Digitally Supported Formative Assessment and Achievement Motivation: Evidence from the REFRESH Project

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Abstract: This study explores the impact of digitally supported formative assessment on changes in achievement motivation among higher vocational school students preparing for the teaching profession in pre-school and after-school education. The research is conducted within doctoral studies at the Faculty of Education, University of Ostrava, and is linked to the REFRESH – Centre for Research on Energy and Social Change project (CZ.10.03.01/00/22_003/0000048). The research sample consisted of 136 students from four classes. A quasi-experimental design was employed, including three experimental groups using digital formative assessment tools (e.g., Microsoft Forms, Mentimeter, self-assessment and peer assessment tools) and one control group receiving traditional instruction. Due to natural attrition during the study, the data were analysed as non-paired. Achievement motivation was assessed using the School Performance Motivation Questionnaire (Hrabal & Pavelková, 2011), focusing on the need for achievement (NfA) and avoidance of failure (NAF). The results show an increase in the need for achievement, while changes in avoidance of failure differed across groups among students exposed to digitally supported formative assessment. Differences between experimental and control groups indicate a positive association between formative assessment and the development of achievement motivation. Further analysis suggests variation in the intervention effect between students from mining family backgrounds and other students. These findings are consistent with prior research highlighting the role of formative assessment and feedback in enhancing student motivation and engagement (Black & Wiliam, 2009; Dunn & Mulvenon, 2009; Fong et al., 2019; Winstone & Carless, 2020) and extend current knowledge by providing a more detailed analysis of motivational components within a digitally enriched learning environment in initial teacher education. The study offers practical implications for educators, researchers, and policy makers seeking to design effective technology-supported feedback environments in teacher preparation.

Keywords: Formative Assessment, Digital Feedback Tools, Achievement Motivation, Pre-Service Teacher Education, Educational Technology

1. Introduction

The landscape of contemporary education is increasingly shaped by digital technologies. Such tools transform both the accessibility of knowledge and the mechanisms through which student learning is assessed. Within the spheres of vocational and teacher education, these shifts present novel challenges regarding student engagement and self-regulation. Developing performance motivation is particularly critical for pre-service teachers, as it significantly influences their own learning processes as well as their future professional practice.

Formative assessment (FA) is defined as a continuous process of collecting and interpreting information about student progress, with the primary aim of adapting instruction to meet specific learner needs (Black and Wiliam, 2009). Previous research has consistently shown that FA increases student engagement and supports a deeper understanding of the subject matter. When digital tools are integrated into FA, they create enhanced opportunities for immediate feedback and personalised learning trajectories (Winstone and Carless, 2020). Digital platforms, such as Microsoft Forms, Mentimeter, and various self-assessment tools, enable real-time interactivity that was previously difficult to achieve in larger or more diverse learning environments.

Despite the documented benefits of digitally supported formative assessment, there remains a lack of empirical research specifically situated within the context of initial teacher education. This gap is particularly significant in vocational education, where student populations are often heterogeneous. The present study is conducted as part of the REFRESH project (Research Excellence for Region Sustainability and High-tech), which examines social and technological changes in regions undergoing profound economic transformation. In such contexts, students' motivational profiles are frequently shaped by diverse socio-economic backgrounds, including families with a multi-generational history in the mining industry.

The aim of this study is to investigate the impact of digitally supported formative assessment on the performance motivation of students in higher vocational education. The research focuses on two key components of performance motivation: the need for successful performance (NfA) and the need to avoid failure (NAF), as conceptualised by Hrabal and Pavelková (2011). Utilising a quasi-experimental design, the study compares students exposed to systematic digital formative assessment with a control group receiving traditional instruction.

This paper contributes to the ongoing academic discourse on the role of feedback in digitally enriched learning environments. It provides empirical evidence on how technology-supported formative assessment can enhance students' performance motivation within specific socio-economic contexts. Ultimately, the findings offer practical implications for educators and policy makers involved in designing effective feedback practices for modern teacher education programmes.

