-pendents**	**Proactive Feed-backers**	**Consistent Seekers**
group	proportion	0.76	0.73	0.82	0.55
Pre task	proportion	0.52	0.59	0.53	0.48

Post task	proportion	0.48	0.41	0.47	0.52
Pre type	proportion	0.41	0.45	0.71	0.45
Post type	proportion	1.00	0.86	1.00	0.88
Pre feedback count	mean (median)	2.76 (2)	0.05 (0)	0.00 (0)	3.94 (3)
	proportion	0.00	0.95	1.00	0.00
Post feedback count	mean (median)	0.00 (0)	0.00 (0)	3.71 (2)	3.37 (3)
	proportion	1.00	1.00	0.00	0.00
Pre q1 (Interesting)	mean (median)	1.59 (1)	1.55 (1.5)	1.94 (2)	1.81 (2)
Post q1 (Interesting)	mean (median)	2.07 (2)	1.68 (2)	2.00 (2)	2.00 (2)
Pre q2 (Easy)	mean (median)	1.97 (2)	1.95 (2)	2.18 (2)	2.13 (2)
Post q2 (Easy)	mean (median)	1.69 (2)	1.59 (1.5)	1.82 (2)	1.90 (2)
Pre q3 (Useful)	mean (median)	1.55 (1)	1.50 (1.5)	1.71 (2)	1.78 (2)
Post q3 (Useful)	mean (median)	1.90 (2)	1.64 (2)	1.94 (2)	2.00 (2)
Pre q4 (User-friendly)	mean (median)	1.52 (1)	1.55 (1)	1.47 (1)	1.64 (1)
Post q4 (User-friendly)	mean (median)	1.55 (1)	1.27 (1)	1.59 (1)	1.67 (2)
Pre q5 (Instructions)	mean (median)	1.62 (2)	1.59 (2)	2.00 (2)	1.67 (2)
Post q5 (Instructions)	mean (median)	2.00 (2)	2.00 (2)	1.94 (2)	2.04 (2)
Pre q6 (Feedback)	mean (median)	1.72 (2)	1.91 (2)	1.88 (2)	1.94 (2)
Post q6 (Feedback)	mean (median)	1.97 (2)	1.95 (2)	1.88 (2)	2.03 (2)
Pre q7 (Learning)	mean (median)	1.52 (1)	1.41 (1)	1.53 (1)	1.82 (2)
Post q7 (Learning)	mean (median)	1.93 (2)	1.59 (2)	1.71 (1)	1.97 (2)

Table 4: Profiles and descriptive statistics.

Within-Profile Differences

This section evaluates whether significant changes, or the lack thereof, occurred within each profile from pre-test to post-test, pinpointing specific characteristics unique to that profile.

There are three binary variables: the theme of the task ('task'), the type of feedback ('type'), and whether the student has requested feedback ('no feedback'). Since 'task' and 'type' are variables intentionally manipulated within the study's design, their changes are not random. Therefore, conducting significance tests for intra-profile changes on these variables is

unnecessary. For 'no feedback', a contingency table is created, as shown in **Table 5**. McNemar's mid-p test is then employed to determine the significance of changes from pre-test to post-test, which helps in understanding the behaviour characteristic of each profile. The result is shown in **Table 6**.

	No feedback requested in Post-Test	**Feedback requested in Post-Test**
No feedback requested in Pre-Test	a	b
Feedback requested in Pre-Test	c	d

Table 5: Contingency table for the 'no feedback' variable.

		Profile			
Variable		**1 (N = 29)**	**2 (N = 22)**	**3 (N = 17)**	**4 (N = 67)**
		Disengaged Learners	**Paradoxical Independents**	**Proactive Feedbackers**	**Consistent Seekers**
no feedback	[a, b, c, d]	0, 0, 29, 0	21, 0, 1, 0	0, 17, 0, 0	0, 0, 0, 67
	p	<.001*	.500	<.001*	1.000

* p < .05

Table 6: McNemar's mid-p test result.

