



The role of feedback self-efficacy in student feedback engagement

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ABSTRACT

Educational feedback research is shifting from feedback provision to feedback reception, but more theory-based studies on student feedback engagement are still needed for targeted interventions. In higher education, promoting feedback engagement can streamline study trajectories and reduce fail and dropout rates. This study focused on first-year university students ($N = 392$) receiving feedback on their program-specific validated academic achievement prediction, based on various background/(non-)cognitive variables, along with remediation and competence training recommendations. Using a Theory of Planned Behavior model, we analyzed students' intentional (IFE) and behavioral (BFE) feedback engagement, as well as their feedback self-efficacy (FSE) and received feedback. Results show IFE positively influences BFE, while FSE positively affects IFE. Feedback indicating a higher chance of study success increases FSE. IFE fully mediates the relationship between FSE and BFE, and FSE between students' received feedback and IFE. We discuss directing educational interventions towards enhancing FSE to promote student feedback engagement.

Making a higher education study choice that is feasible and aligns with one's vocational interests is challenging for students, especially in open-access higher education systems with a wide range of study choice. Indeed, among the full-time students enrolling in a bachelor's program, 12–16 % drop out after one year (OECD, 2022) and first-year fail rates can increase to 60 % (Schelfhout, Wille, et al., 2022), entailing costs for students, parents and society (OECD, 2022; Schelfhout, Bassleer, et al., 2022). Therefore, society and students are likely to benefit from adequate support from the beginning of the higher education journey. This support includes feedback on estimated (first-year) academic success, with recommendations for actions that students can undertake to improve their higher education chances. Noteworthy, such feedback surpasses the typical research focus on feedback related to a specific competence, as elucidated by meta-analyses (Kluger & DeNisi, 1996; Wisniewski, Zierer, & Hattie, 2020).

Feedback has become a cornerstone of educational practice and policy (Hattie & Timperley, 2007; Panadero, 2023). Well-established meta-analyses state the importance of seeing feedback as a multifaceted concept, encompassing various forms with distinct effects on diverse student outcomes (Kluger & DeNisi, 1996; Wisniewski et al., 2020). Until lately, feedback effectiveness research predominantly

concentrated on identifying key attributes of feedback *provision* (e.g., regarding the feedback type and source) (Wisniewski et al., 2020). More recently, however, literature has expanded its focus beyond the act of providing feedback to include the previously overlooked dimension of feedback *reception* (Lipnevich, Eßer, Park, & Winstone, 2023; Xiaomeng & Ravindran, 2024). Feedback reception no longer views feedback as passively provided information, but rather as an active process in which students seek out and engage with feedback (Boud & Molloy, 2013; Lipnevich & Panadero, 2021). Such a shift is necessary, as previous studies consistently demonstrate student dissatisfaction with received feedback, which can prove detrimental to their engagement (e.g., Van der Kleij & Lipnevich, 2020).

As such, feedback engagement highlights the learner's co-responsibility in the feedback process (Dann, 2017; Winstone, Hepper, & Nash, 2019), as this engagement plays a vital role in closing the so-called feedback gap (Adams, Wilson, Money, Palmer-Conn, & Fearn, 2020; Carless, 2019). The feedback gap occurs when provided feedback is not picked up or properly acted upon by the student (Ajjawi & Boud, 2017; Van der Kleij & Lipnevich, 2020). Some studies already started to close this gap by describing the variables and processes that determine feedback engagement (e.g., Lipnevich & Panadero, 2021). However,

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literature still calls for more empirical understanding of student feedback engagement, its determinants, and its underlying mechanisms (i.e., related to how and why feedback works) to refine educational practices within this realm (Panadero & Lipnevich, 2022; Winstone & Nash, 2023). As an example, Panadero (2023) advises to focus on student characteristics as possible determinants, hereby recognizing the feedback agent as central to the feedback process. More specifically, students' higher education journey can be enhanced by pinpointing factors that determine student feedback engagement and unraveling its mechanisms, allowing for a more targeted approach. As an example, feedback self-efficacy (FSE) is a promising target for research and practical interventions (Winstone et al., 2019) as self-efficacy is a part of a student's feedback orientation (Linderbaum & Levy, 2010). Indeed, especially those students at risk of low predicted study success should be reached and encouraged to engage with the feedback they receive. Ultimately, (first-year) fail and drop-out rates can be reduced, benefiting both students and society (OECD, 2022; Schelfhout, Bassleer, et al. 2022).