2. Research Design and Hypotheses

The primary objective of this study is to evaluate the impact of digitally supported formative assessment (FA) on students' performance motivation within a quasi-experimental framework. The research design is situated within the specific socio-economic context of the REFRESH project, which examines educational adaptations in regions undergoing industrial transformation. By comparing experimental groups exposed to systematic digital feedback with a control group receiving traditional instruction, the study seeks to explore potential associations between assessment methods and motivational shifts.

2.1 Research Questions

To achieve the research objectives, the following research questions (RQ) were formulated:

- RQ1: How do changes in performance motivation differ between students exposed to digitally supported formative assessment and those taught using traditional instructional methods?
- RQ2: How do the individual components of performance motivation—specifically the need for successful performance (NfA) and the need to avoid failure (NAF)—develop in response to the systematic application of digital formative assessment?
- RQ3: Does the effect of digitally supported formative assessment on performance motivation differ between students from mining backgrounds and those from other socio-economic backgrounds?

2.2 Hypotheses

Based on the theoretical framework and the research questions, the following hypotheses (H) were formulated as analytical assumptions guiding the descriptive comparison of motivational development across groups.

- H1: Students exposed to digitally supported formative assessment will demonstrate a higher level of need for successful performance (NfA) at the end of the intervention compared to students in the control group.
- H2: Students exposed to digitally supported formative assessment will demonstrate a lower level of need to avoid failure (NAF) compared to students in the control group.
- H3: The overall positive shift in performance motivation (characterised by an increase in NfA and a decrease in NAF) will be more pronounced in the experimental groups than in the control group.
- H4: The impact of digitally supported formative assessment on performance motivation will differ between students from mining backgrounds and students from other backgrounds, reflecting the interaction between the intervention and specific socio-economic factors.

3. Theoretical Background

The theoretical framework of this study integrates three key domains: performance motivation, digital formative assessment, and the socio-economic context of vocational teacher education. In the era of Society 4.0, the preparation of future teachers must transcend traditional pedagogical methods to foster digital agency and self-regulated learning.

3.1 Performance Motivation and the Impact of Feedback Timeliness

Initial teacher education (ITE) represents a specific environment where professional competencies are formed, heavily influenced by students' performance motivation. According to Hrabal and Pavelková (2011), this motivation consists of the need for successful performance (NfA) and the need to avoid failure (NAF). Recent research by Fisher, Brotto and Lim (2025) identifies motivation as a key driver of learning, which can be quickly enhanced or diminished by the nature of feedback.

Crucially, the timeliness of feedback is a significant determinant of student motivation. Fisher et al (2025) found that students express significantly lower levels of motivation if feedback takes longer than 10 days to be delivered. While students do not necessarily distinguish between 'timely' (e.g. 7 days) and 'extremely timely' (e.g. less than 5 days) feedback, exceeding the 10-day threshold leads to a marked motivational decline. Furthermore, Solis Trujillo et al (2025) argue that timely and specific feedback is essential for reducing student anxiety, which directly relates to mitigating the NAF component and preventing avoidance behaviour.

3.2 Digital Formative Assessment and Personalised Feedback Loops

Formative assessment (FA) is defined as a continuous process of collecting evidence of learning to adapt instruction (Black and Wiliam, 2009). Modern digital tools, such as Microsoft Forms and Mentimeter, facilitate this process by enabling immediate interactivity. Solis Trujillo et al (2025) highlight that technological tools empower students to manage their learning more effectively by providing personalised and accessible feedback that tailors the experience to individual needs.

However, the content of feedback remains the most impactful factor. Fisher et al (2025) report that 57% of students prioritise the quality of feedback content, particularly appreciating thorough, personalised, and specific assessments of their strengths and weaknesses. This aligns with the concept of feedback literacy (Winstone and Carless, 2020), where students develop the capacity to use feedback for self-regulation. Digital FA platforms support this by creating transparent feedback loops that allow for feed-forward—providing students with actionable information on what to do next to build on their current performance (Fisher et al, 2025; Palmberg et al, 2024).

3.3 Socio-Economic Context and Educational Equity

The motivational effects of digital FA are deeply intertwined with the students' social environment. Within the REFRESH project, this study focuses on students from mining backgrounds, for whom industrial transformation presents unique career challenges. Solis Trujillo et al (2025) emphasise that feedback strategies that consider individual differences contribute to greater equity and effectiveness in education. By fostering a sense of competence and autonomy (Deci and Ryan, 2000), digitally supported FA can mitigate the performance strain (NAF) often found in students from regions undergoing economic transition.

