Exploring learning in a self-paced online mathematics course for NEET learners:
Insights into learning outcomes and self-direction

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Abstract: This article examines the design and evaluation of a self-paced online mathematics course developed for NEET (Not in Education, Employment, or Training) learners in Finland. The course aims to lower barriers to education by providing foundational mathematics, digital skills, and field-specific modules, all structured to support self-directed learning (SDL). The pedagogical model emphasizes authenticity, guidance, and feedback-rich assessment to foster learner autonomy and engagement. The study analyses quantitative data from three pilot groups (2024–2025), revealing statistically significant improvements in mathematical skills among participants. Key SDL dimensions - motivation to learn and self-control - were found to be associated with course completion, though high scores in Self-Directed Learning Readiness Scale (SDLRS) alone did not guarantee success, highlighting the importance of additional factors such as time management and accurate self-assessment. Participant feedback was generally positive, though technical barriers, particularly a complex login process, affected participation rates. The findings underscore the importance of accessible onboarding, immediate feedback, and inclusive learning environments. The results demonstrate that a well-designed, flexible, and feedback-rich online course can effectively support the development of mathematical skills and self-directed learning among NEET learners, thereby promoting their re-engagement with education.

Keywords: NEET learners, self-paced learning, online mathematics education, learning outcomes, self-directed learning

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1 Introduction

A persistent mismatch exists between educational attainment and labour market demands in Finland (Huttunen, 2022). According to recent labour market analyses by the Finnish Ministry of Economic Affairs and Employment, Finland is simultaneously facing labour shortages in engineering and healthcare and labour oversupply in several clerical and service-oriented occupations, reflecting persistent structural mismatches in the labour market (Työ- ja elinkeinoministeriö, 2024). The Technology Industries of Finland (Teknologiateollisuus, 2023) has projected that the technology sector alone will require

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approximately 130,000 new professionals over the next decade. These roles will necessitate qualifications at both the university and vocational levels.

Despite the clear correlation between higher education and lower unemployment rates, approximately 14 per cent of Finnish youth lack a secondary education (Witting, 2021). Witting (ibid) further notes that educational attainment is often intergenerational: children from less educated families are statistically less likely to pursue tertiary education and are more prone to discontinuing their studies. Although the underlying causes of this phenomenon fall outside the scope of this discussion, the data underscore the urgency of supporting youth in completing their education.

Addressing the misalignment between educational outcomes and labour market needs requires ensuring flexible access to education throughout life. In the Finnish context, several barriers may hinder continuous education. For instance, the entrance examinations for universities of applied sciences include mathematical-logical tasks that can be an obstacle for applicants who lack confidence in their mathematical abilities. Additionally, immigrants - despite often possessing high levels of education - frequently encounter difficulties entering the Finnish labour market without a Finnish qualification (Yamate, 2025).

Access to education constitutes a fundamental prerequisite for career advancement. Individuals with limited or no formal education frequently encounter substantial barriers to professional growth (OECD, 2024). Rapid technological change has accelerated skill obsolescence, rendering many traditional occupations obsolete and increasing the need for reskilling and upskilling. At the same time, a key barrier to re-engaging with education—particularly among adults with weaker educational backgrounds—is low confidence in one's academic abilities, especially in relation to theoretical and abstract learning (OECD, 2025a, 2025b; Van Nieuwenhove & De Wever, 2024; World Economic Forum, 2025).

To address these challenges, the KoKo - Towards Education initiative offers a freely accessible online course designed to support individuals who are Not in Education, Employment, or Training (NEET). The course allows participants to review foundational mathematics at their own pace, beginning with the most basic concepts, such as calculator use. It revisits primary and lower secondary school mathematics and integrates field-specific calculations relevant to various professional domains. The course aims to lower the threshold for entering education by demystifying the mathematical skills required.

In addition to mathematics, the course introduces essential digital competencies, including spreadsheet and word processing skills, which are increasingly vital in both educational and professional contexts. The curriculum is structured into three modules: study skills, mathematics, and field-specific calculations. Successful completion requires passing the study skills and mathematics modules, along with at least one professional field module, which participants may select based on their interests.

Effective competence-based vocational education fosters self-directed and authentic learning experiences both within and beyond the workplace (de Brujin & Leeman, 2010). To support individuals seeking new employment opportunities - particularly those aiming to pursue undergraduate education - it is essential to develop and strengthen relevant skills through targeted training. In addition to targeted training, structured feedback and interactive assessment are critical for supporting self-directed learning and skill development in online vocational education. Recent research highlights that innovative feedback strategies, such as interactive exercises, foster a robust learning environment and help cultivate self-directed learning skills (Hurme et al., 2026).

2 Challenges and pedagogical foundations for supporting self-directed learning in online mathematics education

Self-paced online learning environments pose distinctive challenges for learners, particularly in mathematics education (Elibol & Bozkurt, 2023; Radmehr & Goodchild, 2022; Shank et al., 2025). Online learning environments are inherently fragmented, requiring learners to engage with content in short, often irregular intervals and to employ diverse cognitive strategies to construct knowledge (Liang et al., 2018). Consequently, participation in self-paced online courses demands a high level of learner autonomy and persistence.

Numerous studies have documented high dropout rates on online courses, particularly during the early stages of participation (Elibol & Bozkurt, 2023; Ihantola et al., 2020; D. Onah et al., 2014; D. F. Onah et al., 2021). Notably, these studies focus on university students, who are generally presumed to possess effective study skills and strategies. In contrast, the target group for this project consists of NEET learners, many of whom have been disengaged from formal education for extended periods, and may face additional cognitive, motivational, and situational challenges. For such learners, self-paced online learning environments can be both enabling and demanding: while flexibility may lower access barriers, success requires skills related to self-direction, persistence, and confidence in one's learning abilities. Consequently, courses designed for NEET learners must provide clear guidance, structured progression, and feedback-rich learning activities to support engagement and reduce attrition (Hattie & Timperley, 2007; Kõiv et al., 2024).

One often overlooked aspect of self-paced and distance learning is the social and socio-emotional dimension, as learners frequently study in isolation and have limited access to peer and institutional support (Brubacher & Silinda, 2021; Culduz, 2024). This course is completed independently at one's own pace, which means that participants do not form a peer-supportive group causing that some students may feel isolated (Culduz, 2024). Thus, social support tends to come from the participant's immediate circle. However, if there are no individuals in the participant's environment who have experience with self-paced online learning, their ability to provide encouragement and assistance may be limited (Brubacher & Silinda, 2021).

Empathy in teaching can be defined as the ability of an instructor to deeply understand students' personal and social situations, to feel care and concern in response to their emotions, and to respond compassionately without losing focus on learning objectives

(Myers et al., 2019). Within educational psychology, empathy has been conceptualised as a component of teachers' social-emotional competence that primarily influences the quality of teacher–student interactions and emotional support rather than learning outcomes directly. A systematic review by Aldrup et al. (2022) highlights that while empathy is theoretically associated with supportive instructional interactions, empirical evidence for direct effects on academic achievement is mixed and methodologically constrained.

In online and self-paced learning environments, empathy is therefore best understood as an enabling condition that supports motivation, engagement, and persistence, rather than as a direct determinant of learning outcomes (Aldrup et al., 2022; Myers et al., 2019). Myers et al. (ibid) further emphasise that teacher empathy is not merely an individual trait but an integral element of teaching presence, manifested through communication style, responsiveness, and instructional decisions. Empathy may thus contribute to learners' sense of belonging, which has been shown to predict educational persistence more strongly than prior grades alone (Myers et al., 2019).