The results suggest that students in profiles 1 and 3 underwent significant shifts in feedback seeking actions. Profile 1 requested feedback in the pre-test but not in the post-test. Profile 3 shows the opposite pattern, requested feedback only in the post-test. In contrast, no significant changes were observed in profiles 2 and 4. Students in profile 2 generally did not seek feedback, while those in profile 4 consistently requested it in both tests. Further analysis will be performed to explore the factors behind these changes or their absence.

For the remaining variables, which include the number of feedback requested ('feedback count') and the responses from the survey form ('q1' to 'q7'), the Wilcoxon signed-rank test has been employed to determine if there are significant within-profile changes. The results are presented in **Table 7**, where '+R' denotes the sum of ranks for observations where the post-test score was higher than the pre-test score, and '-R' represents the sum of ranks for observations where the pre-test score was higher than the post-test score. In the context of 'feedback count', a negative rank indicates a decrease in the number of feedback requests; for 'q1' to 'q7', it signifies a tendency towards disagreement. 'Z' represents the Z-statistic, 'r' indicates the effect size, and 'p' denotes the level of statistical significance.

Variable	Profile 1 (N = 29) Disengaged Learners					Profile 2 (N = 22) Paradoxical Independents				
	+R	*-R*	*Z*	*r*	*p*	*+R*	*-R*	*Z*	*r*	*p*
feedback count	0	435	-4.7	-0.87	<.001*	0	22	-4.11	-0.88	.317
q1 (Interesting)	41	289	-3.82	-0.71	.004*	54	108	-2.35	-0.5	.317
q2 (Easy)	229	86	-2.84	-0.53	.091	170.5	46.5	-2.6	-0.55	.033*
q3 (Useful)	28.5	253.5	-4.09	-0.76	.006*	38	95	-2.87	-0.61	.257
q4 (User-friendly)	138.5	160.5	-1.71	-0.32	.792	129.5	18.5	-3.51	-0.75	.034*
q5 (Instructions)	49.5	280.5	-3.63	-0.67	.007*	56	161	-2.29	-0.49	.075
q6 (Feedback)	91	224	-2.74	-0.51	.117	85	90	-1.35	-0.29	.928
q7 (Learning)	97	283	-2.61	-0.48	.037*	52.5	122.5	-2.4	-0.51	.206

Variable	Profile 3 (N = 17) Proactive Feedbackers					Profile 4 (N = 67) Consistent Seekers				
	+R	*-R*	*Z*	*r*	*p*	*+R*	*-R*	*Z*	*r*	*p*
feedback count	153	0	-3.62	-0.88	<.001*	831	1311	-1.92	-0.24	.129
q1 (Interesting)	42	56	-1.63	-0.4	.705	556	1161	-3.64	-0.44	.041*
q2 (Easy)	84.5	13.5	-2.98	-0.72	.056	1194	455	-4.28	-0.52	.011*
q3 (Useful)	0	62	-3.62	-0.88	.046*	377	1040	-4.76	-0.58	.018*
q4 (User-friendly)	15.5	46.5	-2.89	-0.7	.317	811	906	-2.05	-0.25	.749
q5 (Instructions)	56	42	-1.63	-0.4	.705	273	1410	-5.41	-0.66	.000*
q6 (Feedback)	43.5	43.5	-1.56	-0.38	1.00	712	971	-2.67	-0.33	.380
q7 (Learning)	0	33	-3.62	-0.88	.157	485	890	-4.09	-0.5	.142

Table 7: Wilcoxon signed-rank test result.

The test results are presented below with an assignment of descriptive names to each profile.

Profile 1, the Disengaged Learners, demonstrates a reduction in number of feedback seeking. Participants in this group reported finding the tasks less interesting and useful as the study progressed. Additionally, they felt the clarity of instructions and overall learning decreased.

Profile 2, the Paradoxical Independents, displays a consistent pattern of not requesting feedback throughout the study, despite recognising the task as easier and the system as more user-friendly. This paradoxical behaviour suggests a complex interplay of factors

influencing their engagement with feedback seeking. Subsequent analysis, including comparisons between profiles in the next section, could shed light on potential underlying factors.

Profile 3, the Proactive Feedbackers, is characterised by an increase in seeking feedback. However, there is a notable decrease in the perceived usefulness of the tasks.