Effective formative assessment, supported by high-quality teaching and timely digital interventions, provides the necessary emotional and cognitive support to shift students towards a positive performance type (Type 1) as defined by Hrabal and Pavelková (2011). Thus, the integration of technology is not merely a technical enhancement but a pedagogical strategy to strengthen engagement and professional resilience in diverse student populations.

4. Methodology

This study employs a quasi-experimental research design with a non-equivalent control group and two distinct measurement points: an entry measurement (T1) and an exit measurement (T2). This design was selected to reflect the authentic conditions of educational practice, where random assignment of participants is not feasible. Due to anonymous data collection and natural attrition between measurements, individual responses could not be paired; consequently, the data were analysed as independent samples.

4.1 Participants and Setting

The research was conducted at a Czech higher vocational school within a three-year study programme preparing future teachers for pre-school and out-of-school education. The total sample comprised 136 students distributed across four classes: A (n = 37), B (n = 41), C (n = 29), and Year 2 (n = 26). Classes A, B, and the Year 2 group formed the experimental groups, in which digitally supported formative assessment was systematically implemented. Class C served as the control group and followed a traditional instructional approach without targeted formative intervention.

The Year 2 group represented a longitudinal case, as these students had been exposed to formative assessment strategies for two consecutive years. Their results are therefore interpreted separately, with particular emphasis on the effects of long-term exposure to formative practices. Furthermore, the sample included a subgroup of 18 students from mining backgrounds, reflecting the socio-economic focus of the REFRESH project.

4.2 Intervention

The intervention was integrated into regular teaching over the course of one academic year. It was grounded in the core principles of formative assessment: clarifying learning objectives, establishing transparent assessment criteria, providing continuous and actionable feedback, and fostering active student involvement. Digital tools, specifically Microsoft Forms and Mentimeter, were utilised to facilitate immediate feedback and support adaptive instruction. Additional strategies included self-assessment, peer assessment, and structured pedagogical dialogue, all aimed at enhancing students' self-regulation and engagement.

4.3 Instrumentation

Performance motivation was measured using the standardised instrument School Performance Motivation of Students (Hrabal and Pavelková, 2011). This questionnaire distinguishes between two primary dimensions: the need for successful performance (NfA) and the need to avoid failure (NAF). The instrument is well established in the Czech educational context and demonstrates satisfactory psychometric reliability. For the purposes of this study, raw scores for NfA and NAF were used for descriptive comparison. The standardized norms of the instrument informed the interpretation of motivational profiles.

4.4 Data Analysis

Data analysis was conducted descriptively. Mean scores and standard deviations were calculated for both NfA and NAF at T1 and T2. Due to anonymous data collection, individual responses could not be paired across measurements; therefore, the analysis focused on group-level comparisons of independent samples. Changes between T1 and T2 were interpreted using mean differences. No inferential statistical testing was applied, and the results are therefore interpreted cautiously as descriptive trends rather than causal effects.

4.5 Ethics and AI Declaration

Ethical approval for this research was obtained from the Ethics Committee of the Faculty of Education, University of Ostrava (Ref: REFRESH-2023-04). Participants were informed about the purpose of the study and their right to withdraw at any time.

In the preparation of this manuscript, an AI tool (large language model) was used for linguistic refinement and stylistic consistency. All AI-generated suggestions were carefully reviewed and revised by the authors to ensure academic integrity and factual accuracy.

5. Results

Descriptive statistics for all groups are presented in Table 1. Changes between the input measurement (T1) and output measurement (T2) are summarized in Table 2 and illustrated in Figures 1 - 3.