Empathy can also be expressed through instructional support, including clear explanations, appropriate cognitive challenge, and scaffolding through timely and constructive feedback (Aldrup et al., 2022). In this study, empathy is not introduced as a separate pedagogical principle or analytical construct; rather, it has informed the instructional design from the outset and is manifested through guidance, feedback practices, and teaching presence embedded in the learning environment.

2.1 Self-directed learning as a learner readiness construct

Self-directed learning (SDL) is widely recognised as a central concept in adult education and lifelong learning, particularly in relation to learners' autonomy, responsibility, and control over their learning processes (Garrison, 1997). In its broadest sense, SDL refers to the extent to which learners take responsibility for planning, implementing, and evaluating their own learning processes, particularly in contexts where external structure and direct instructional guidance are limited. Rather than describing a specific instructional method, SDL is commonly conceptualised as a set of learner characteristics and dispositions that enable effective learning in autonomous and flexible learning environments (Saks & Leijen, 2013).

In adult education research, SDL has frequently been conceptualised as a multidimensional learner readiness construct encompassing learners' ability to manage their learning, their motivation or desire to learn, and their capacity for self-control and persistence (Fisher & King, 2010; Garrison, 1997). This conceptualisation has been widely applied in studies of online and distance learning, where learners are required to regulate their study time, sustain engagement in the absence of fixed schedules, and cope with learning challenges with limited immediate instructor support (Artino, 2008; Park et al., 2022). These demands make SDL particularly relevant in self-paced online courses, where success depends not only on content mastery but also on learners' self-regulatory and motivational resources.

In the present study, self-directed learning is treated explicitly as a learner readiness construct rather than as an outcome of instruction. SDL is thus conceptualised as a relatively stable set of dispositions at the beginning of the course that may be associated with subsequent learning processes, engagement, and outcomes, rather than as a competence that necessarily develops during the course. Consistent with established SDL research, SDL is operationalised through three interrelated dimensions: *self-management*, *desire for learning*, and *self-control* (Fisher & King, 2010). Self-management refers to learners' ability to plan, organise, and monitor their learning activities. Desire for learning reflects intrinsic interest, curiosity, and willingness to engage in learning tasks. Self-control refers to persistence, discipline, and the ability to regulate effort in the face of difficulties (ibid).

By conceptualising SDL in this way, the study aligns with prior research emphasising learners' preparedness for autonomous learning as a key factor in online and adult education contexts. Importantly, SDL is not assumed to be uniformly high or low among NEET learners; rather, existing literature suggests considerable variation in SDL readiness within this population, with implications for engagement and persistence in self-paced learning environments (Kõiv et al., 2024). Providing a transparent account of learners' initial SDL levels is therefore essential for interpreting subsequent findings and for understanding how different dimensions of SDL relate to course participation and outcomes.

2.2 Pedagogical principles supporting self-paced learning

While SDL describes learner characteristics, learning environments can either support or hinder the enactment of self-directed learning. To clarify this interaction, the present study is informed by a small set of pedagogical principles that guided the course design and are relevant to the interpretation of learners' experiences.

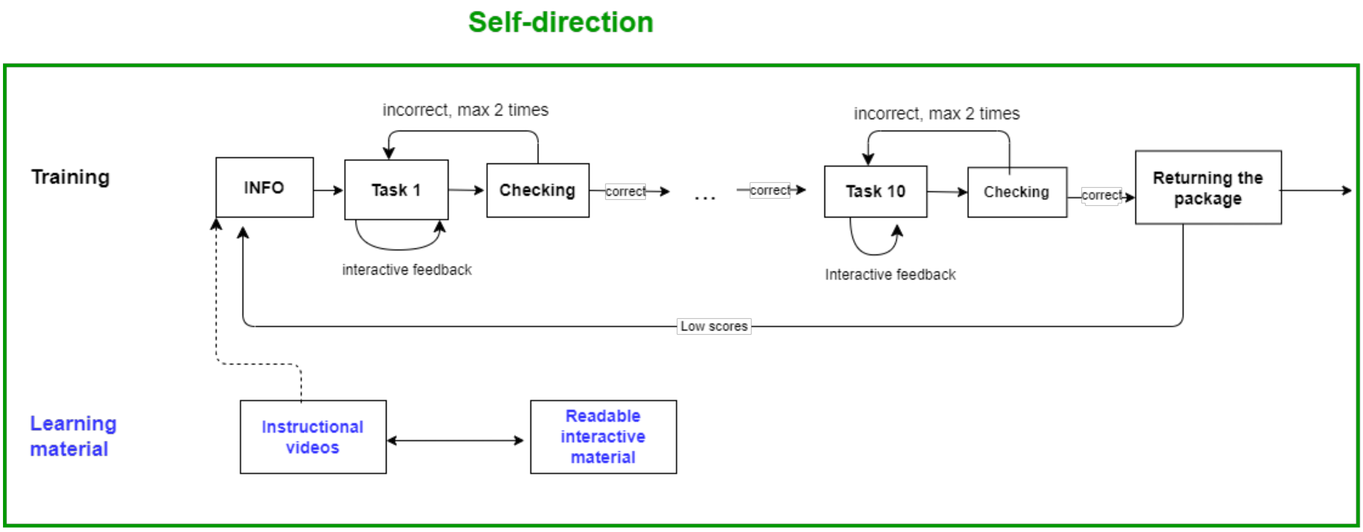
First, *autonomy-supportive design* refers to providing learners with meaningful choices regarding pacing, sequencing, and engagement with learning materials. In self-paced courses, autonomy is inherent in the absence of fixed schedules; however, autonomy support also requires clear structure, transparent expectations, and guidance that helps learners make informed choices rather than leaving them unsupported.

Second, *activity design and authenticity* concern the extent to which learning tasks are perceived as meaningful and connected to learners' goals. In mathematics education, abstract content can easily appear detached from learners' experiences (Mitchelmore & White, 2004; Watson, 1998). Designing activities that emphasise problem-solving, application, and relevance may therefore be particularly important for learners with negative prior experiences of mathematics.

Third, *scaffolding and feedback* play a critical role in supporting learners with varying levels of confidence and prior knowledge. In self-paced environments, scaffolding is often embedded in task sequences, hints, worked examples, and automated feedback. Such supports are intended to reduce cognitive overload and help learners persist through challenging content without immediate instructor intervention.

These principles function as contextual enablers rather than independent variables and are summarised in the conceptual Figure 1. The framework integrates three principles—(1) autonomy-supportive design (meaningful choices with clear structure and guidance), (2) activity design and authenticity (problem-solving, application, and relevance to learners' goals), and (3) scaffolding and feedback (sequencing, hints, worked examples, and automated feedback)— as the contextual backdrop within which learners' SDL readiness and motivational resources are enacted, consistent with prior work emphasising authentic and self-directed learning as an outcome of integrated pedagogical arrangements rather than isolated instructional techniques (de Brujin & Leeman, 2010).

Figure 1. Conceptual pedagogical framework for a self-paced online mathematics course.



(Porras et al., 2024)

2.3 Designing a pedagogical model for self-directed online mathematics learning

The rapid transition to fully online teaching during the COVID-19 pandemic revealed substantial challenges in mathematics education, particularly in relation to understanding the diverse obstacles students face in virtual learning environments. Radmehr and Goodchild (2022) showed that lecturers often struggled to recognise students' individual cognitive, motivational, and situational difficulties when teaching online, and that access to digital technologies and internet connectivity alone was insufficient to ensure effective mathematics learning. These findings are especially relevant for NEET learners, who may face additional structural and educational barriers and whose prior experiences of mathematics are often characterised by low confidence and disengagement.