Profile 4, the Consistent Seekers, shows a steadiness in the pattern of feedback requests, but with participants reporting a decline in task interest and usefulness, alongside less clear instructions. Despite these views, they perceived the tasks to be easier.

Between-Profile Comparisons

In this section, descriptive statistics from **Table 4** will be examined. While some differences between profiles are clearly visible, statistical tests will be applied to those disparities that are not immediately apparent or when there is a need to confirm their significance. This approach is crucial to ensure that the analysis is thorough and the conclusions drawn are substantiated, thereby solidifying the findings of the study.

Number of Feedback ('feedback count' and 'no feedback')

These variables are the key differentiators between the student profiles. As identified in the previous section, Disengaged Learners showed a decrease in feedback use from pre-test to post-test. Paradoxical Independents did not utilise any feedback in both tests. Proactive Feedbackers utilised more feedback, while Consistent Seekers maintained a steady level of feedback use throughout.

Intervention or Control Group ('group')

The proportion of students in the intervention group is significantly lower in the Consistent Seekers compared to Disengaged Learners, Paradoxical Independents, and Proactive Feedbackers. This difference is supported by a two-sided Mann-Whitney U Test ($p = .010$). Further analysis reveals that 30 out of 46 students in the control group are classified under the Consistent Seekers profile. This suggests that, particularly within the Consistent Seekers profile, students from the control group are less likely to modify their feedback seeking actions without the influence of an intervention. Thus, the intervention may play a role in shifting feedback seeking attitudes, even though it does not explicitly address feedback literacy as described in the experimental design section.

Topic of the Task ('task')

The proportion of students performing the forest task in the pre-test ('Pre task' = 1) is fairly consistent across all profiles, with a tendency to hover around 0.5. Similarly, the distribution of in the post-test ('Post task') remains balanced. This indicates that the topic of the task, forest or swamp, does not disproportionately influence any single profile, suggesting it has a limited effect on the variance in feedback seeking observed among the different groups.

Long or Short Feedback ('type')

Most students in the post-test received long feedback, leading to notable variations between the pre-test and post-test feedback type variables ('Pre type' and 'Post type'). It is noted that Proactive Feedbackers had a significantly higher proportion of long feedback in the pre-test (0.71) compared to other profiles, which ranged from 0.41 to 0.45. However, Proactive Feedbackers did not utilise any feedback at the beginning. Therefore, no conclusions can be drawn from this pattern.

Task Interest ('q1')

Paradoxical Independents has the lowest mean on this item in both pre-test and post-test. This difference was statistically significant in the post-test compared to other profiles according to the two-sided Mann-Whitney U Test ($p = .047$). In this context, lower means on a Likert scale indicate higher agreement with the statement. Hence, Paradoxical Independents showed the most interest in the task compared to other profiles.

Easy ('q2')

It can be observed that the Disengaged Learners and Paradoxical Independents profiles have lower means than the Proactive Feedbackers and Consistent Seekers profiles for both pre-test and post-test on this item. A one-sided Mann-Whitney U Test was conducted to compare if Disengaged Learners and Paradoxical Independents perceived the task as easier than Proactive Feedbackers and Consistent Seekers. The differences were statistically significant, with $p = .042$ for pre-test and $p = .016$ for post-test. These results indicate that Disengaged Learners and Paradoxical Independents found the task easier in both tests. Interestingly, students in both profiles did not request feedback in the post-test. This implication will be discussed in the next section.

Usefulness ('q3') and User-Friendliness ('q4')

Similar to the findings for perceived task interest ('q1'), Paradoxical Independents displayed the lowest mean scores for usefulness ('q3') and user-friendliness ('q4') in the post-test relative to other profiles. Statistical significance for these differences was confirmed by two-sided Mann-Whitney U tests, yielding p-values of .042 for 'usefulness' and .032 for 'user-friendliness'. It should be noted that, within this context, a lower score indicates a tendency towards agreement. Therefore, these results imply that, compared to their peers, Paradoxical Independents found the task to be more useful and the KidNET platform more user-friendly following the intervention.

Clarity of Instructions ('q5') and Feedback Support ('q6')

In the analysis of these two items, the Mann-Whitney U tests revealed no significant differences across all profiles in both pre-test and post-test phases ($p > .05$). This uniformity suggests that the perception of instruction clarity and feedback support was consistent among students, regardless of their profile classification.