Table 1: Descriptive Statistics of Performance Motivation Across Groups at T1 and T2

Group	N T1	N T2	NfA T1 (M±SD)	NfA T2 (M±SD)	NAF T1 (M±SD)	NAF T2 (M±SD)
Class A	32	25	21.72 ± 2.65	22.75 ± 2.58	20.97 ± 3.67	23.36 ± 3.94
Class B	36	31	21.33 ± 3.02	22.23 ± 2.96	20.78 ± 4.06	21.90 ± 3.87
Class C	23	16	21.35 ± 2.41	22.25 ± 2.86	22.35 ± 3.64	20.94 ± 4.33
Year 2	26	26	21.23 ± 2.63	21.69 ± 2.87	20.73 ± 4.17	20.15 ± 4.35

Source: own elaboration 2026

5.1 Development of the Need for Successful Performance (NfA)

As shown in Table 1 and Figure 1, the mean values of the need for successful performance (NfA) increased across all groups between T1 and T2.

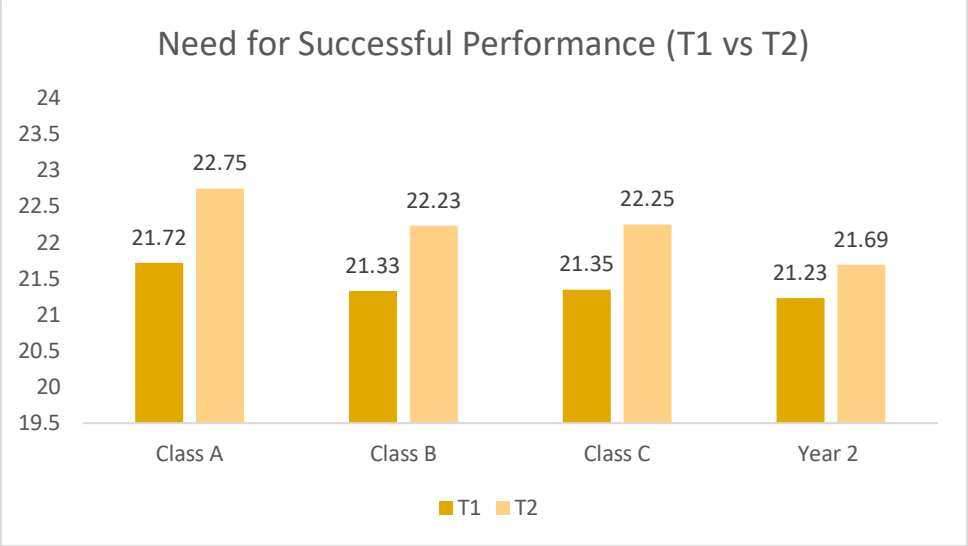


Figure 1: Need for successful performance (NfA) across groups at T1 and T2.

Source: own elaboration 2026

In Class A, the mean score increased from M = 21.72 (SD = 2.65) to M = 22.75 (SD = 2.58). A similar trend was observed in Class B (from M = 21.33, SD = 3.02 to M = 22.23, SD = 2.96) and Class C (from M = 21.35, SD = 2.41 to M = 22.25, SD = 2.86).A smaller increase was found in the second-year cohort, where NfA rose from M = 21.23 (SD = 2.63) to M = 21.69 (SD = 2.87).

Overall, an increase in performance-oriented motivation was observed across all groups.

5.2 Development of the Need to Avoid Failure (NAF)

The development of the need to avoid failure (NAF) showed a more differentiated pattern (Table 1, Figure 2).

In Classes A and B, NAF increased between T1 and T2. In Class A, the mean rose from M = 20.97 (SD = 3.67) to M = 23.36 (SD = 3.94), and in Class B from M = 20.78 (SD = 4.06) to M = 21.90 (SD = 3.87).

In contrast, a decrease in NAF was observed in Class C (from M = 22.35, SD = 3.64 to M = 20.94, SD = 4.33) and in the second-year cohort (from M = 20.73, SD = 4.17 to M = 20.15, SD = 4.35).

These results suggest that while performance motivation increased across all groups, changes in failure avoidance were not uniform.