Although the pandemic accelerated the adoption of digital tools and prompted a reassessment of pedagogical practices in mathematics education (Engelbrecht et al., 2020), such developments have not automatically improved accessibility or learning conditions for all learners. While digital technologies offer new possibilities for visualising mathematical concepts and supporting interaction, their pedagogical benefits are unevenly distributed and strongly dependent on instructional design. This underscores the need for pedagogical models that explicitly address learners' needs, rather than assuming that technological solutions alone will resolve learning challenges.

In response to these insights, the online learning environment developed in this project is structured around four interrelated pedagogical features: authenticity, activity design, guidance, and evaluation (de Brujin & Leeman, 2010; Hurme et al., 2023; Porras et al., 2024). The four pedagogical features described here operationalise the three overarching pedagogical principles outlined in Section 2.2. These features are not treated as isolated instructional techniques but as elements of a coherent learning arrangement that aims to support learners' engagement and self-directed learning in a self-paced online context.

Authenticity is conceptualised in two complementary dimensions. First, it is embedded in the use of profession-specific tasks that reflect real-world practices and challenges. Second, authenticity serves as a motivational resource that supports learners' self-efficacy and fosters an "I can" identity, which is particularly important for individuals considering educational or career transitions. By engaging with meaningful, context-rich tasks drawn from professional domains, learners are encouraged to see mathematics as relevant to their goals, thereby lowering the threshold for engaging with abstract content. To accommodate diverse interests and career aspirations, advanced tasks are organised into thematic modules—business, social and health care, tourism and hospitality, and technology—allowing learners to select pathways aligned with their personal goals.

The pedagogical model summarised in Figure 1 is grounded in a modified version of Bloom's taxonomy (Bloom, 1968, 1984; Pelkola et al., 2018) adapted for vocational education and implemented within the Moodle learning platform (Porras et al., 2023). The model emphasises reflective learning and leverages automated assessment and feedback to support self-direction and mastery in STEM competencies. Rather than focusing solely on task completion, the approach aims to foster metacognitive awareness by encouraging learners to reflect on their progress and learning strategies.

Automated assessment and immediate feedback play a central role in this model by supporting self-directed learning and embedding empathetic design features in the absence of continuous teacher presence. Real-time feedback during task execution helps learners identify misunderstandings, regulate effort, and maintain motivation without immediate instructor intervention. By embedding scaffolding and feedback mechanisms directly within learning tasks, the environment supports continuous reflection and adjustment, which is particularly important for learners with varying levels of confidence and prior knowledge.

Importantly, the pedagogical model presented in Figure 1 is conceptual rather than causal. The design principles it integrates—autonomy-supportive design, activity design and authenticity, and scaffolding and feedback—function as contextual enablers rather than as independent variables. The model is therefore used to structure the learning environment and to interpret learners' experiences and engagement, rather than to posit direct causal effects on learning outcomes. This perspective aligns with prior research emphasising that authentic and self-directed learning emerge from coherent pedagogical arrangements that respond to learners' needs, rather than from the mere presence of digital tools (de Brujin & Leeman, 2010; Radmehr & Goodchild, 2022).

3 Operationalising the pedagogical framework through learner-centred interactive task design

Building on the conceptual pedagogical framework presented in Section 3, this section describes how the identified pedagogical principles—autonomy-supportive design, activity design and authenticity, and scaffolding with feedback—are operationalised through learner-centred interactive task design. The purpose of this section is not to introduce new pedagogical concepts, but to illustrate how the conceptual framework is realised in practice within the self-paced online mathematics course. We operationalised the framework using automated assessment (STACK) and dynamic visual interaction (JSXGraph) to embed guidance and feedback at task level (see Section 5 for platform context and constraints).

In line with the framework, feedback and guidance are treated as design features embedded within learning tasks, rather than as independent pedagogical variables. Interactive tasks are designed to provide learners with immediate, actionable information that supports self-regulation, error correction, and persistence in a self-paced environment. This implementation-focused perspective is particularly important in online mathematics education, where opportunities for real-time teacher intervention are limited and learners must rely on task-level support to regulate their learning.

3.1 Learner-centred interactive task design in practice

The interactive task design employed in the course builds on earlier work by Porras et al. (2023) and Hurme et al. (2023), which highlights the role of automated assessment and feedback in supporting conceptual understanding and mastery learning in mathematics. A learner-centred design emphasises active engagement with mathematical concepts and seeks to accommodate diverse learning needs, prior experiences, and confidence levels.

In practice, this approach involves the integration of dynamic prompts, hints, and guiding messages within tasks. These features aim to support learners' engagement and motivation without removing responsibility for problem solving. Usability is a central consideration: interactive elements are designed to function intuitively and consistently to minimise unnecessary cognitive load. As Brown (2023) notes, poorly designed digital environments may disproportionately hinder learners with weaker self-regulation skills, underscoring the importance of inclusive and accessible task design.

Rather than relying solely on post-submission feedback, tasks are designed to provide guidance during the learning process itself. This supports learners in monitoring their progress, identifying misunderstandings, and making adjustments before final submission. Such design choices align with the autonomy-supportive principle outlined in Section 3 by enabling learners to make informed decisions while retaining ownership of their learning.

3.2 Feedback as an embedded design feature

In fully online and self-paced courses, feedback assumes a central pedagogical role due to the absence of continuous teacher–student interaction. In this study, feedback is conceptualised as embedded within task structures, serving both instructional and motivational functions. It is not examined as a separate intervention but as an integral component of interactive task design.

Effective feedback is understood to go beyond indicating correctness. It should explain why a response is incorrect, help learners interpret errors, and suggest strategies for improvement (Brown, 2023; Hattie & Timperley, 2007; Shute, 2008). A supportive tone is particularly important for learners with low academic confidence, as it can reduce anxiety and encourage persistence (Malecka et al., 2022). Immediate feedback can support learners in regulating their effort and sustaining motivation in self-paced environments, where external guidance is limited (Brubacher & Silinda, 2021; Culduz, 2024; Malecka et al., 2022).

The design of interactive tasks therefore incorporates multiple feedback modalities, ranging from facilitative hints to reflective prompts. This approach supports learners' feedback literacy by encouraging them to engage actively with feedback rather than treating it as a passive message delivered after task completion (Winstone, 2019).

3.3 Interactive feedback and guidance in practice

The pedagogical potential of embedded feedback is illustrated through interactive STACK- and JSXGraph-based tasks. These technologies enable both automated assessment and real-time interaction with mathematical objects. STACK evaluates mathematical expressions using a potential response tree (PRT), while JSXGraph allows mouse-based interaction with graphical elements.

