

Digital Formative Assessment and Motivation in Initial Teacher Education: Findings from the REFRESH Project

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Abstract: This study investigates the potential of digitally mediated formative assessment to influence the performance motivation of higher vocational school students preparing for the teaching profession in pre-school and after-school education. The research is carried out within the framework of doctoral studies at the Faculty of Education of the University of Ostrava and linked to the REFRESH - Centre for Research on Energy and Social Change project (CZ.10.03.01/00/22_003/0000048). The research population consisted of 136 students from four classes. Three groups were taught using digital formative tools (Microsoft Forms, Mentimeter, self-assessment forms, peer feedback), while the control group was taught in a traditional way. Achievement motivation was assessed using the School Performance Motivation Questionnaire (Hrabal & Pavelková, 2011), which takes into account the tendency to succeed (NFA) and the avoidance of failure (NAF). The results show an increase in NFA and a decrease in NAF for students involved in formative assessment. There was also a shift in the typology of performance motivation towards a performance-oriented type. These findings confirm the findings of previous studies on the benefits of formative assessment in developing student motivation (Black & Wiliam, 2009; Brophy, 2004) and underscore the importance of feedback and active student engagement in the professional preparation of teachers. The findings offer actionable insights for educators, researchers, and educational policy makers seeking to develop technology-supported feedback environments in teacher preparation.

Keywords: Formative Assessment, Digital Feedback Tools, Pre-service Teacher Education, Achievement Motivation, Vocational Education, Educational Technology, REFRESH Project

1. Introduction

Contemporary vocational education faces the challenge of effectively supporting not only the development of professional knowledge, but also students' motivation to learn, self-regulation and career orientation. Particularly in the preparation of future pre-school and after-school teachers, it is crucial to foster performance motivation, which significantly influences their attitudes towards learning and subsequent teaching practice (Eccles & Wigfield, 2002).

One promising tool for the development of intrinsic motivation is formative assessment, which in recent years has been profiled as a key component of modern teaching. In the literature, it is understood as a process of collecting, interpreting and using information about student progress in order to adjust teaching and support learning (Black & Wiliam, 2009). The introduction of digital technologies into this process brings new opportunities for interactivity, personalisation and immediate feedback (Carless & Boud, 2018; Nicol, 2020).

Despite the growing interest in digital formative tools, the use of these approaches in vocational education, and especially in higher education settings, remains under-researched. Working with heterogeneous groups of students, some of whom come from socially disadvantaged backgrounds where performance motivation may be impaired by, for example, fear of failure or low self-concept, is also a specific challenge (Hrabal & Pavelková, 2011; Deci & Ryan, 2000).

This study responds to the aforementioned challenges and explores how digitally mediated formative assessment can influence the performance motivation of higher education students in the context of their career preparation. The research is carried out as part of a PhD study at the Faculty of Education, University of Ostrava and is linked to the REFRESH - Centre for Research on Energy and Social Change project, which involves the development of innovative educational strategies reflecting the needs of a changing society.

2. Research Design and Hypotheses

The aim of this study is to analyse the impact of digitally mediated formative feedback on the school performance motivation of higher education students in the context of vocational education. The research also focuses on a specific subgroup of students coming from a mining background in order to identify possible differences in the changes in their motivational characteristics.

2.1 Research Questions

1. What is the impact of formative assessment on changes in the performance motivation of students in vocational education?
2. Does students' performance motivation differ between groups with and without formative intervention?
3. What is the baseline typology of students' performance motivation and how does it change after the intervention?
4. Are there differences in performance motivation between students from mining backgrounds and others?

2.2 Hypotheses

- **H1:** Students in the experimental groups (classes A, B, 2nd year) will show a higher need for successful performance (NfA) and a lower need for avoiding failure (NAF) after the intervention than before the intervention.
- **H2:** Students in class C (no intervention) show no significant change in performance motivation.
- **H3:** The proportion of positive performance motivated types (Type 1) will be higher in the posttest for the experimental group than for the control group.
- **H4:** Students from mining backgrounds will have higher NAF and lower NfA than the others in the pretest, but their performance motivation will improve comparably or more than in the other students in the posttest.