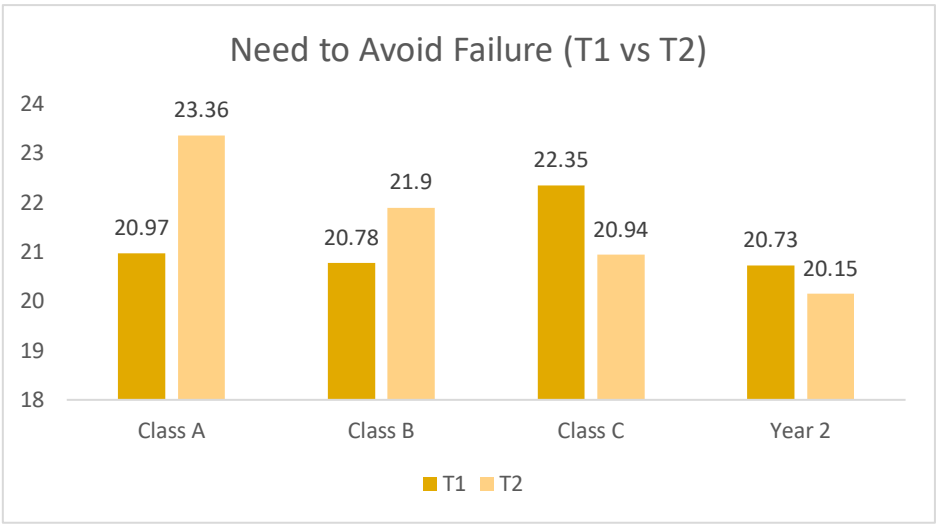


Figure 2: Need to avoid failure (NAF) across groups at T1 and T2.

Source: own elaboration 2026

5.3 Changes in Performance Motivation

The magnitude and direction of changes between T1 and T2 are summarized in Table 2 and illustrated in Figure 3.

Table 2: Changes in Performance Motivation Between T1 and T2

Group	Change in NfA	Change in NAF
Class A	+1.03	+2.39
Class B	+0.90	+1.12
Class C	+0.90	−1.41
Year 2	+0.46	−0.58

Source: own elaboration 2026

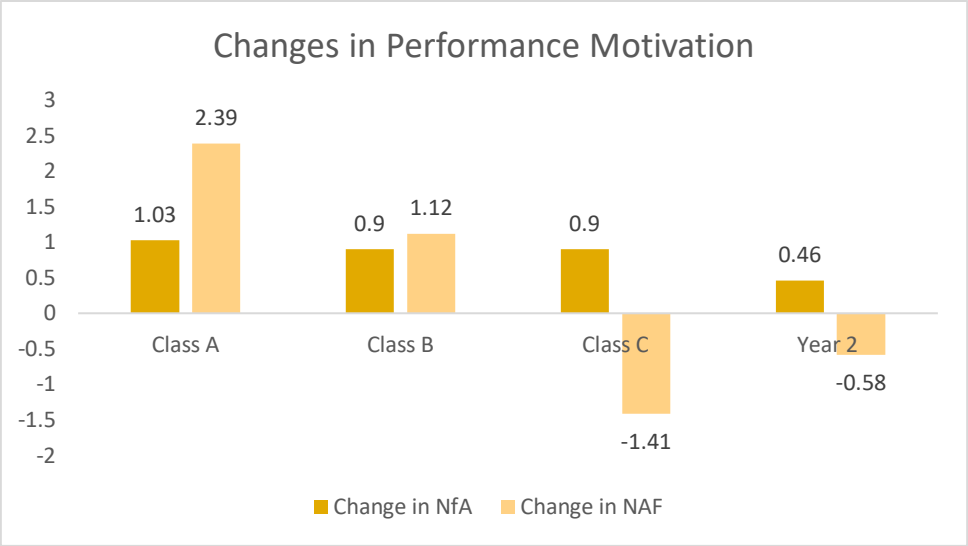


Figure 3: Changes in performance motivation between T1 and T2.

Source: own elaboration 2026

An increase in NfA was observed in all groups, with the largest increase in Class A (Δ = +1.03), followed by Classes B and C (Δ = +0.90), and the smallest increase in the second-year cohort (Δ = +0.46).

Changes in NAF differed across groups. While Classes A (Δ = +2.39) and B (Δ = +1.12) showed an increase, Classes C (Δ = −1.41) and the second-year cohort (Δ = −0.58) exhibited a decrease.