The present study addresses the need for more theory-based empirical research on determinants and underlying mechanisms related to student feedback engagement (Panadero, 2023; Winstone & Nash, 2023). For this purpose, we consider the Theory of Planned Behavior (TPB) (Ajzen, 1991, 2012) to examine student feedback engagement within the higher education context. Indeed, the TPB specifically predicts and explains diverse behaviors by emphasizing the role of behavioral intention (e.g., active engagement with feedback), influenced by perceived behavioral control (PBC; e.g., student characteristics like self-efficacy). For a meta-analysis on the TPB and PBC, we refer to Hirschey and colleagues (2020). In contrast to other existing feedback models (Lipnevich & Panadero, 2021), the TPB is in fact broadly recognized as a consistent and robust theoretical model. Hence, the TPB has become widely spread in fields like business and public environmental health (Bosnjak, Ajzen, & Schmidt, 2020), and more recently also within educational contexts (e.g., Opoku, Cuskelly, Pedersen, & Rayner, 2021). In educational context, the theory supports both contemporary educational research in general (Kennedy & Zhu, 2025; Knauder & Koschmieder, 2019), as well as more specific research regarding self-efficacy in undergraduate students (Pfundt & Peterson, 2024) and feedback in kindergarten (Dangis et al., 2023). As a concrete example and in line with the more recent focus on active feedback reception (Xiaomeng & Ravindran, 2024), recent studies already use the TPB to explain the information seeking behavior of students (Barber & Anderson, 2025). Using a TPB-based model in a higher education context, the present study thus researches how feedback leads to student feedback engagement, as we monitor the mediating role of FSE (see also Fig. 1). This approach offers insights into student characteristics as determinants of student feedback engagement and its underlying mechanisms that can be targeted in educational interventions aimed at

promoting student feedback engagement (Ajjawi & Boud, 2017; Winstone et al., 2019). Consequently, students (at-risk of failure) are enabled to receive more tailored support during their higher education journey, which can eventually facilitate their study careers.

1. Feedback

Feedback literature encompasses various viewpoints and interpretations of the term feedback (Winstone & Boud, 2022). We adopt a feedback definition that aligns to that of Lipnevich and Panadero (2021), which is compiled from prominent feedback models and theories like Hattie and Timperley's (2007) feedback model. Feedback is information on students' present performance level, goal alignment, future direction, and improvement guidance. The information originates from various sources, such as teachers (Cui, Schunn, & Gai, 2022), peers (Gao, Noroozi, Gulikers, Biemans, & Banihashem, 2024), tutors (van Ginkel, Gulikers, Biemans, & Mulder, 2017), generative artificial intelligence (Banihashem, Kerman, Noroozi, Moon, & Drachler, 2024) or, as in the present study, computer-based systems (Fonteyne et al., 2017). For the present study, the generated feedback takes the form of computer-generated standardized advice, based on the judgment of subject matter experts. Additionally, feedback aims to improve student outcomes by encouraging students' active processing of the performance-related information (Lipnevich & Panadero, 2021). Within the TPB, feedback can be considered an information-related background characteristic influencing intention and behavior antecedents (see further) (Ajzen, 2020; Ajzen & Fishbein, 2005).

The present study's feedback emanates from a self-assessment tool that probes academic potential and vocational interests, aiding prospective students in their decision-making process of their study choice, and offering tailored guidance to first-year higher education students (i.e., the SIMON project). Instead of manipulating feedback conditions experimentally and/or virtually (Wisniewski et al., 2020), students are presented with their actual first-year predicted chance of study success (i.e., (very) low, (fairly) high). These predictions are validated based on historical longitudinal data of background and (non-)cognitive predictors of academic achievement. Additionally, students receive a comprehensive overview of their (non-)cognitive competences, linked to recommendations for remediation/competence training activities (Fonteyne et al., 2017). As such, this feedback extends beyond feedback focused on a specific competence, as commonly observed in feedback research (Kluger & DeNisi, 1996; Wisniewski et al., 2020).

1.1. Student feedback engagement

Student feedback engagement has reached consensus in literature as a three-dimensional construct, as the concept features a cognitive,