3. Theoretical Background

Initial teacher education in vocational and technical schools represents a specific learning environment in which the key professional and learning competencies of future teachers are formed. This environment is influenced not only by curricular and institutional factors, but also by the personal characteristics of learners, especially their performance motivation. As stated by Näsström et al. (2021), motivation is an essential prerequisite for effective learning and formative assessment can contribute significantly to both behavioural engagement and the development of both autonomous and controlled components of learners' motivation.

Performance motivation, according to Hrabal and Pavelková (2011), is made up of two basic components - the need for successful performance (NfA) and the need to avoid failure (NAF). The ratio between these components influences how students approach challenging learning tasks and how they respond to assessment situations. When the NFA component predominates, the student tends to actively engage and overcome challenges, whereas the dominance of the NAF may lead to anxiety or avoidance behaviour.

In the context of Society 4.0, which emphasises digital competence, adaptability, reflectivity and autonomous decision-making, the form of assessment in education takes on a new dimension. Current conceptions of digital literacy include not only technical skills but also the ability to critically evaluate information, collaborate, share content and manage one's own learning (Ala-Mutka, 2011; Carretero et al., 2017). These skills are crucial in the use of digital formative feedback tools that can enhance learners' self-regulation and create space for a reflective approach to learning.

Formative assessment is defined in the literature as the process of continuously collecting and interpreting information about learners' progress in order to adjust instruction to benefit student learning (Black & Wiliam, 2009). This process can be teacher-driven or actively mediated by learners through self- or peer-assessment and feedback (Nicol & Macfarlane-Dick, 2006). The authors emphasize that the effectiveness of formative assessment increases with the degree of student involvement in clarifying learning goals, self-reflection, and understanding of performance criteria.

Palmberg et al. (2024, p. 4) state in their case study that, "Such comprehensive multi-approach formative assessment practices may consist of the teachers working with the students to attain a shared understanding of the learning goals [...] and the teachers supporting the students in carrying out peer-assessment and [...] self-assessment." In their research, the combination of multiple approaches proved to be an effective way of activating learning motivation and promoting a deeper understanding of the curriculum.

The importance of this approach is also supported by a randomized study by Lichtenberger et al. (2025), who found that a combination of feedback, conceptual question work, and teacher reflection yielded significant

improvements in curricular understanding. The use of digital tools in this type of assessment contributes to greater interactivity and transparency of the whole learning process.

Muho and Taraj (2022) identified the most significant motivational effect for strategic questions asked by the teacher, followed by self-assessment, peer assessment and student portfolios. The results of their study show that the combination of different forms of formative assessment positively influences intrinsic motivation and active student engagement: "The factor that had the greatest impact on motivation for learning were strategic questions used by the teacher during formative assessment, followed by self-assessment, peer assessment and student's portfolios" (Muho & Taraj, 2022, p. 31).

All of these findings are consistent with the research focus of this study, which aims to investigate how digitally mediated formative feedback affects the performance motivation of college students preparing to become preservice and inservice teachers. Special attention is also paid to a subgroup of students from mining backgrounds, whose motivation is examined in relation to possible specificities of the socio-economic context. Thus, the study contributes to the discussion on the transformations of assessment in vocational education and its role in enhancing the career orientation and intrinsic motivation of future teachers.