Figure 2. Interactive feedback (left) and guidance (right) on solving equations

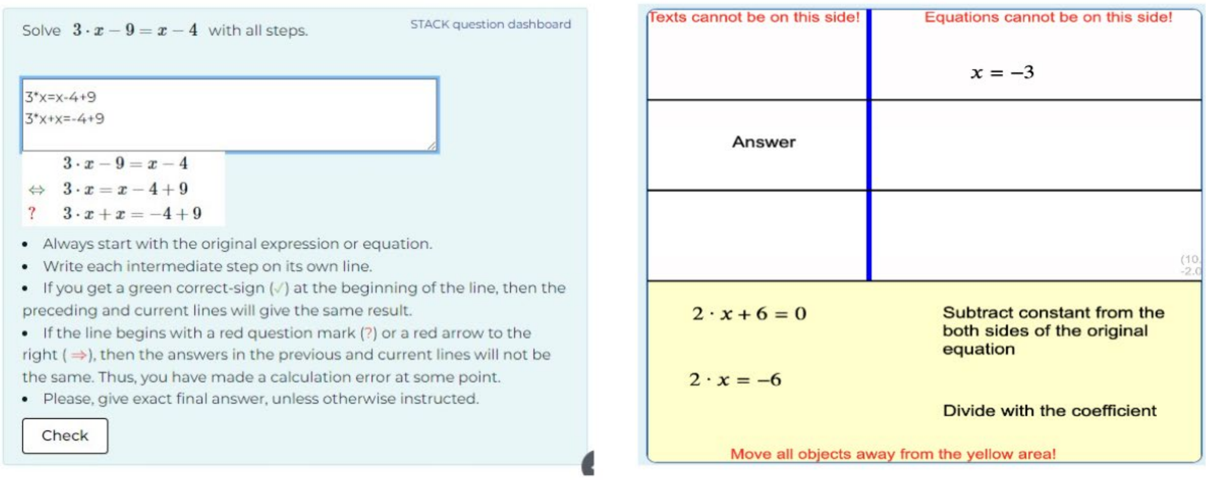


Figure 2 (left) illustrates an equation-solving task in which learners receive immediate visual cues during task execution. When an error is detected, a red question mark highlights the stage at which the mistake occurred. Although the system does not explicitly identify the nature of the error, instructional hints are provided beneath the interface. This design encourages learners to diagnose and correct their own errors prior to final submission, supporting self-regulation and reflection.

Figure 2 (right) presents a drag-and-drop task based on dynamic geometry. All procedural steps are provided, but learners must arrange them in the correct order. While the interface guides learners in placing elements on the correct side, no immediate correctness feedback is provided during the task. This intentional design choice promotes deeper cognitive engagement by requiring learners to reason about the sequence of steps rather than relying on immediate confirmation.

Both guided feedback tasks and more open-ended interactive tasks play complementary roles. The former supports confidence building and early error correction, while the latter encourages higher-order thinking and problem-solving skills. Together, they align with the pedagogical framework by balancing guidance with learner autonomy.

3.4 Monitoring engagement with feedback

Recent research highlights a gap in understanding how learners engage with feedback in digital environments and how such engagement relates to learning processes (Jin et al., 2025; Winstone, 2019). In response to this gap, the present approach places emphasis on the learning process rather than solely on task outcomes.

Building on the feedback classification model introduced by Lähteenmäki et al. (2024), this study adopts an extended categorisation scheme that distinguishes different forms of embedded feedback within interactive tasks. This classification supports systematic analysis of feedback features without attributing causal effects to specific feedback types.

Allowing learners to interact directly with feedback mechanisms—through hints, prompts, and visual cues—provides insights into their learning behaviour and self-regulation strategies. This process-oriented perspective is consistent with the conceptual framework presented in Section 3, where pedagogical principles are treated as contextual enablers rather than independent explanatory variables.

3.5 Inclusivity and usability considerations

Inclusive task design is essential in supporting learners with diverse educational backgrounds, language proficiencies, and learning difficulties. Interactive and visually supported tasks can be particularly beneficial for learners who experience challenges with text-based materials, such as limited language proficiency or reading-related learning difficulties (Brubacher & Silinda, 2021; Culduz, 2024; Malecka et al., 2022).

Consistency in layout, interaction patterns, and feedback presentation is critical for maintaining focus and reducing extraneous cognitive load. Poorly designed tasks may lead to errors unrelated to mathematical understanding, thereby undermining learning. By contrast, clear and intuitive interfaces help learners concentrate on conceptual and procedural aspects of mathematics.

The examples presented in Figure 2 illustrate how interactive task design can support exploratory learning while maintaining clarity and structure. Through careful integration of STACK and JSXGraph, tasks are designed to be adaptable to different difficulty levels, enabling gradual progression and personalised learning pathways.

3.6 Summary

This section has illustrated how the conceptual pedagogical framework presented in Section 3 is operationalised through learner-centred interactive task design. Feedback and guidance are embedded within task structures to support self-regulation, persistence, and engagement in a self-paced online mathematics environment. Rather than introducing new pedagogical constructs, the section demonstrates how autonomy-supportive design, authenticity, and scaffolding with feedback are realised in practice.

By focusing on implementation rather than theory, the section provides a concrete link between the conceptual framework and the technical and instructional solutions used in the course. This operationalisation supports the interpretation of learners' experiences and learning processes examined in the subsequent Results section.

4 Technical foundations and pedagogical potential of STACK and JSXGraph in digital mathematics education

This section provides the technical context for the learner-centred interactive task design described in Section 4. The aim is not to evaluate digital platforms as such, but to clarify how the affordances and constraints of the tools used—Moodle, STACK, and JSXGraph—enable the implementation of the pedagogical framework presented in Figure 1.

The course was implemented in the Moodle learning management system, which supports learner activity and independence in online environments (Takaendengan & Santosa, 2018). Mathematical assessment and automated feedback were delivered using STACK (Sangwin & Oyendo, 2026; STACK Team, 2024), an open-source e-assessment system based on the Maxima computer algebra system (Maxima Project, 2024). STACK supports a wide range of mathematical response types, including algebraic expressions, matrices, integers, and numerical values. Through randomisation of task parameters, each learner receives an individualised instance of a task, supporting repeated practice without reliance on memorisation.

In this project, STACK was used to implement curriculum-aligned exercises designed to support the development of foundational mathematical skills before learners progressed to more advanced topics (Porras et al., 2023). Automated assessment is implemented through potential response trees (PRTs), which enable structured evaluation of learner responses and the delivery of immediate feedback in self-paced learning contexts where continuous instructor support is limited.

To extend interactivity beyond text-based input, STACK was combined with JSXGraph (JSXGraph Team, 2024), a JavaScript-based dynamic geometry library that enables mouse-driven interaction with graphical elements such as equations, shapes, and text objects. This integration allows learners to engage with mathematical representations by dragging, arranging, and manipulating elements, thereby supporting visual reasoning and exploratory learning. The pedagogical use of JSXGraph in this study reflects deliberate design choices rather than generic platform functionality.

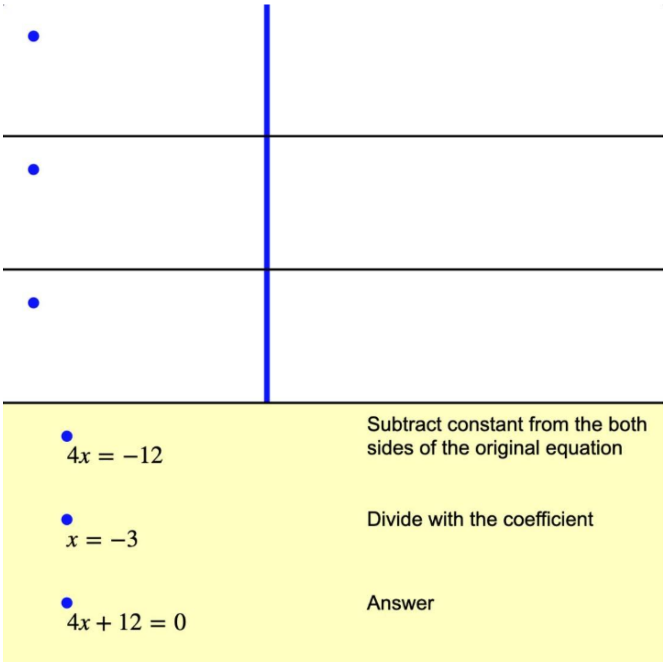
Developing advanced interactive tasks that combine STACK and JSXGraph requires substantial technical expertise and time investment, as it involves proficiency in Maxima, STACK, Moodle, and JavaScript (Amour, 2023). These practical constraints influenced task design decisions, emphasising pedagogical clarity and reusability over technical complexity.