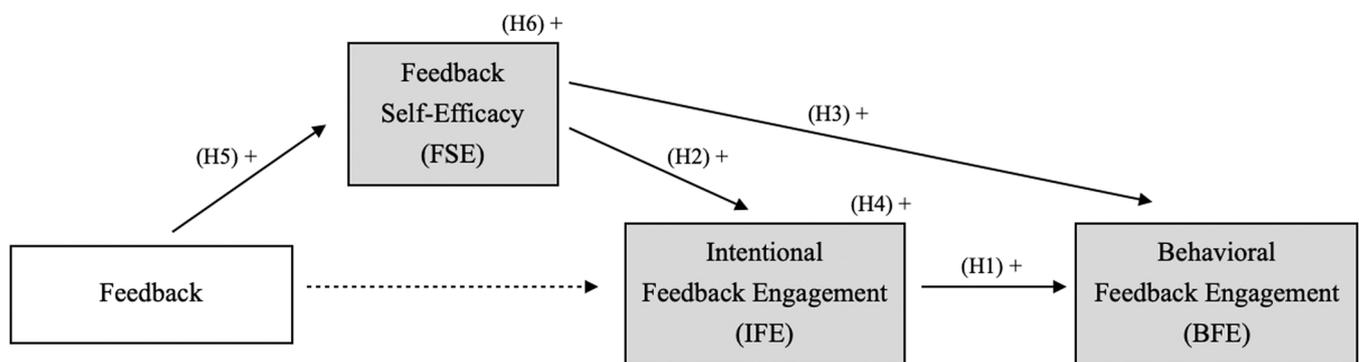


Fig. 1. Hypothesized Model Using a Modified Version of the Theory of Planned Behavior. Note. The solid and dashed lines represent the hypothesized significant and non-significant paths, respectively. H4 displays the mediation of IFE between FSE and BFE, and H6 the mediation of FSE between feedback and IFE. Feedback refers to the feedback first-year university students receive at the start of their study career regarding feasibility and recommendations for remediation/competence training initiatives.

affective, and behavioral dimension (e.g., Ellis, 2010; Yu, Zhang, Zheng, Yuan, & Zhang, 2019). The cognitive dimension pertains to how students pay attention to and process the received feedback, while the affective dimension includes emotional responses and reactions. The behavioral dimension involves whether and how students subsequently act upon the received feedback (Lipnevich & Smith, 2022; Zhang & Hyland, 2018). Consequently, the behavioral changes and developmental actions stemming from feedback can be situated within this latter dimension (Jellicoe & Forsythe, 2019). Moreover, Winstone and colleagues (2017) introduced the concept of proactive recipience of feedback, which refers to a state or activity in which learners actively participate in feedback processes and take co-responsibility for their effectiveness. The present study emphasizes the behavioral dimension of student feedback engagement (Ellis, 2010; Yu et al., 2019). More specifically, we consider two types of student feedback engagement within this dimension, corresponding to the proposed categorization of Handley and colleagues (2011). The first type, IFE, represents an individual's willingness to engage with feedback (i.e., readiness to invest time and effort). The second type, BFE, reflects an individual's active feedback engagement (i.e., taking actions) (Handley, Price, & Millar, 2011).

Reviews on educational feedback studies reveal that many of these studies focus on how feedback should be provided to effectively facilitate student outcomes (e.g., showing less favorable effects of feedback that relies on punishment/reward) (e.g., Hattie et al., 2017; Van der Kleij et al., 2019). However, such investigations consequently view feedback as a more unidirectional and linear process driven by teachers, hereby neglecting student feedback engagement (Ajjawi & Boud, 2017; Van der Kleij & Lipnevich, 2020). In addition, findings across these feedback studies do not exhibit a coherent pattern (Shute, 2008; Winstone, Nash, Parker, & Rowntree, 2017). Hence, researchers argue that feedback only becomes genuinely effective for student outcomes when students behave as active agents rather than as passive receivers during the feedback process (Carless & Boud, 2018; Winstone et al., 2019). The relationship between student feedback engagement and positive student outcomes is also empirically supported (e.g., Zhang & Hyland, 2018). Nonetheless, empirical studies focusing on student feedback engagement still lack adequate representation in literature (Lipnevich & Panadero, 2021; Van der Kleij et al., 2019).

In the present study, we examine student feedback engagement within the framework of the TPB. This theory suggests that an individual's behavior is mainly determined by their intention to perform that behavior (Ajzen, 1991, 2012), which is supported by meta-analyses (e.g., Hirschey et al., 2020). We similarly hypothesize a positive effect of IFE on BFE (H1) (see Fig. 1).

1.2. Role of Student Characteristics

Recently, the field of feedback research is increasingly investigating how various feedback design variables (e.g., timing) can contribute to student feedback engagement (Jonsson, 2013; Van der Kleij et al., 2019). However, Panadero and Lipnevich (2022) reviewed the major developed descriptive feedback models across educational levels and state that the student, along with their individual characteristics, should assume a more central role in such models. Indeed, students' responses to feedback tend to vary based on their diverse individual characteristics (Lipnevich & Panadero, 2021; Van der Kleij et al., 2019). For instance, literature already suggests that reception and implementation of feedback may vary based on gender (Ajjawi & Boud, 2017), motivation (Gan & Wang, 2025), cognitive ability (Daniel, Msambwa, & Wen, 2025), personality (Kerman et al., 2024), prior knowledge (Zong, Schunn, & Wang, 2023), cultural background (Ranjbaran et al., 2023), attitude towards feedback (Van der Kleij & Lipnevich, 2021), and feedback literacy and tolerance (Nieminen & Carless, 2023). Further examination of student feedback engagement and the role of student characteristics is therefore highly encouraged (Panadero, 2023), and researchers are

gradually venturing into this direction (Adams et al., 2020; Winstone et al., 2019). This approach can lead to a more effective alignment of feedback with students' educational needs, thereby enhancing their feedback engagement and learning outcomes (Panadero & Lipnevich, 2022; Winstone & Nash, 2023).