Summarizing the theoretical underpinnings above, it can be concluded that formative assessment - especially in digital form - has the potential to support students' performance motivation through fostering a sense of competence, autonomy and meaningfulness (Deci & Ryan, 2000; Brophy, 2013; Nicol & Macfarlane-Dick, 2006). Effective feedback, active student involvement in assessment, and transparent criteria are factors that the authors suggest contribute to self-regulation and greater willingness to take risks in learning, which is particularly important for students with a tendency to avoid failure. Therefore, the research design of this study deliberately integrates these approaches to investigate whether the students experience a change in performance adjustment - in particular, a decrease in performance strain (NAF) and a shift towards a positive performance type (Type 1 according to Hrabal and Pavelková, 2011). Thus, the theoretical frameworks directly shape the research assumptions and provide the interpretive basis for subsequent analysis of the results.

4. Methodology

The research was conducted at a Czech higher vocational school within a three-year study programme aimed at preparing future teachers of pre-school and out-of-school pedagogy. The research population consisted of a total of 136 students from four classes: A (n = 37), B (n = 41), C (n = 29) and 2nd year (n = 26). Classes A and B were assigned to the experimental group, which received instruction with targeted use of formative assessment supported by digital tools. The intervention took place over the course of one academic year. Class C was defined as the control group and received instruction without intervention. The Year 2 class represented a special case as the formative approach had been applied to this group for two years. For this reason, it is analysed separately in the results section with emphasis on its long-term experience with formative strategies.

To measure performance motivation, the standardized diagnostic instrument "School Performance Motivation of Students" (Hrabal & Pavelková, 2011) was used. The questionnaire contains two scales - the need for successful performance (NfA) and the need to avoid failure (NAF). The resulting scores of both scales were converted into a five-point standardized scale, which allowed not only a quantitative comparison of baseline and outcome values, but also the classification of individual students into typological categories of performance motivation according to the authors of the instrument.

The formative intervention was integrated into regular teaching and included regular use of digital feedback tools, particularly Microsoft Forms and Mentimeter. These tools allowed to obtain up-to-date information on students' progress and to adapt the teaching to their needs. The intervention also included the use of self-assessment forms, peer assessment and targeted pedagogical interviews. The teacher set clear assessment criteria, defined deadlines for outcomes, and actively involved the students in the evaluation process. The teaching structure thus created space for reflection, development of self-regulation and strengthening of intrinsic motivation. The way digital tools were used was based, among other things, on international research confirming the benefits of immediate feedback for adaptive learning management (Näsström et al., 2021).

The control group received instruction without the use of digital tools and without targeted formative intervention. The assessment in this group was mainly implemented through traditional, summative methods. This contrast allowed for a comparison of differences in performance motivation between the groups exposed to formative intervention and the group exposed to the traditional approach.

Particular attention was paid to a subgroup of 18 students coming from families of mining industry employees (e.g. OKD and partner companies). These students were evenly distributed among the classes studied and their performance motivation was analysed separately. The aim of this analysis was to test whether digitally mediated formative assessment can be an effective tool also in socially disadvantaged groups.

The collected data was subjected to descriptive analysis, including the calculation of the mean values of the two dimensions studied. Subsequently, it was converted into standardized scores and individual students were classified into five types of performance motivation according to Hrabal and Pavelková. The results of the pretest and posttest were compared between the classes as well as between the experimental and control groups. Separately, the trajectory of performance motivation of students from mining backgrounds was also examined.

5. Results

5.1 Impact of Formative Assessment on the Students' Performance Motivation (RQ1, H1)

The results of the entry and exit measures show (see Table 1, Figure 1) that for the classes targeted by the formative intervention (Classes A, B and Year 2), there was an increase in the need for successful performance (NfA) and a concomitant decrease in the need to avoid failure (NAF). In Class A, there was a shift from a mixed type of performance motivation (Type C) to a clearly performance-oriented profile (Type A) (see Table 1). A similar trend was also evident for students in Class B (see Table 1). For the students in the 2nd year, the values of the NfA remained relatively stable, but the NAF showed a slight decrease (see Table 1, Figure 2). In contrast, Class C, which served as the control group, showed a significant increase in NfA values at posttest (see Figure 1), but without a corresponding decrease in NAF (see Figure 2), which may indicate a one-sided shift without a comprehensive improvement in motivational profile. An overview comparison of the mean values for each class in the pretest and posttest is presented in Table 1. The observed values are further illustrated in the form of Figure 1, which shows the evolution of NfA over time and across classes.