Learning Outcomes ('q7')

Paradoxical Independents emerges again as the outlier, with the lowest mean scores in both the pre-test and post-test on this item. A one-sided Mann-Whitney U Test was conducted to investigate if Paradoxical Independents reported significantly lower mean scores in the Likert scale compared to other profiles. The results were statistically significant in both pre-test ($p = .047$) and post-test ($p = .029$). Therefore, the results suggest that Paradoxical Independents perceived themselves as learning more compared to other profiles.

Discussions

The analysed results from the within-profile and between-profile comparisons in the above section are summarised in **Table 8**. The findings from the profiles reveal interesting patterns on feedback seeking.

Profile	**1 (N = 29)** **Disengaged Learners**	**2 (N = 22)** **Paradoxical Independents**	**3 (N = 17)** **Proactive Feedbackers**	**4 (N = 67)** **Consistent Seekers**
Feedback Behaviour	Using less	Keep zero	Using more	Keep using
Within-Profile Significant Features	less interesting, task less useful, instructions less clear, less learning	easier, more user-friendly	task less useful	less interesting, easier, task less useful, instruc-tions less clear
Between-Profile Significant Features	easy	interesting, easy, useful, user-friendly, learning	/	more students in the control group

Table 8: Summary of significant features of each profile.

Profile 1: Disengaged Learners

The Disengaged Learners share numerous within-profile significant features with the Consistent Seekers, particularly both profiles seek feedback during the pre-test phase. However, a key distinction between them is that the former profile ceases to seek feedback subsequently, whereas the latter continues to utilise it. The primary difference lies in the perception of learning, as the Disengaged Learners often perceive minimal learning from the pre-test and a greater number of students in this profile find the tasks to be easy compared to other profiles. This might lead to a lack of volition, where students do not feel challenged enough to seek further feedback, believing they have already mastered the content and thus see little value in additional effort (Nash & Winstone, 2017). It is also possible that some students may have received short feedback in the pre-test phase, and they might find that the feedback failed to address the process level in model of Hattie & Timperley (2007), which

is the actionable step to further proceed. Eventually, students may use their agency to decide that seeking additional feedback is futile (Nash & Winstone, 2017), as they perceive that the feedback does not provide sufficient guidance for improvement, leading to a decision to disengage from the feedback process.

Profile 2: Paradoxical Independents

The Paradoxical Independents profile presents a unique scenario where students perceived an increase in ease, usefulness, and user-friendliness of the KidNET platform and felt they had learned from it yet did not involve themselves in seeking feedback. This profile highlights an important consideration: student engagement to the learning platform and perceived learning gains in the task do not automatically translate to the appreciation to the value of feedback, which is a fundamental aspect of engaging feedback (Carless & Boud, 2018). Additionally, as previously discussed in the context of Disengaged Learners, their perception that the task was easy may lead to overconfidence and a lack of volition (Erat et al., 2022; Nash & Winstone, 2017), potentially compromising the effectiveness of feedback initiatives. Finally, some students may also be comfortable with their current methods, aligning with the concept of cognizance as a psychological barrier to engaging with feedback, as discussed by Nash & Winstone (2017). This barrier entails a lack of knowledge on how to effectively implement feedback, which can result in students not seeking or utilising feedback.

Profile 3: Proactive Feedbackers

The Proactive Feedbackers profile has fewer significant features, making it challenging to understand why these students did not initially seek feedback. However, their subsequent engagement with feedback may be explained by the social dimensions of feedback practices (Sutton, 2012; Carless & Winstone, 2020). There are 82% of students in this profile belongs to the intervention group. They had more lessons between tests, providing additional opportunities to use the learning platform. Through discussions with peers or support from teachers, these students might have overcome the initial hesitation and realised the utility of the feedback function. According to Dawson et al. (2023), a changing perception of feedback utility can prompt students to seek and use feedback more actively in subsequent tests, even they thought that the tasks are not useful.