1.3. Feedback self-efficacy

The present study therefore incorporates the role of FSE as a student characteristic and its possible determinant effect on the association between feedback and student feedback engagement. This deliberate selection to focus on FSE stems from the decision to (partially) adopt the TPB as the theoretical framework for this study. FSE, in fact, closely parallels the concept of PBC within the TPB (Ajzen, 1985; Bosnjak et al., 2020).

Self-efficacy indicates an individual's belief in their competences to perform a behavior (Bandura, 1977). Ajzen (1985) incorporated this self-efficacy construct into the Theory of Reasoned Action (Ajzen & Fishbein, 1980) in the form of PBC. The addition of PBC (i.e., self-efficacy) as the third determinant of behavioral intention (alongside attitude towards the behavior and subjective norm) eventually led to the development of the TPB (Ajzen, 1991, 2012). In the specific case of a feedback context, FSE refers to a part of an individual's feedback orientation (Linderbaum & Levy, 2010). FSE differs from academic self-efficacy, as the latter encompasses a broader belief in one's abilities to engage in effective study behaviors (Sander & Sanders, 2009). The concept of FSE is well-vested in literature even above and beyond student characteristics, as research pinpoints the origins of FSE in determinants like prior feedback experiences (Hattie & Timperley, 2007), feedback literacy (Carless & Boud, 2018), and social and cultural context (Ajjawi & Boud, 2017), amongst others.

A review (Schneider & Preckel, 2017) and meta-analysis (Talsma, Schütz, Schwarzer, & Norris, 2018) show a positive relationship between academic self-efficacy and academic achievement across various educational stages. Within the feedback context, researchers also demonstrate that academic self-efficacy mediates the relationship between feedback and academic achievement (e.g., Brown, Peterson, & Yao, 2016). Specifically focusing on student feedback engagement, studies indicate a positive association between academic self-efficacy and use of feedback (Adams et al., 2020; Handley et al., 2011), FSE and use of feedback (Winstone et al., 2019), and between FSE and readiness-to-engage (Handley et al., 2011). These findings are also supported by the TPB, as self-efficacy (i.e., FSE) influences behavioral intention (i.e., IFE) and actual behavior (i.e., BFE). Indeed, individuals with higher FSE tend to exhibit an increased sense of control, and seem to be more confident in effectively managing the feedback they receive (Adams et al., 2020; Putwain, Sander, & Larkin, 2013; but see Vancouver and Kendall (2006) for potential drawbacks of (very) high self-efficacy). Furthermore, behavioral intention mediates the relationship between self-efficacy and behavior (Ajzen, 1991, 2012), implying that individuals who believe in their ability to perform a behavior are more likely to perform that behavior when they have a strong intention to do so. Therefore, the present study expects to find a positive effect of FSE on IFE (H2) and BFE (H3), and a mediation of IFE in the relationship between FSE and BFE (H4) (see Fig. 1).

Additionally, researchers highlight the potential role of student characteristics, such as FSE, as mediators in the relationship between feedback and student feedback engagement (Lipnevich & Panadero, 2021; Panadero, 2023). In other words, students' belief in their own feedback engagement capabilities (partially) explains the extent to which students engage with received feedback. Indeed, FSE can contribute to interpreting negative feedback as less threatening and more as valuable learning opportunities or challenges to overcome (Adams et al., 2020; Putwain et al., 2013). Moreover, the TPB emphasizes the importance of recognizing that self-efficacy (and the other antecedents of intention and behavior) are functions of underlying

beliefs. For self-efficacy, this relates to one's control beliefs, which can be influenced by various background factors, categorized into individual (e.g., personality), social (e.g., education), and information-related (e.g., intervention) factors (Ajzen, 2020; Ajzen & Fishbein, 2005). Feedback literature similarly indicates the favorable impact of more positive, concrete, process-level etc. feedback on (academic) self-efficacy (Brown et al., 2016; Hattie & Timperley, 2007). However, TPB-based research often disregards this potential influence of background variables on the antecedents of intention. The present study includes the feedback received by students as a background factor. As such, we predict a positive effect of more favorable feedback on FSE (H5) and, consequently, a mediation of FSE in the relationship between feedback and IFE (H6) (see Fig. 1).

1.4. Present Study

Using a TPB-based model in a higher education context, the present study researches how feedback leads to student feedback engagement, as we monitor the mediating role of student self-efficacy (see also Fig. 1). In such a way, we aim to predict and explain student feedback engagement to develop targeted interventions that can facilitate feedback-engaging behavior (Panadero, 2023; Winstone & Nash, 2023), thereby enabling (at-risk) first-year university students to experience a successful study career. Our model's feedback refers to the feedback provided to these students at the onset of their higher education journey. This feedback includes their first-year validated chance of study success (i.e., (very) low, (fairly) high) prediction based on their background/(non-)cognitive competences, supplemented with recommendations for remediation/competence training activities.