Table 1 shows the evolution of the mean values of the need for successful performance (NfA) and the need to avoid failure (NAF) between pretest and posttest across the observed classes. Classes A, B, and year 2 underwent the formative intervention, while Class C served as the control group without intervention.

Table 1: Trends in the mean values of need for successful performance (NfA) and need to avoid failure (NAF)

Class	Stage	NfA(mean)	NAF (mean)
A	Pretest	21.53	21.02
A	Posttest	22.83	19.43
B	Pretest	21.51	20.60
B	Posttest	22.11	18.86
C	Pretest	20.40	21.62
C	Posttest	22.70	21.20
2 nd year	Pretest	21.69	19.80
2 nd year	Posttest	21.74	18.86

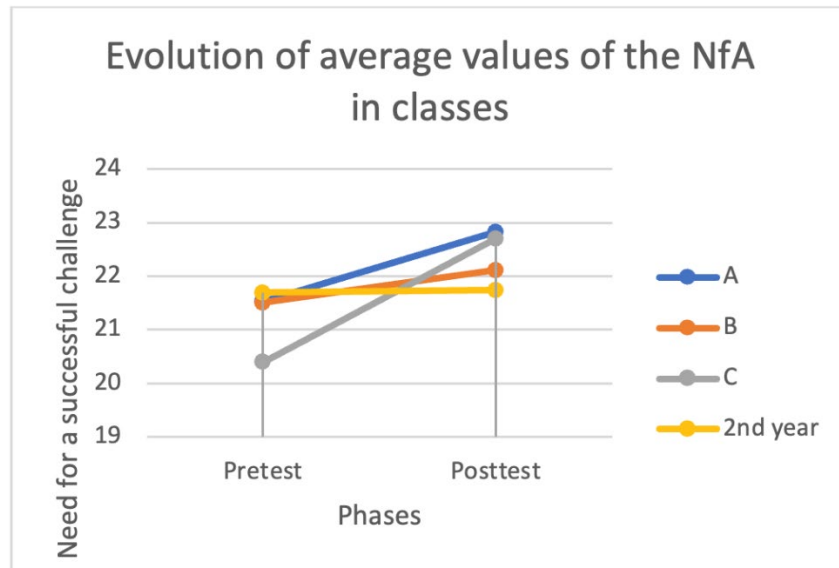


Figure 1: Evolution of average NfA values in classes

Source: own elaboration 2025

The evolution of the mean values of the need for successful performance (NfA) in the studied classes between pretest and posttest. The graph shows the change in the performance orientation of the students depending on the type of instruction. For classes A and B which were exposed to formative assessment, there was an increase in the values of NfA. In the 2nd year, where the intervention was applied for a long period of time, the NfA values remained stable. The significant increase in control class C (no intervention) is noteworthy and requires interpretation in a broader pedagogical context.