4.1 Illustrative example: an interactive equation-solving task

Figure 3 illustrates how the technical affordances of STACK and JSXGraph are used to support conceptual understanding in a self-paced online mathematics task. In this exercise, learners are asked to construct the solution process for a linear equation by dragging equations and written explanations from a source area into designated target windows. STACK is used to randomise the numerical values of the equations, ensuring individualised task instances for each learner.

The equation-solving steps are intentionally presented in written form. Research has shown that learning is enhanced when students articulate mathematical processes in words or engage with written explanations, rather than relying solely on symbolic notation (Porras, 2015). In the present task, the written explanations are displayed in either English or Finnish, depending on the learner's selected language in Moodle. Following Bloom's Learning for Mastery framework (1968), this design supports learners in first understanding the conceptual relationship between verbalised procedures and equation-solving steps, before progressing to more formal symbolic representations, such as applying equivalent operations to both sides of an equation.

Figure 3. Interactive exercise testing the student's conceptual understanding of the steps for solving a linear equation. STACK is used to randomise the numbers for the equations



The initial configuration shown in Figure 3 represents the most demanding version of the task, requiring learners to position all elements correctly. However, the same exercise can be adapted to different difficulty levels by pre-placing one or more equations in the correct windows and requiring learners to organise only the written explanations. This flexibility allows the task to be reused across varying levels of prior knowledge while maintaining the same underlying conceptual structure.

Learner responses are evaluated using STACK's potential response tree (PRT), which assesses the validity of placements, assigns scores, and generates automated feedback. In addition to post-submission evaluation, the task incorporates real-time, pre-submission annotations triggered by the spatial position of objects within the interface. These annotations guide learners during interaction—for example, prompting them to reposition elements placed on the incorrect side or indicating when items remain unassigned. Such feedback supports early error detection and correction before final evaluation.

Interactive and visually supported exercises of this kind can be particularly supportive for learners with dyslexia or limited proficiency in the language of instruction, as they reduce reliance on dense symbolic input and facilitate intuitive understanding. By enabling experimentation, reflection, and immediate feedback, the task exemplified in Figure 3 illustrates how the technical infrastructure described in this section supports the pedagogical principles of scaffolding, feedback, and autonomy outlined earlier in the paper.

5 Objectives and research questions

The primary objectives of the project were 1) to reduce barriers to educational re-engagement among NEET learners by offering an accessible and self-paced online mathematics course; 2) to strengthen participants' foundational mathematical skills required for further studies; 3) to provide an inclusive, feedback-rich, and pedagogically coherent digital learning environment; and, more broadly, to support learners' pathways back into education and towards improved employability by enhancing their confidence and academic readiness.

This study examines how such a self-paced online mathematics course can support NEET learners in re-engaging with education by developing both their mathematical competencies and their self-directed learning skills. The analysis focuses on three core dimensions: learners' progress in foundational mathematics, the role of self-directed learning readiness in successful course completion, and learners' experiences of the course's structure, interactivity, and feedback mechanisms. Accordingly, the study seeks to answer the following research questions:

(RQ1) How are the dimensions of self-directed learning readiness (self-management, desire for learning, self-control) associated with course completion and learning outcomes?
(RQ2) How do NEET learners' mathematical skills develop during the self-paced online course?
(RQ3) How do students perceive the structure of the course, the interactive tasks, and the feedback?
(RQ4) What factors promote or hinder learner engagement and course completion in a self-paced online mathematics environment for NEET learners?

6 Methods

This study employed an observational, mixed-methods research design to examine the implementation and outcomes of a self-paced online mathematics course developed for NEET (Not in Education, Employment, or Training) learners. The methodological focus is descriptive and associative rather than causal. Specifically, the study documents learning outcomes in mathematics, associations between learners' baseline self-directed learning (SDL) readiness and course completion, learners' experiences of course structure, interactivity, and feedback, and participation patterns.

Accordingly, the analyses are intended to identify indicative patterns within the specific course context, not to establish causal effects of pedagogical design elements. All findings are interpreted as context-bound and exploratory.

6.1 Participants

Participants self-enrolled in the course across three pilot implementations conducted in autumn 2024, spring 2025, and autumn 2025. Recruitment took place through public channels, including social media, employment services (TE offices), and referrals from educators. Participation was voluntary and open to both Finnish and immigrant learners.

In total, 95 individuals enrolled in the course. Participation followed a multi-stage process, including registration, login to the Moodle learning environment, completion of SDL readiness questionnaires, engagement with mathematics tasks, and course completion. Attrition occurred at multiple stages, which is typical in self-paced online learning environments (Elibol & Bozkurt, 2023; Ihantola et al., 2020; D. Onah et al., 2014). To maintain transparency, participation is reported descriptively at each stage, and no missing data were imputed.

6.2 Course context and platforms

The course was implemented in the Moodle learning management system. Mathematical assessment and automated feedback were delivered using STACK, an open-source computer-algebra-based e-assessment system, with tasks evaluated through potential response trees. Interactive visual elements were implemented using JSXGraph, enabling mouse-based interaction with graphical and algebraic objects. These platforms constitute the instructional context of the study rather than variables of analysis. The study does not evaluate the platforms themselves, but rather examines how their affordances were used to support self-paced learning. (JSXGraph Team, 2024; Maxima Project, 2024; STACK Team, 2024)

6.3 Instruments

Learners' baseline self-directed learning readiness was measured at course entry using three dimensions derived from the Self-Directed Learning Readiness Scale (SDLRS) framework: self-management, desire for learning, and self-control. Following Fisher and King's (2010) operationalisation of SDL readiness, these dimensions were implemented as three separate questionnaires. This design choice was necessitated by technical limitations of the Moodle questionnaire tool, which does not support reverse-scored items within a single Likert-scale instrument. Each questionnaire produced a summative score representing the corresponding SDL dimension.

Learners' experiences were collected through two anonymous feedback questionnaires: F1, completed by active participants, focusing on course structure, interactivity, feedback, and technical usability; F2, targeted at participants who did not complete the course, focusing on reasons for non-completion. In addition, optional open-ended feedback was collected via email. Given the limited number of responses, feedback data were analysed descriptively.

Learning outcomes in mathematics were assessed using an Initial Knowledge Test and a Final Test. The tests were purpose-built for this course to align with the instructional content and learning objectives. They were not intended as standardized measures of general mathematical proficiency, but as curriculum-aligned indicators of learners' progress in foundational skills addressed in the course. The tests were parallel in structure, containing identical task types with randomized numerical values to minimise memorisation effects. Each test had a maximum score of six points and a time limit of 30 minutes. The tests covered foundational mathematical competencies addressed in the course, including calculation order, basic algebra, elementary geometry, interpretation of diagrams, and logical reasoning. They do not represent a comprehensive assessment of mathematical proficiency but are aligned with the course's instructional focus.

6.4 Procedure

At the beginning of the course, participants completed the three SDL readiness questionnaires. Completion of these questionnaires was required before access to course materials was granted. Based on questionnaire responses, learners received encouraging and guiding feedback intended to support awareness of their learning strategies.

After completing the SDL questionnaires, participants gained access to two compulsory modules: study skills and mathematics. Field-specific calculation modules were unlocked after successful completion of the mathematics module.