Specifically, we hypothesize that IFE has a positive effect on BFE (H1), and FSE similarly on IFE (H2) and BFE (H3) (Ajzen, 1991, 2012). Here, FSE constitutes a key component of PBC of the TPB (Ajzen, 1985; Bosnjak et al., 2020). Also, consideration is given to the mediation of IFE in the relationship between FSE and BFE (H4) (Ajzen, 1991, 2012). Additionally, we anticipate that positive feedback increases FSE (H5) (Ajzen & Fishbein, 2005; Brown et al., 2016). And lastly, the mediation of FSE in the relationship between feedback and IFE is assumed (H6) (Lipnevich & Panadero, 2021). A graphical representation of our hypothesized model for the present study is displayed in Fig. 1.

2. Materials and methods

2.1. Participants

For the present study, we used data from a large Western European university that ranked in the top 75 of the Academic Ranking of World Universities (formerly Shanghai Ranking, see <https://www.shanghairanking.com/rankings/arwu/2024>). The Ethics Committee at Ghent University, FPPW, granted a favorable recommendation for the project. Our sample comprises first-year university students in an open-access environment, excluding re-registrants, who have a uniform curriculum within a study program. This open-access environment implies that anyone with a degree of secondary education can enter nearly every study program at any given college or university, with a maximum tuition fee of about €1150 or \$1200, not including possible scholarships. Longitudinal data of $N = 392$ (62 % female, 42 % (very) low first-year predicted chance of study success) first-year university students in the academic years 2021–2022 and 2022–2023 were used, as these students were surveyed through feedback questionnaires at two measurement points before the first exam period (i.e., October and December). These feedback questionnaires addressed the feedback the students received after participating in the longitudinal university-wide study (re)orientation and remediation project by filling out the SIMON test battery (Fonteyne, 2017; Schelfhout, Wille, et al., 2022). For more detail about the sample, see [Supplementary Information \(SI\), Table S1](#).

2.2. Measures

2.2.1. Feedback

First-year university students using the SIMON tool received personalized computer-generated feedback upon completion (see also the introduction's feedback section). We based the computer-generated feedback on algorithms and predictive models that were conceptualized and operationalized by experts (Fonteyne et al., 2017). Students were informed a priori about which information they would receive. As such, the student's generated feedback reported (1) a personal chance of study success in the first year, (2) more detailed skill scores, and (3) possible remediation towards skill maximization and possibilities for further support. For concrete feedback examples, we refer to *SI*, Feedback Examples.

The instrument estimates students' first-year chance of study success using recursive feature elimination and cross-validation. Background factors (e.g., secondary education degree) and (non-)cognitive characteristics (e.g., motivation, mathematical skills), recognized as significant predictors for academic achievement, are considered (Fonteyne et al., 2017). In the present study, we distinguished between two student groups as determined within the SIMON project: students who received feedback with a (very) low first-year predicted chance of study success ($= 0$) and those with a (fairly) high predicted chance of study success ($= 1$). Please see Fonteyne and colleagues (2017) for details on the operationalization of these predicted chances of study success.

2.2.2. Feedback engagement

Intentional Feedback Engagement was measured through the behavioral and developmental change dimension of the Feedback in Learning Scale (FLS) (Jellicoe & Forsythe, 2019). The adapted questionnaire consisted of six items (e.g., "I will search for study guidance activities in line with competences described in my received SIMON feedback") ($M = 2.5$, $SD = 0.8$, Cronbach's $\alpha = .87$). Students rated their item agreement on a Likert-scale from 1 (totally not agree) to 5 (totally agree). The individuals' scale scores were determined by averaging their item scores. IFE was surveyed in October for both academic years, after the students received their feedback through the SIMON project (Fonteyne et al., 2017). The survey can be found in *SI*, Table S2.

Behavioral Feedback Engagement was assessed through the same questionnaire employed for IFE (i.e., FLS; Jellicoe & Forsythe, 2019), with the verb form as the only difference (e.g., "I have searched for study guidance activities in line with competences described in my received SIMON feedback") ($M = 2.1$, $SD = 0.7$, Cronbach's $\alpha = .83$). Again, the average of the item scores was used to determine the individuals' scale scores. BFE was questioned in December for both academic years. The survey can be found in *SI*, Table S3.

2.2.3. Feedback self-efficacy

Feedback Self-Efficacy was measured by using the same-named subscale of the Feedback Orientation Scale (FOS) (Linderbaum & Levy, 2010). The subscale consisted of five items (e.g., "I believe that I have the ability to deal with feedback effectively") ($M = 3.6$, $SD = 0.7$, Cronbach's $\alpha = .85$). Students rated their item agreement on a 5-point Likert-scale. The individuals' scale scores were obtained by averaging their item scores. FSE was surveyed in October for both academic years, together with IFE.

2.3. Analyses

First, to have an overview of the data, we calculated Pearson correlations between the included continuous variables. For the correlations between the continuous variables and the dichotomous variable *Feedback*, point-biserial correlations were used.