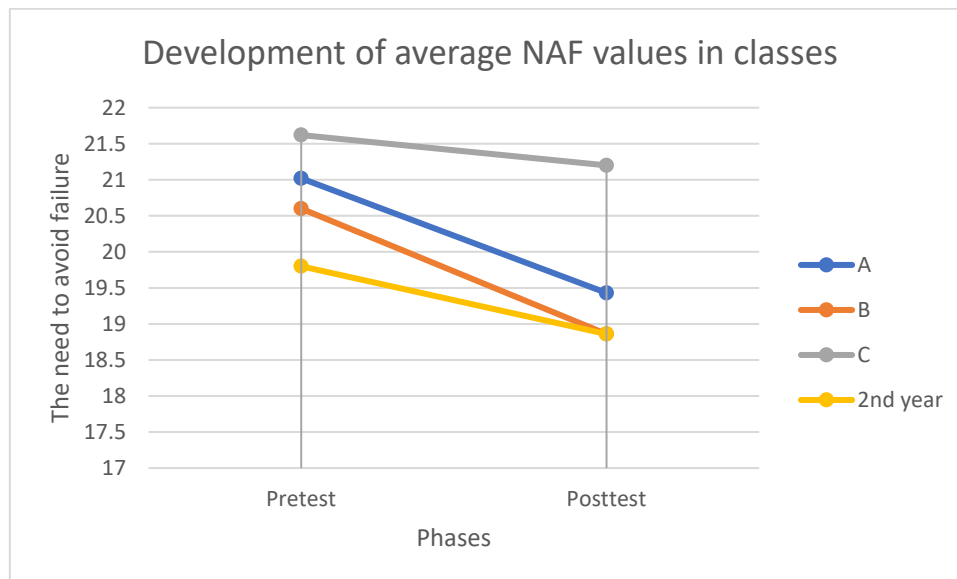


Figure 2: Evolution of average NAF values in the classes

Source: own elaboration 2025

Evolution of the mean values of the need to avoid failure (NAF) in the treatment classes between pretest and posttest. The graph shows the evolution of students' performance strain in relation to the application of the formative approach. The most significant decrease in NAF was observed in classes A and B, confirming the positive impact of regular feedback and active participation in the classroom. In Year 2, the decrease is moderate and may be related to the stabilisation of attitudes. For Class C, the change in NAF was minimal, which is consistent with the absence of intervention.

5.2 Typology of Performance Motivation According to Hrabal and Pavelková (RQ3, H3)

Based on the standardised scores, the students were classified into five typological categories of performance motivation according to Hrabal and Pavelková's (2011) model, which works with a combination of the need for successful performance (NfA) and the need to avoid failure (NAF) measures. The most represented type was Type 5 - undefined motivation, characterized by fluctuating or intermediate values of both dimensions. This type was identified in more than 70% of all students, indicating a predominant absence of a distinct performance focus in the baseline measure.

Following the implementation of the formative intervention, there was a significant shift towards a positive performance type (Type 1) in experimental classes A and B, confirming the effect of the digital feedback-based interventions. In contrast, in Class C, which was not exposed to the formative intervention, the motivational typology remained virtually unchanged. The distribution of the different types across the whole population is shown in Table 2 and visualized in Figure 3. A synthetic overview of these data is visualized in Figure 3.

Table 2 shows the distribution of the students according to Hrabal and Pavelková's typology of performance motivation. Type 5 - undefined motivation was the most frequent, while the positively performance-oriented Type 1 was the least represented.

Table 2: Distribution of types of performance motivation across the research population

Type	Description	Number of Students	Percentage (%)
1	High NfA, low NAF (Positive performance)	7	5.2 %
2	Low NfA, high NAF (Anxious type)	19	14.1 %
3	High NfA, high NAF (Conflict type)	5	3.7 %
4	Low NfA, low NAF (Unmotivated)	4	3.0 %
5	Medium/unstable values (Undifferentiated)	100	74.1 %