The Initial Knowledge Test was completed prior to engaging with mathematics content, while the Final Test was administered at the end of the mathematics module. Feedback questionnaires were made available at course completion or after withdrawal from the course.

6.5 Outcomes and variables

The following outcomes and variables were examined:

- Participation metrics: registration, login activity, initiation of mathematics tasks, and module completion.
- Mathematics learning outcomes: scores on the Initial and Final Tests.
- Course outcome: categorical course status (failed, partly passed, passed).
- SDL readiness: summative scores for self-management, desire for learning, and self-control.
- Learner experiences: descriptive feedback from F1 and F2 questionnaires and open-ended responses.

6.6 Data analysis

Quantitative analysis

Associations between SDL readiness dimensions and course outcomes were examined using Somers' d, an asymmetric, non-parametric measure suitable for ordinal predictors and ordered outcome variables. SDL dimensions were treated as predictors, and course outcome as the ordered dependent variable. The analysis focuses on the direction and strength of associations rather than on causal interpretation.

Normality of the difference scores was assessed using visual inspection (Q–Q plot) and a Shapiro–Wilk test and was not violated. Given the small sample size ($N = 21$), a Wilcoxon signed-rank test was additionally conducted as a robustness check. Learning gains in mathematics were analysed using paired-samples t-tests for participants who completed both the Initial and Final Tests. The paired-samples t-test was used to test the null hypothesis that the mean difference between the Initial and Final Test scores equals zero.

All quantitative analyses were conducted using IBM SPSS Statistics 30. For each analysis, the number of included cases (N) is reported explicitly.

Qualitative analysis

Due to the small number of feedback responses, qualitative data were analysed descriptively. Open-ended responses were reviewed to identify recurring themes related to engagement, usability, motivation, and barriers to participation. These qualitative insights complement the quantitative findings by providing contextualised interpretations of learners' experiences.

6.7 Risk of bias and limitations

Several limitations should be acknowledged. First, participation was voluntary, and self-selection and attrition were substantial, which limits generalisability. Second, mathematics learning gains are based on a relatively small subset of participants who completed the course and both tests. Third, the SDLRS-based questionnaires were adapted to fit technical constraints, which may affect psychometric precision.

To address these limitations, analyses are reported transparently, without data imputation, and findings are interpreted cautiously as context-specific associations rather than general effects.

6.8 Ethical considerations

Participation in the study was voluntary, and informed consent was obtained from all participants. Data were collected and stored in accordance with institutional data protection guidelines. All questionnaire responses were anonymised prior to analysis, and no personally identifiable information was used. Public access to the dataset is restricted in accordance with institutional data protection policies.

7 Results

This section presents descriptive and inferential results related to learners' baseline self-directed learning readiness, mathematics learning outcomes, participation patterns, and learner feedback. Interpretive implications are addressed in the subsequent Discussion section.

7.1 Self-directed learning readiness (RQ1)

Results were categorized into four levels: weak (< 40%), average (40–60%), good (61–80%), and excellent (> 80%) based on maximum scores. Table 1 presents the baseline distribution of SDL dimensions based on participants' responses at course entry. SDL is treated in this study as a learner readiness construct, reflecting dispositions present at course entry rather than skills assumed to develop as a result of the course. Results are therefore interpreted as indicators of learners' preparedness for self-paced learning, not as diagnostic classifications.

Table 1. Baseline Distribution of SDL Dimensions

N=54	Self-management	Desire for learning	Self-control
weak	1.9%	-	-
average	13.0%	7.4%	5.6%
good	46.3%	44.4%	46.3%
excellent	38.9%	48.1%	48.1%

Self-directed learning readiness was examined across three dimensions: self-management, desire for learning, and self-control. Among learners who successfully completed the course, all demonstrated at least a good level of readiness across these dimensions. Here, a 'good level' refers to SDL readiness scores classified as good or higher according to the thresholds defined in the Methods section. Statistical analysis using Somers' d indicated that higher scores in Desire for Learning ($N = 54$, test value = 0.405, $p < 0.001$) and Self-Control ($N = 54$, test value = 0.360, $p < 0.004$) were positively associated with course completion and higher course grades.

7.2 Development of mathematical skills (RQ2)

Learners' mathematical skills were examined through a comparison of the Initial Knowledge Test and the Final Test. Across all three pilot groups, mean scores on the Final Test were higher than those on the Initial Knowledge Test. When data from all pilots were combined, the improvement was statistically significant, indicating measurable learning gains among participants who completed both tests. Analysis of task-level performance indicated that learners experienced the greatest difficulty in areas related to logical reasoning, whereas more procedural topics, such as basic calculations and absolute values, were completed with higher average scores.

Normality was assessed for both tests using the Shapiro-Wilk test. For the Initial Knowledge Test, the test statistic was 0.959 with a p-value of 0.501 (N = 21), and for the Final Test, the test statistic was 0.954 with a p-value of 0.399 (N = 21). As the assumption of normality was met, a paired-samples t-test was conducted. Table 2 summarizes Initial Knowledge and Final Test scores for the three pilot runs and for the combined sample. Across all pilots, mean scores were higher in the Final Test than in the Initial Knowledge Test. Paired-samples t-test (N = 21, mean difference = -1.16, 95% CI = (-1.63, -0.69), t = -5.136, p < 0.001, Cohen dz = 1.21) indicated statistically significant improvement in the combined data. The Wilcoxon signed-rank test yielded the same directional conclusion as the paired-samples t-test (N = 21, W = 198, Z = 3.47, p < 0.001, r = 0.76) supporting the robustness of the observed difference among course completers. These results should be interpreted cautiously, as the Final Test was completed mainly by learners who finished the course. These within-person gains among completers should not be interpreted as causal effects or generalized beyond the engaged subgroup, given self-selection and attrition.

Table 2. Results in Initial Knowledge and Final Tests

		N	Initial Mean	St.dev
Autumn 2024	Initial	16	2.76	1.48
	Final	8	4.55	1.16
Spring 2025	Initial	20	2.75	1.57
	Final	8	4.61	0.89
Autumn 2025	Initial	19	2.75	1.11
	Final	5	4.30	0.42
All combined	Initial	54	2.76	1.39
	Initial Completers	21	3.35	1.41
	Final	21	4.51	0.89

7.3 Learner experiences and feedback (RQ3–RQ4)

Learner feedback was collected through two questionnaires and optional email responses. Overall, participants evaluated in F1 (N = 21) the course structure and content positively. Interactive tasks, learning videos, and immediate feedback were frequently mentioned as strengths, particularly in supporting understanding and maintaining engagement.

Feedback from participants in F2 (N = 11) who did not complete the course highlighted a lack of time and personal life circumstances as the most common reasons for non-completion. Technical difficulties were reported in the earliest pilot but were largely resolved in subsequent implementations. Notably, none of the participants contacted the course assistant, despite support being available. This may indicate that learners either preferred autonomous problem solving or were reluctant to seek help in an asynchronous setting.

Email feedback, including unsolicited comments from non-completers, suggests that the course was perceived as valuable even when learners were unable to finish it. Such feedback underscores the potential of flexible, low-threshold online courses to support re-engagement with learning, even when formal completion is not achieved. One participant wrote:

> “I can also tell you that even though I didn't finish the course, it was very useful, and I would have loved to have done everything if I had had enough time. … Thank you so much anyway and great that such a course is being developed!”