Second, we tested our model with the predetermined set of hypotheses through a path analysis of a structural equation model using maximum likelihood estimation through the R package lavaan (Rosseel,

2012). The fit of our model was evaluated using different goodness-of-fit indices (i.e., chi-square test, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR)).² To calculate better standard errors (and *p*-values) of the assumed indirect effects (i.e., mediations) compared to the standard approach (i.e., the delta or Sobel method), the bootstrap method was used (Bollen & Stine, 1992; Rosseel, 2012; Sobel, 1982). We also added a fixed seed value for random sampling to ensure the results' reproducibility and comparability. Furthermore, we applied the Benjamini-Hochberg False Discovery Rate (FDR) procedure to adjust *p*-values for multiple testing, striking a balance between maximizing power and still effectively controlling Type I errors (Benjamini & Hochberg, 1995).

3. Results

3.1. Path analysis

The goodness-of-fit indices indicate a good fit of the data to the model. For the correlation matrix, we refer to *SI*, Table S4. The observed and model-implied covariance matrices can be found in *SI*, Tables S5 and S6. Fig. 2 displays the path analysis results, presenting the standardized regression coefficients with the FDR-adjusted significance levels, and the explained variances for the endogenous variables within the model. For the statistics regarding the direct, indirect, and total effects within the path model, see Table 1.

3.2. Hypotheses testing

H1 stated that IFE has a positive effect on BFE. We indeed find a significant effect of IFE on BFE ($r = .58$). As the IFE level increases, so does the BFE level. H1 is thus confirmed. Additionally, H2 assumed a positive effect of FSE on IFE. The results show that FSE significantly influences IFE ($r = .20$). Higher FSE is associated with higher IFE, confirming H2. Also, H3 stated that FSE has a positive effect on BFE. We observed no significant effect between FSE and BFE ($r = .08$), so H3 cannot be confirmed. Further, H4 proposed a mediation of IFE in the relationship between FSE and BFE. The bootstrap method demonstrates a significant effect of FSE on BFE, fully mediated by IFE. Higher FSE increases the BFE level, but this relationship completely relies on the IFE level (the higher IFE, the higher BFE). As such, H4 is confirmed. Moreover, H5 stated a positive effect of feedback on FSE. We find a significant relationship between feedback and FSE ($r = .36$). Students who received feedback with a (fairly) high chance of study success show higher FSE ($M = 3.91$, $SD = 0.68$) compared with students who received a (very) low chance of study success ($M = 3.35$, $SD = 0.77$), confirming H5. Finally, H6 assumed a mediation of FSE in the relationship between feedback and IFE. The analyses show a significant effect of feedback on IFE ($r = .11$), fully mediated by FSE. Students who received a (fairly) high chance of study success shows higher IFE ($M = 2.58$, $SD = 0.89$) compared with students who received a (very) low chance of study success ($M = 2.39$, $SD = 0.84$), but this association completely depends on their FSE level (the higher FSE, the higher IFE). Hence, we confirm H6. The detailed statistics of the direct, indirect, and total effects within the path model can be found in Table 1. For the concrete feedback formulations, please refer to *SI*, Feedback Examples.

4. Discussion

In (open-access) higher education, (first-year) fail and dropout rates are alarmingly high (OECD, 2022; Schelfhout, Wille, et al., 2022).

² Ideally, the chi-square test is not significant, incremental fit indices like CFI > .90, and measures such as RMSEA and SRMR < .06 for a good fit or between .06 and .08 for an acceptable fit (Rosseel, 2012).

Hence, supporting students from the start of their higher education journey is likely to hold advantage for both students and society (OECD, 2022; Schelfhout, Bassleer, et al., 2022). Addressing this challenge ideally involves providing students with feedback on their validated first-year academic achievement prediction, derived from (non)cognitive competencies, alongside recommendations for remediation and competence training activities. This feedback exceeds the conventional feedback typically associated with a specific competence (Kluger & DeNisi, 1996; Wisniewski et al., 2020). Although such feedback alone is unlikely to meet all the needs of students, educational policy should at least incorporate this type of feedback as a specific tool to address fail rates and dropout (Schelfhout, Bassleer, et al., 2022).

Acknowledging the multidimensional nature of feedback is important, given its diverse forms that can yield distinct impacts on different student outcomes (Hattie & Timperley, 2007; Wisniewski et al., 2020). Previous feedback effectiveness studies mainly focused on identifying factors associated with feedback design and thus with feedback provision. However, such research overlooks feedback reception, including students' active role in the feedback process (Boud & Molloy, 2013; Lipnevich et al., 2023; Van der Kleij & Lipnevich, 2020; Xiaomeng & Ravindran, 2024). Meanwhile, feedback literature increasingly emphasizes how and to what extent students engage with their received feedback, which is essential for ultimately achieving improved student outcomes (Dann, 2017; Winstone et al., 2019). Nevertheless, theory-based empirical studies regarding student characteristics as possible determinants of student feedback engagement and its underlying mechanisms are limited, necessitating additional research to advance our comprehension and educational practices in this area (Panadero & Lipnevich, 2022; Winstone & Nash, 2023).