Source: own elaboration 2025

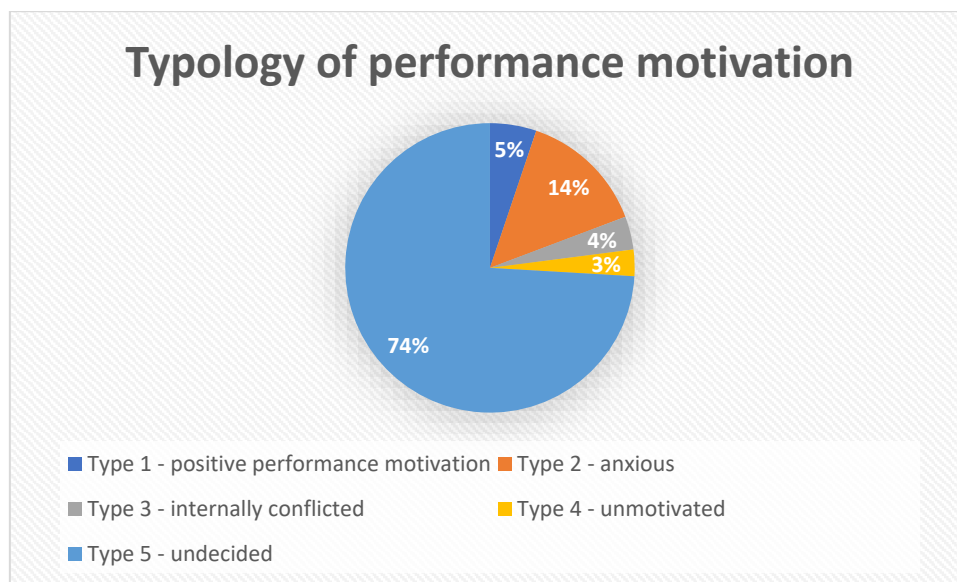


Figure 3: Typology of performance motivation according to Hrabal and Pavelková

Source: own elaboration 2025

Typology of performance motivation according to Hrabal and Pavelková - number of students by motivation types. The dominance of the undefined type (Type 5) confirms the need for systematic support of performance orientation in the educational process. The shift towards positive performance profiles (Type 1) after the intervention was observed mainly in the experimental classes.

5.3 Comparison of Groups with and without Intervention (RQ2, H2)

When comparing the performance motivation between the groups with the formative intervention and the group without intervention (Class C), it was found that although Class C showed a slight improvement in NfA values, the NAF remained almost unchanged. Typologically, this group continues to correspond to the mixed type (Type C). The results support hypothesis H2 that there was no significant change in performance motivation in the control group without intervention.

5.4 Performance Motivation of Students from Mining Backgrounds (RQ4, H4)

For the subgroup of 18 students coming from families of employees in the mining industry, a lower value of NfA (21.22) and a concomitantly increased value of NAF (21.16) were observed in the pretest, corresponding to increased performance strain and lower levels of self-confident achievement orientation. After the implementation of the intervention, an increase in NfA (22.88) and a concomitant slight increase in NAF (22.50) were noted (see Table 3). These results support hypothesis H4, which states that the performance motivation of this subgroup improved comparably or even more than that of the other students, although the increased performance strain persists.

Table 3 shows the evolution of the mean values of need for successful performance (NfA) and need to avoid failure (NAF) for the students from mining backgrounds between pretest and posttest. An increase in NfA indicates a positive impact of the intervention on performance ambition, although an increased NAF indicates persistent performance strain.

Table 3: Trends in the mean values of NfA and NAF for students from a mining background.