7.4 Participation patterns and course progression (RQ4)

Table 3 summarises participation across the three pilot implementations. Of the 95 individuals who enrolled in the course, a substantial proportion did not proceed to active engagement in the Moodle environment. Attrition occurred at multiple stages, including before first login, after initial login, and after completion of the SDL readiness questionnaires.

Table 3. Participation and course completion across pilots

	Enrolled	No login	Log into Moodle	No start	Passed	Failed
Autumn 2024	22	6	16	2	7	7
Spring 2025	30	11	19	0	9	10
Autumn 2025	43	14	29	4	7	18
Total	**95**	**31**	**64**	**6**	**23**	**35**

Such attrition patterns are consistent with prior research on self-paced online courses and MOOCs, particularly among adult learners with heterogeneous educational backgrounds (Elibol & Bozkurt, 2023; Ihantola et al., 2020; D. Onah et al., 2014). While low participation was initially assumed to reflect limited motivation or insufficient self-directed learning skills, feedback from the spring 2025 pilot indicates that technical barriers, especially the complexity of the email account activation process, also contributed to early dropout. This observation highlights the importance of accessible onboarding procedures in self-paced online learning environments.

Among those who accessed the mathematics section, engagement varied across task packages. Basic calculator-related tasks were completed by nearly all active participants, whereas participation decreased in later sections requiring more advanced skills, such as field-specific calculations. These patterns suggest that task difficulty, perceived relevance, and learners' available time interact in shaping engagement and persistence.

8 Discussion

Taken together, the results suggest that a self-paced online mathematics course can support the development of foundational mathematical skills and self-directed learning processes among NEET learners who actively engage with the course. The findings also illustrate that engagement and completion are shaped by a combination of learner readiness, pedagogical design, and contextual factors, including technical accessibility and life circumstances.

It is important to interpret these results with caution. The Final Test was completed primarily by learners who also completed the course, and thus the observed learning gains reflect the outcomes of this engaged subgroup rather than the full population of enrolled participants. Nevertheless, the consistent direction of improvement across pilot groups suggests that the course supported the development of foundational mathematical skills among active learners.

Interpreting the associations observed for RQ1 requires caution. While higher scores in Desire for Learning and Self-Control were positively associated with course completion, these findings do not imply that self-directed learning readiness is a sufficient predictor of success in a self-paced online mathematics context. Rather, the results suggest that learners' motivation to engage with learning tasks and their capacity to regulate effort and persist through challenges may function as facilitating conditions that support engagement when contextual circumstances allow.

The observed discrepancy—where some learners with high self-reported SDL readiness did not complete the course—may partly reflect limitations of self-assessment, as individuals with weaker skills can overestimate their competencies, a phenomenon documented in earlier research (Knof et al., 2024). It may also reflect the influence of external factors such as limited time, competing life responsibilities, and technical barriers, which are not captured by SDL readiness measures. This interpretation is exploratory and intended as one possible explanatory lens rather than a definitive account.

Consistent with the conceptual framework presented earlier, pedagogical principles such as autonomy-supportive structure, authentic and relevant tasks, and embedded scaffolding with feedback appear to function as contextual enablers rather than as determinants of outcomes. While these principles do not eliminate attrition, they may help sustain engagement and support learning among those who are able to participate.

Importantly, the results highlight that non-completion should not be interpreted solely as failure. For some learners, partial participation and exposure to mathematical content may still contribute to increased confidence, awareness of learning needs, or readiness for future educational engagement. From this perspective, flexible self-paced courses may play a broader role in educational pathways than is captured by completion rates alone.

Conclusions

The self-paced online mathematics course developed for NEET learners demonstrates that thoughtfully designed digital education was associated with measurable improvements among course completers foundational mathematical skills (RQ2), a finding that aligns with earlier evidence showing that web-based mathematics learning environments can lead to measurable performance improvements (Oumelaid et al., 2023). Furthermore, the positive association identified in this study between learners' desire for learning, self-control, and successful course completion (RQ1) is consistent with prior research emphasizing the critical role of self-directed learning skills in promoting engagement and persistence among NEET youth in digital learning contexts (Kõiv et al., 2024). Third, learners' feedback highlighted that the interactive tasks, immediate feedback, and clear progression structure were perceived as highly supportive, although some participants experienced technical barriers and challenges in maintaining long-term motivation (RQ3). Finally, the results suggest that inclusive task design, empathetic guidance, and accessible onboarding processes play an important role in supporting engagement, whereas external life circumstances and technical hurdles remain key barriers to completion (RQ4). Together, these insights underline the importance of combining pedagogical, motivational, and technical support when designing online learning opportunities for NEET learners.

The course's structure - combining foundational mathematics, digital competencies, and field-specific modules – was designed to lower barriers to educational re-engagement, especially for individuals who have been disconnected from formal learning or face challenges in accessing traditional education. Oumelaid et al. (2023) found that web-based mathematics self-learning, supported by digital resources, leads to measurable improvements in test scores, while Kõiv et al. (2024) highlight that inclusive, individualized approaches are particularly effective in re-engaging NEET learners and fostering self-directed learning.

Quantitative results show statistically significant improvements on the mathematics tests scores, indicating measurable improvement within this specific course context. It should be noted that the Final Test was primarily completed by those who finished the course; consequently, these participants also demonstrated learning gains. However, participation rates were affected by technical barriers such as email account activation, highlighting the importance of accessible onboarding processes in online education. This observation is supported by Faza and Lestari (2025), who, in their systematic review, emphasize that technical challenges and limited access are common obstacles in digital learning environments. They recommend that institutions prioritize user-friendly onboarding and robust technical support to ensure all learners - especially those less familiar with digital platforms - can fully participate and benefit from online courses.

Analysis of SDL readiness reveals that while strong self-directed learning skills are necessary for success in self-paced online courses, they are not always sufficient - other factors such as motivation and accurate self-assessment also play critical roles. Statistical analysis using Somers' d in IBM SPSS showed that higher scores in desire for learning and self-control were positively associated with better course grades suggesting that higher scores in these SDL dimensions were positively associated with successful course completion in this sample. This is also supported by Faza and Lestari (2025), who found in their systematic review that self-regulated learning in digital environments depends not only on core SDL competencies but also on learners' ability to set goals, manage motivation, and accurately assess their own progress. Their findings highlight that a holistic approach to SDL - including metacognitive and motivational strategies - is essential for optimal outcomes in online education.

Empathy was embedded at the level of instructional design and feedback. The intention was to foster motivation and a sense of belonging rather than to claim direct effects on achievement. Prior literature on NEET-youth similarly emphasizes that empathetic, individualized support can help cultivate motivation, engagement, and a sense of connectedness to learning pathways (Kõiv et al., 2024).

Overall feedback was positive, with requests for additional video tutorials and minor improvements. The absence of contact with course assistants suggests that offering low-threshold, real-time support options could further enhance outcomes. Consistent with earlier work, diversified engagement strategies—timely feedback, multimedia resources, and opportunities for interaction—are frequently associated with stronger learner satisfaction and outcomes in online environments (Martin & Bolliger, 2018; Oumelaid et al., 2023).

Despite the limited number of active participants and the sporadic nature of feedback, the course presents a compelling framework for supporting NEET learners by employing inclusive, feedback-rich, and competence-based online educational practices. Future iterations should focus on reducing technical barriers, expanding multimedia resources, and fostering accurate self-assessment to maximize both engagement and achievement.

Research ethics

Author contributions

P.P.: original draft preparation, formal analysis, writing - review and editing
J.H.: writing - review and editing
H.L.: writing - review and editing.

All authors have read and agreed to the published version of the manuscript.