The present study therefore researched how feedback leads to student feedback engagement within a higher education context, as we monitored the mediating role of student self-efficacy. We evaluated a model grounded in the Theory of Planned Behavior (TPB, Ajzen, 2012), well-known for predicting and explaining various behaviors, by integrating insights from previous (feedback) research (Dangis et al., 2023; Kennedy & Zhu, 2025; Knauder & Koschmieder, 2019; Pfundt & Peterson, 2024). To investigate determinants and underlying mechanisms of student feedback engagement within higher education, we conducted a path analysis using longitudinal data from $N = 392$ first-year university students and so differentiated between their intentional (IFE) (October) and behavioral feedback engagement (BFE) (December). Additionally, the proposed model incorporated students' feedback self-efficacy (FSE) and the feedback they received at the start of their higher education journey regarding feasibility and recommendations for remediation/competence training initiatives.

4.1. Feedback self-efficacy, intentional and behavioral feedback engagement

Our findings confirm that students with higher IFE show higher BFE, signifying more actual engagement with received feedback when the corresponding intention is more present, and thus consistent with the TPB's core idea that behavioral intention influences the actual behavior (Ajzen, 1991, 2012). This alignment is further supported by meta-analyses across various fields (e.g., Hirschey et al., 2020). Indeed, intentions capture individuals' willingness to allocate effort and time towards performing a behavior (Ajzen, 1991; Handley et al., 2011).

Next, students with higher FSE exhibit higher IFE, reflecting a stronger readiness to invest effort and time to engage with received feedback when students have greater confidence in their feedback engagement capabilities. This finding confirms previous feedback research (Handley et al., 2011) and matches with one of the basic tenets of the TPB concerning Perceived Behavioral Control (PBC) (i.e., self-efficacy) that, among other things, determines behavioral intention (Ajzen, 1991, 2012). Individuals who consider themselves capable of succeeding in a task have more self-confidence and an increased sense of

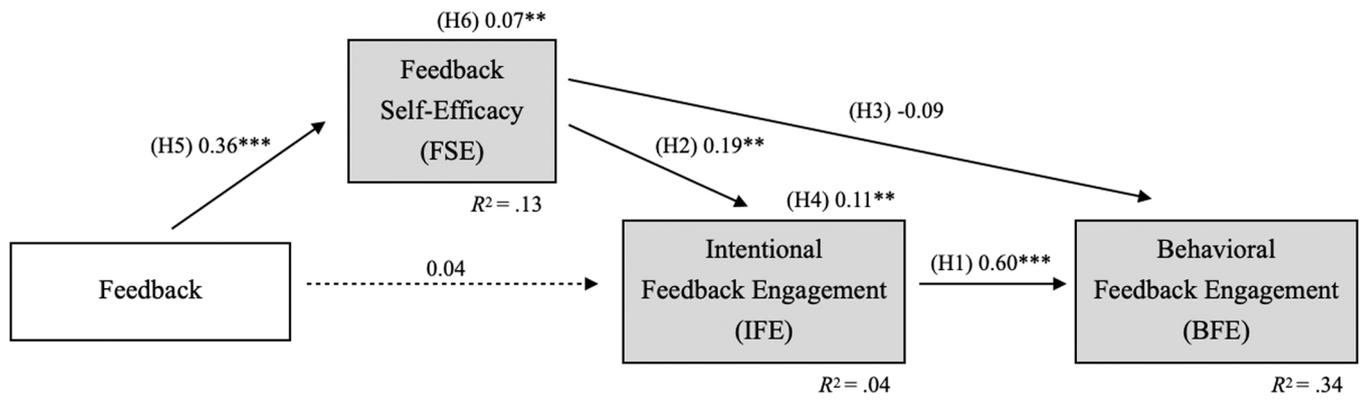


Fig. 2. Path Analysis Results (N = 392). Note. *** $p < .001$; ** $p < .01$; * $p < .05$. The p -values are FDR-adjusted using the Benjamini-Hochberg procedure for multiple testing. R^2 = explained variance. The solid and dashed lines represent the significant and non-significant effects, respectively. The values associated with the lines are the standardized path coefficients. H4 displays the mediation of IFE between FSE and BFE, and H6 the mediation of FSE between feedback and IFE. Model fit statistics: $\chi^2 = 1.57$, $df = 1$, $p = .210$; CFI = 0.998; RMSEA = .038; SRMR = .015.

Table 1
Direct, Indirect, and Total Effects Within the Path Model.