This pattern highlights variability in the development of performance motivation across different groups.

5.4 Mining Background Subgroup

A separate descriptive analysis was conducted for students from a mining background (N = 18), as presented in Table 3.

In this subgroup, the mean NfA increased from M = 21.22 at T1 to M = 22.88 at T2. The mean NAF showed a slight increase from M = 21.16 to M = 21.77.

Given the smaller sample size, these findings should be interpreted with caution.

Table 3: Performance Motivation of Students from Mining Backgrounds

Group	N	NfA T1	NfA T2	NAF T1	NAF T2
Mining background	18	21.22	22.88	21.16	21.77

Source: own elaboration 2026

6. Discussion

The aim of this study was to examine the impact of digitally supported formative assessment on the performance motivation of students in vocational teacher education, with a particular focus on differences between groups and a subgroup of students from a mining background.

6.1 Interpretation of the Main Findings (RQ1, H1)

The results indicate that the implementation of formative assessment supported by digital tools was associated with an increase in the need for successful performance (NfA) across all observed groups. This trend was evident not only in the experimental classes (A, B, and Year 2), but also, to a certain extent, in the control group (Class C).

These findings are consistent with the conceptualization of formative assessment as a process that supports learning through continuous feedback and adaptive instruction (Black & Wiliam, 2009). From the perspective of self-determination theory, the observed increase in performance-oriented motivation may reflect enhanced feelings of competence and autonomy supported by formative feedback (Deci & Ryan, 2000).

This finding is partially consistent with Hypothesis 1, which assumed that students exposed to formative intervention would show higher NfA and lower NAF after the intervention. While an increase in NfA was observed, the development of the need to avoid failure (NAF) was not consistent across groups. In some cases (Classes A and B), NAF increased, whereas in others (Class C and Year 2), it decreased.

These results suggest that formative assessment may effectively enhance students' performance orientation, but its impact on reducing fear of failure is more complex and context-dependent.

6.2 Differences Between Groups (RQ2, H2)

The comparison between groups with and without formative intervention reveals a differentiated pattern. Although Class C (control group) showed an increase in NfA, this change was not accompanied by a consistent decrease in NAF. This contrasts with some of the experimental groups, where a more balanced motivational shift was observed.

Therefore, the observed pattern is only partially consistent with Hypothesis 2, which assumed no substantial change in the control group. The observed increase in NfA in Class C may reflect external influences such as maturation, teaching style, or classroom climate, rather than the effect of formative assessment alone.

These findings highlight the importance of considering contextual and instructional factors when interpreting changes in student motivation.

6.3 Variability in Motivational Development

A key finding of this study is the variability in the development of performance motivation across groups. While all groups showed an increase in NfA, the direction of change in NAF differed, indicating that the relationship between performance ambition and fear of failure is not linear.

This variability suggests that formative assessment does not operate as a uniform intervention, but rather interacts with classroom-specific dynamics, including teacher practices, peer interactions, and the overall learning environment.

The variability observed across groups may be explained by differences in how students engage with feedback, as effective feedback requires active student interpretation and self-regulation (Nicol & Macfarlane-Dick, 2006). At the same time, the mixed development of NAF corresponds with findings that feedback interventions can have both positive and negative effects depending on how they are perceived and processed by learners (Kluger & DeNisi, 1996).

6.4 Students From a Mining Background (RQ3, H4)

The analysis of students from a mining background provides additional insight into the role of socio-economic context in shaping performance motivation. In the pretest, this subgroup exhibited slightly lower NfA and relatively higher NAF, which may reflect increased performance-related uncertainty.

Following the intervention, an increase in NfA was observed, accompanied by a slight increase in NAF. These findings are partially consistent with Hypothesis 4, suggesting that while formative assessment may enhance performance ambition in this subgroup, it does not necessarily reduce performance-related anxiety.

Given the limited sample size, these results should be interpreted with caution. However, they indicate that formative assessment may have the potential to support motivation even in students from more challenging socio-economic backgrounds, although its effects may differ in magnitude and direction.