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Copilot was used for language editing and literature identification; the authors are fully responsible for the content.

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Data availability statement

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Conflicts of Interest

The authors declare no conflicts of interest.

Appendix A

Questionnaire for self-management (SM)

1. I am self-diciplined.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

2. I am organised.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

3. I set strict time frames.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

4. I have good management skills.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

5. I am methodogical.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

6. I am systematic in my learning.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

7. I set specific times for my study.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

8. I prioritize my studies.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

9. I can be trusted to pursue my on learning.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

10. I am confident in my ablility to search out information.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

Appendix B

Questionnaire for desire for learning (DL)

1. I want to learn new information.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

2. I enjoy learning new information.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

3. I have a need to learn.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

4. I like challenges.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

5. I like studying.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

6. I critically evaluate new ideas.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

7. I learn from my mistakes.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

8. I need to know why.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

9. When presented with a problem I cannot resolve, I will ask for assistance.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

Appendix C

Questionnaire for self-control (SC)

1. I am responsible for my own decisions/actions.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

2. I am in control of my life.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

3. I have high personal standards.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

4. I prefer to set my own learning goals.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

5. I evaluate my own performance.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

6. I am logical.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

7. I am responsible.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

8. I am able to focus on a problem/assignment.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

9. I am aware of my own limitations.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

10. I know how to look for the information I need.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

11. I have high beliefs in my abilities.

○ I totally disagree. ○ I somewhat disagree. ○ I neither agree or disagree. ○ I somewhat agree. ○ I totally agree.

Appendix D

Feedback form F1

Feedback form

Continue

Mode: Anonymous

1.From which professional field did you do the exercises?

- (1) Engineering
- (2) Social and Health sciences
- (3) Tourism and Hospitality
- (4) Business
- (5) None

2. Do you think the instructions for completing the course were sufficient?

- (1) No, I had great difficulty getting started.
- (2) Quite good
- (3) Yes, there were enough instructions.

3.How did you feel about the course as a whole?

- (1) poor
- (2) satisfactory
- (3) good
- (4) very good
- (5) excellent

4. Estimate how many hours it took you to complete the course.

- (1) less than 70 h
- (2) 70 - 90 h
- (3) more than 90 h

5. Did the theory in the course help you learn the topics covered?

- (1) poorly
- (2) satisfactorily
- (3) well
- (4) very well
- (5) excellently

6. Did the interactive assignments in the course help you learn the topics covered?

- (1) poorly
- (2) satisfactorily
- (3) well
- (4) very well
- (5) excellently

7. Did the instructional videos in the course help you learn the topics covered?

- (1) poorly
- (2) satisfactorily
- (3) well
- (4) very well
- (5) excellently

8. Do you think the course assignments were versatile?

- (1) poorly
- (2)satisfactorily
- (3) well
- (4) very well
- (5) excellently

9. How did you manage to write the solutions for the course assignments?

- (1) poorly
- (2) satisfactorily
- (3) well
- (4) very well
- (5) excellently

10. Did you find the model solutions for the course assignments useful and clear?

- (1) poorly
- (2) satisfactorily
- (3) well
- (4) very well
- (5) excellently

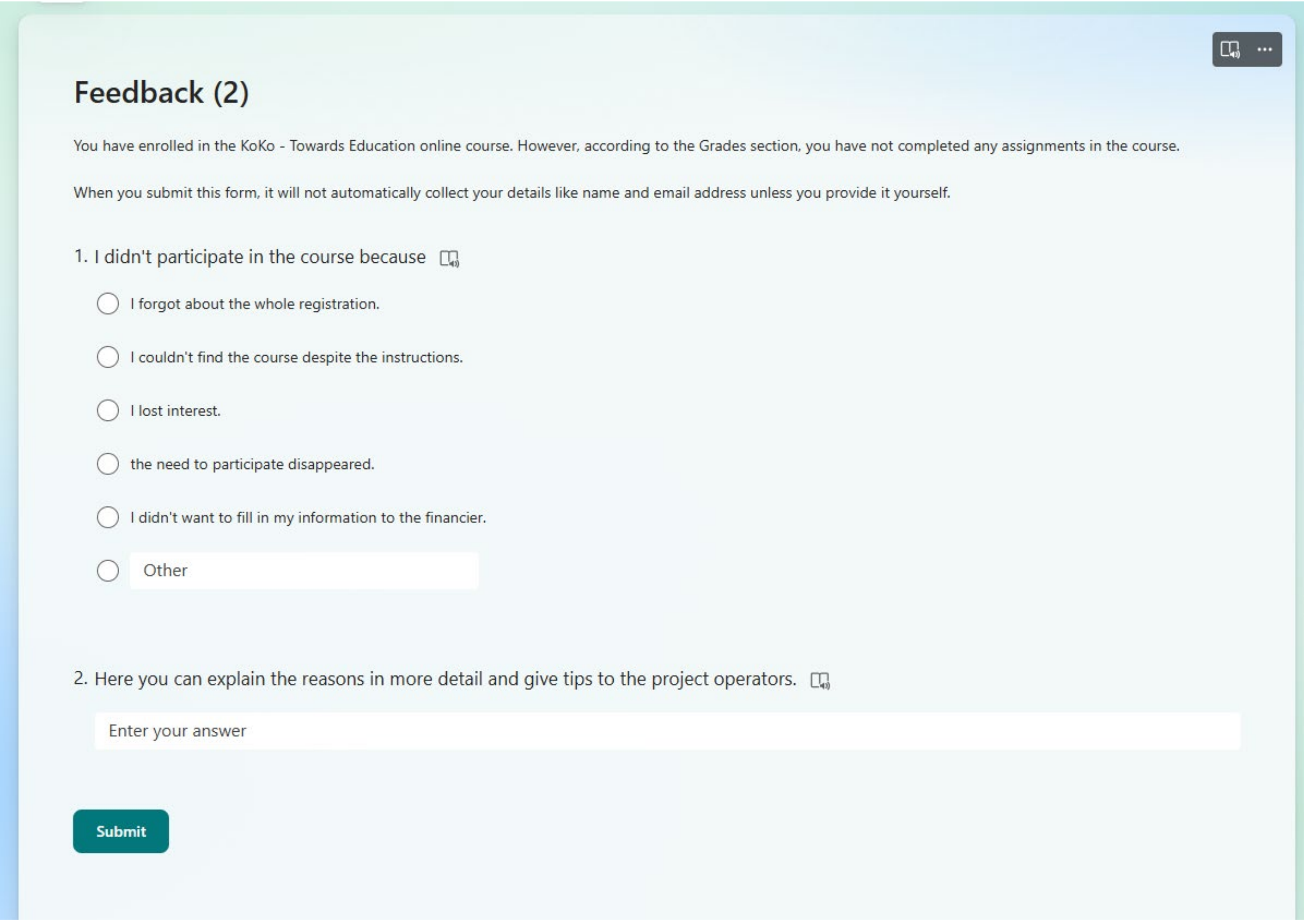
11. Leave comments and development suggestions about the course.

Required

Continue

Appendix E

Feedback form F2



Feedback (2)

You have enrolled in the KoKo - Towards Education online course. However, according to the Grades section, you have not completed any assignments in the course.

When you submit this form, it will not automatically collect your details like name and email address unless you provide it yourself.

1. I didn't participate in the course because

- I forgot about the whole registration.
- I couldn't find the course despite the instructions.
- I lost interest.
- the need to participate disappeared.
- I didn't want to fill in my information to the financier.
- Other

2. Here you can explain the reasons in more detail and give tips to the project operators.

Enter your answer

Submit

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