Phase	NfA (mean)	NAF (mean)
Pretest	21.22	21.16
Posttest	22.88	22.50

Source own elaboration 2025

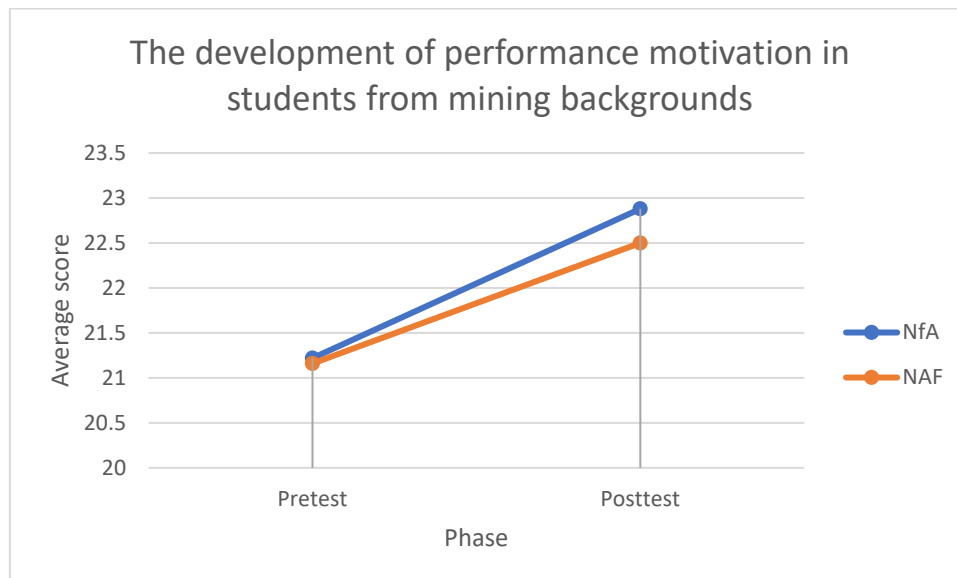


Figure 4: Development of performance motivation in students from mining background

Source own elaboration 2025

Development of performance motivation in students from mining background between pretest and posttest (see Table 3 and Figure 4). While the NfA shows a significant increase, the NAF values have slightly increased. The results suggest a positive impact of formative assessment on ambition even in the socially disadvantaged group, with increased strain persisting.

6. Discussion

The data obtained confirm that digitally mediated formative assessment is an effective tool for promoting students' performance motivation in vocational education. In the experimental groups, an increase in the need for successful performance (NfA) was observed along with a decrease in the need to avoid failure (NAF), which can be interpreted as a shift from passive to anxious motivation to autonomous performance settings. This development corresponds with Hrabal and Pavelková's (2011) model of performance motivation, who state that "performance motivation is not only a matter of ambition, but also of the balance between the expectation of success and the fear of failure" (p. 22).

Positive changes were also noted in the typology of executive motivation, as illustrated by the results in Table 2 and Figure 3. In the experimental classes, there was a shift away from the undefined and anxious types toward a positive performance orientation (see Table 2 and Figure 3). This result can be linked to the comprehensive implementation of a formative approach including feedback, self-assessment and clear assessment criteria. Nicol and Macfarlane-Dick (2006) emphasize that "feedback is effective when the student understands the learning objectives, has access to assessment standards, and is able to reflect on his or her performance against these benchmarks" (p. 205). In the control group, which received instruction in a traditional manner, the typological profile of performance motivation remained virtually unchanged, highlighting the limitations of a conventional instructional approach without formative assessment elements.

This development is consistent not only with Hrabal and Pavelková's (2011) model of performance motivation, but also with broader findings from research on motivation in education. Brophy (2004) highlights that motivation to learn is strongly influenced by whether the learning environment provides students with a sense of meaning, autonomy and competence. According to him, "students feel motivated if they believe they understand the expectations, are likely to succeed, and perceive the learning as valuable" (p. 20). It is the formative approach, which links feedback, self-assessment and transparent criteria, that creates such conditions and thus can fundamentally transform learning attitudes.

Specific attention was paid to a subgroup of students from families of employees in the mining industry. These students showed lower levels of performance ambition (NfA) and higher performance strain (NAF) in the pretest, which may be related to the overall setting of expectations and self-concept in the context of socioeconomic disadvantage. However, there was an increase in performance orientation following the implementation of digital feedback (see Figure 4), suggesting that a comprehensible and supportive learning environment can contribute significantly to performance confidence. According to Näsström et al. (2021), "formative assessment can promote behavioural engagement while stimulating both autonomous and controlled components of motivation" (p. 1). However, the persistence of higher NAF in this group also highlights the need for long-term and sensitive work with fear of failure and performance uncertainty.

The results of the study support the need to systematically incorporate formative assessment into vocational education. Formative strategies based on regular feedback, active student participation, and a transparent assessment structure are consistent with the principles as defined by Black and Wiliam (2009), who view formative assessment as "a process in which teachers and students use information about learning to modify teaching and learning" (p. 5). In our research, a combination of tools (e.g., Microsoft Forms, Mentimeter) and strategies (e.g., self-assessment, layered feedback) were implemented, which is consistent with the findings of Palmberg et al. (2024) who state that "comprehensive multi-approach formative assessment practices may consist of the teachers working with the students to attain a shared understanding of the learning goals, [...] and the teachers supporting the students in carrying out peer-assessment and [...] self-assessment" (p. 4).