Profile 4: Consistent Seekers

Consistent Seekers represent the largest group of students, comprising about half of the total. Despite some finding the tasks less interesting, easier, or less useful, and receiving less clear instructions, they persist in using feedback. This persistence could be indicative of an ingrained habit or a recognition of the value of feedback, which is crucial for effective engagement in feedback (Carless & Boud, 2018). The fact that many students continue to seek feedback is a positive indicator, though further investigation is needed to understand the reason behind. Furthermore, the predominance of students from the control group in this profile suggests that their consistent feedback-seeking behaviour may not be influenced by any specific intervention aimed at enhancing feedback literacy. Instead, their behaviour likely stems from existing practices and attitudes towards feedback. In contrast, it is possible that students in the intervention group with more practice on the learning system may have found

that they no longer need to rely heavily on feedback, potentially reducing their motivation to seek it out.

The diversity in feedback-seeking behaviours indicates a need for tailored approaches to feedback practices.

Implications

In both the Disengaged Learners and Paradoxical Independents profiles, students consistently rated the tasks as easy, yet notably did not seek feedback in the post-test, which could be due to the lack of volition in terms of psychological barriers of feedback (Nash & Winstone, 2017). It raises an important implication for educators: the perceived difficulty of a task may influence the likelihood of students seeking feedback. While making tasks more challenging might be a viable solution, it is equally important, if not more so, for educators to instill in students an understanding of the significance and benefits of receiving feedback for their self-reflections and improvements.

Moreover, as suggested by the Proactive Feedbackers and Consistent Seekers profiles, interventions, or working on similar tasks for multiple times in our case, may play a crucial role in changing attitudes towards feedback seeking. This provides more opportunities for students to practice using the learning platform. Besides specific focus on knowledge and skills such as identifying relevant main points in this study, there could also be an integral component dedicated to feedback seeking and utilisation during an intervention. This approach not only enhances task-based ability but also reinforces the value of feedback in the learning process. Additionally, explained in the framework by Sutton (2012) and Carless & Winstone (2020), building up a sociocultural atmosphere that appreciates feedback during the intervention may further instill the importance of feedback.

In the context of platform design, one effective feature is the ability to monitor the progress of students in seeking feedback. Rather than providing feedback immediately after each action, which could be passive to students, designers are encouraged to implement visible and intuitive mechanisms for requesting feedback. This approach minimises barriers to entry, and the collected statistics can facilitate educators and researchers to identify trends and areas for improvement at both group and individual levels.

Limitations

This study has not yet explored how the effective utilisation of feedback directly influences the identification of key ideas, an investigation that is planned for future research. As Dawson et al. (2023) points out, both seeking and utilising feedback play critical roles in developing feedback literacy. For instance, the impact of long feedback remains to be determined. A deeper understanding of how feedback is applied can provide valuable insights, enabling adjustments in pedagogical approaches to feedback literacy and improvements in feedback mechanisms within educational settings.

As a preliminary study within a broader project, the experimental design of this study was not specifically crafted with feedback-focused research in mind, particularly regarding the intervention component. This limitation suggests that while the study provides valuable

insights, a more feedback-centric approach in future experiments could yield deeper understandings of feedback dynamics.

Lastly, the study did not incorporate qualitative methods to explore participants' perceptions of the feedback mechanisms. For instance, it is beneficial for platform designers to comprehend the underlying reasons why Disengaged Learners discontinue seeking feedback, and it is equally insightful for educators to understand the factors motivating Proactive Feedbackers to initiate feedback-seeking behaviours in the post-test phase. Delving into students' attitudes and beliefs through qualitative inquiry could offer rich, contextual insights into the reasons behind their feedback seeking or lack thereof, contributing to a more nuanced understanding of how feedback tools are perceived and utilised in learning environments.

Conclusion

This study illuminated the nuanced dynamics of feedback seeking in online learning environments, emphasising the importance of feedback literacy. It identified four distinct student profiles based on their feedback seeking tendencies, highlighting the significant role of task difficulty perceptions. The study also noted that high task engagement does not automatically lead to an appreciation for feedback, suggesting educators and platform designers focus on promoting both feedback seeking and usage. Additionally, it pointed out the potential influence of intervention types and feedback nature on student engagement. Future research aims to investigate how feedback utilisation affects learning, with the goal of improving educational methods and feedback mechanisms for learning analytics.

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