6.5 Implications for Practice and Research

The findings of this study have several implications for educational practice. First, they suggest that formative assessment, particularly when supported by digital tools, can play a significant role in enhancing students' performance motivation. The use of tools such as Microsoft Forms and Mentimeter enables immediate feedback, supports student engagement, and facilitates adaptive teaching strategies.

These conclusions are consistent with the work of Hattie (2009), who identifies feedback as one of the most powerful influences on student learning and achievement. At the same time, the variability in NAF development highlights the need for a more nuanced approach to feedback. While increasing performance ambition is desirable, it is equally important to address students' fear of failure and create a psychologically safe learning environment.

These findings also align with the principles of self-determination theory (Deci & Ryan, 2000), which emphasize the importance of supporting students' sense of competence, autonomy, and relatedness in order to foster intrinsic motivation.

6.6 Limitations

Several limitations of the study should be acknowledged. The research design is based on non-equivalent groups, and the composition of respondents differs between T1 and T2, which limits the possibility of causal interpretation.

In addition, the analysis is primarily descriptive and does not include inferential statistical testing. The subgroup of students from a mining background is relatively small, which further limits the generalizability of the findings.

Future research should focus on longitudinal designs, larger samples, and the inclusion of additional variables, such as classroom climate or teacher feedback strategies, to better understand the mechanisms underlying motivational change.

7. Conclusion

This study examined the impact of digitally supported formative assessment on the performance motivation of students in vocational teacher education within the socio-economic context of the REFRESH project. Using a quasi-experimental design with non-equivalent groups, the research focused on the development of two dimensions of performance motivation: the need for successful performance (NfA) and the need to avoid failure (NAF).

The findings indicate that the systematic integration of digitally supported formative assessment was associated with positive changes in students' motivational profiles, particularly in relation to achievement-oriented motivation. Across all observed groups, an increase in NfA was identified between the entry (T1) and exit (T2) measurements, although the magnitude of change varied between groups. These results suggest that formative assessment supported by digital tools may contribute to strengthening students' engagement, perceived competence, and orientation towards successful performance.

However, the development of NAF demonstrated a more differentiated pattern. While some groups showed a decrease in failure avoidance, others exhibited a slight increase. This variability indicates that the relationship between formative feedback and performance-related anxiety is complex and influenced by contextual factors, including classroom climate, feedback interpretation, and students' individual motivational characteristics. Consequently, digitally supported formative assessment should not be viewed as a universally applicable intervention, but rather as a pedagogical process shaped by specific educational environments.

Particular attention was devoted to students from mining backgrounds, representing a subgroup connected to the broader socio-economic focus of the REFRESH project. Although these students demonstrated an increase

in NfA following the intervention, the persistence of elevated NAF values suggests that students from economically transforming regions may require longer-term motivational and emotional support. This finding highlights the importance of considering socio-economic context when implementing formative assessment strategies in vocational teacher education.

The study contributes to the growing body of research on formative assessment and digital feedback environments by extending current knowledge into the field of initial teacher education. It emphasises the pedagogical significance of immediate feedback, active student participation, self-assessment, and transparent assessment criteria in supporting motivational development and self-regulated learning. The use of digital tools such as Microsoft Forms and Mentimeter appears to create conditions that facilitate continuous feedback processes and adaptive instructional practices.

Several limitations of the study should be acknowledged. The research was based on a quasi-experimental design with non-equivalent groups and anonymous independent samples, which limits the possibility of causal interpretation. Furthermore, the subgroup of students from mining backgrounds was relatively small, and the analysis remained primarily descriptive. Future research should therefore focus on longitudinal designs, larger samples, and more detailed analyses of the interaction between formative assessment, classroom climate, and socio-economic variables influencing motivational development.

Despite these limitations, the findings suggest that digitally supported formative assessment represents a promising approach to enhancing performance motivation in contemporary teacher education. The study offers practical implications for educators, researchers, and policy makers seeking to develop inclusive, feedback-oriented, and digitally enriched learning environments that support both academic development and student well-being.

Acknowledgements

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Ethics Declaration

Participation was voluntary, data were anonymised, and no sensitive personal information was collected.

AI Declaration

AI tools (ChatGPT by OpenAI) were used to support language refinement and structure. All outputs were critically reviewed and edited by the author.

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