This strategy is also consistent with the cyclical model of feedback as presented by Carless and Boud (2018), who suggest that "feedback is only meaningful if it stimulates student action" (p. 1313). Learning then becomes not a one-off response to assessment, but a continuous process of self-regulation and competence development.

The study's findings are also in line with the results of an intervention study by Lichtenberger et al. (2025), which shows that "the mere inclusion of conceptual questions is not enough; integration with other formative assessment strategies is key" (p. 27). It also points out that even short-term targeted professional learning for teachers can make a significant difference in the effectiveness of assessment and its impact on student achievement. These findings underscore the importance of professional preparation for future teachers specifically in the area of feedback and evidence-based decision making.

Other research (Boud & Molloy, 2013; Muho & Taraj, 2022) highlights the importance of combining different forms of formative assessment. Boud and Molloy (2013) state that "the effectiveness of feedback is contingent

on its active reception and integration into student learning behaviours" (p. 703). Based on a quantitative investigation, Muho and Taraj (2022) report that "the factor that had the greatest impact on motivation for learning were strategic questions used by the teacher during formative assessment, followed by self-assessment, peer assessment and student's portfolio" (p. 31).

Given that a significant portion of the research sample exhibited an undefined type of performance motivation, it seems appropriate to focus on individual work with students' motivational profiles in the future and to further develop differentiated formative assessment strategies in teacher training. Further research should explore the long-term effect of these approaches across educational contexts and analyse the influence of social and personal factors on the development of performance motivation.

7. Conclusion

The present study has demonstrated that the targeted use of digital formative assessment tools has a positive impact on student teachers' performance motivation in initial teacher education. The formative intervention led to an increase in performance ambition while contributing to a reduction in fear of failure. These changes are particularly important in the context of promoting self-regulation and an active approach to learning, which are key to the professional growth of future teachers.

A significant finding is the identification of the prevalence of the undefined motivational type in the pretest and its transformation towards positive performance profiles as a result of targeted formative interventions. Particular attention to students from mining backgrounds has shown that a supportive and comprehensible learning environment has the potential to compensate for initial disadvantages and contribute to increased self-confidence even in socially disadvantaged groups. Yet the results also highlight the need for long-term work to address performance strain, particularly in students at risk of academic failure.

The findings of the study support the broader thesis that digital formative assessment is not just an assessment tool, but a means of building autonomy, responsibility and a reflective relationship with learning. In pedagogical practice, the emphasis should be on systematically involving learners in the feedback process, on transparently setting assessment criteria and on promoting metacognitive strategies during the learning process. Experience gained during the teaching of vocational courses also shows that the meaningful use of digital applications (e.g. Microsoft Forms, Mentimeter, Nearpod, Canva) can increase not only the level of learners' active engagement, but also their ability to plan their own learning, assess progress and work with learning objectives.

Based on the findings, several recommendations for pedagogical practice can be formulated. The use of digital tools for regular feedback appears to be an effective means of developing performance motivation. Incorporating self- and peer-assessment into teaching should be considered as a standard part of a formative approach. Transparently establishing assessment criteria and structure early in the course helps to reduce performance uncertainty. Long-term work to address fears of failure is also important, particularly for students from higher-risk backgrounds. Individualising feedback and monitoring its impact on the development of performance motivation should be an integral part of the evaluation of teaching.

The findings can serve as inspiration for teachers, didacts and educational policy makers in designing inclusive, digitally supported learning environments aimed at developing students' motivation, self-regulation and career readiness in vocational education.

Ethics Declaration

This study did not require formal ethical approval. 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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