	B	SE _B	β	z	p^1	CI	
						LL	UL
BFE ~ FSE + IFE							
Direct IFE (H1)	0.51	0.04	0.60	13.12	< .001***	0.44	0.59
Direct FSE (H3)	-0.08	0.04	-0.09	-2.01	.060	-0.17	0.00
Indirect FSE (H4)	0.11	0.03	0.11	3.29	.003**	0.04	0.17
Total FSE	0.03	0.05	0.03	0.54	.589	-0.08	0.12
IFE ~ Feedback + FSE							
Direct FSE (H2)	0.21	0.06	0.19	3.37	.003**	0.09	0.34
Direct feedback	0.07	0.09	0.04	0.77	.454	-0.11	0.24
Indirect feedback (H6)	0.12	0.04	0.07	3.06	.008**	0.05	0.20
Total feedback	0.19	0.09	0.11	2.15	.048*	0.02	0.36
FSE ~ Feedback							
Direct feedback (H5)	0.57	0.08	0.36	7.47	< .001***	0.42	0.72
BFE ~ Feedback + FSE							
Indirect feedback	-0.05	0.02	-0.03	-2.09	.057	-0.09	0.00
BFE ~ Feedback + IFE							
Indirect feedback	0.04	0.05	0.02	0.76	.454	-0.06	0.13
BFE ~ Feedback + FSE + IFE							
Indirect feedback	0.06	0.02	0.04	3.03	.008**	0.02	0.11

Note. *** $p < .001$; ** $p < .01$; * $p < .05$. ¹FDR-adjusted using the Benjamini-Hochberg procedure for multiple testing. FSE = Feedback Self-Efficacy; IFE = Intentional Feedback Engagement; BFE = Behavioral Feedback Engagement. B = unstandardized path coefficients; β = standardized path coefficients; CI = bootstrapped 95 % confidence intervals; LL = lower limit; UL = upper limit.

control compared with those who harbor uncertainty about their capabilities (Adams et al., 2020; Bandura, 1977). Linked to the Self-Determination Theory, experiencing a sense of competence and autonomy can indeed foster motivation (Deci & Ryan, 2008), which is assumed to be captured in behavioral intention (Ajzen, 1991, 2012).

Further, the path analysis revealed that IFE fully mediated the effect of FSE on BFE. Students with higher FSE show higher BFE, but only through their IFE level. This result implies that even if students believe they can effectively engage with feedback, they will only do so if they also intend to engage with the feedback. Meta-analyses including TPB-based research in non-educational areas do show that PBC (i.e., self-efficacy) also directly influences behavior (e.g., Hirschey et al., 2020). In the educational context specifically, but not focusing on student feedback engagement, TPB-based studies indicate inconsistent results in this regard (e.g., Opoku et al., 2021). Additionally, Winstone and colleagues (2019) find an association between FSE and use of feedback. However, Ajzen (1991, 2012) highlights that the importance of intention and PBC in predicting behavior can vary across situations and behaviors. One of these predictors may be more crucial, or even the sole determinant of behavior, depending on the context. In fact, not finding a direct effect of FSE on BFE fits the TPB's predecessor, the Theory of Reasoned Action (Ajzen & Fishbein, 1980), which posits that individuals have voluntary control over behavior and thus results in the absence of PBC in this theory.

4.2. Feedback (Self-Efficacy) and intentional feedback engagement

The present study verifies our expectation that students who received feedback indicating a (fairly) high chance of study success demonstrate higher FSE compared with students who received feedback indicating a (very) low chance of study success. The TPB postulates that belief in one's own competences is indeed a function of control beliefs, that can be influenced by information-related factors like feedback (Ajzen, 2020; Ajzen & Fishbein, 2005). Previous feedback studies also find that positive feedback is associated with higher (academic) self-efficacy (and conversely for negative feedback) (Brown et al., 2016; Peifer, Schönfeld, Wolters, Aust, & Margraf, 2020). This pattern is likely applicable to FSE as well. Positive/success versus negative/failure feedback can provide students with a sense of recognition and appreciation, which can boost their emotional positivity (Peifer et al., 2020; Winstone et al., 2017). Additionally, this uplift in emotional/physiological state is an important source of self-efficacy (Bandura, 1977).

Finally, the results of the path analysis demonstrate a full mediation of FSE in the relationship between received feedback and IFE. Students who received feedback indicating a (fairly) high chance of study success (compared with a (very) low chance of study success) show higher

intention to engage with the feedback, but this relationship depends on their belief in the own feedback engagement capabilities. Noteworthy, this finding implies that at-risk students are less reached compared with low-risk students due to negative received feedback reducing their FSE.³ Nash and Thomas (2024) report similar findings in a recent study in which they analyzed students' reflections on feedback: students with lower grades were more likely to ignore feedback. Additionally, this observed mediation confirms that student characteristics like FSE determine the extent to which students engage with received feedback (e.g., Lipnevich & Panadero, 2021). Students with greater FSE may perceive negative/failure feedback as less intimidating and more as valuable learning opportunities or challenges to conquer (Adams et al., 2020; Putwain et al., 2013). Enhancing students' responsiveness to feedback can thus be achieved by strengthening their FSE. Indeed, Warner and French (2020) refer to self-efficacy-based intervention studies across various domains with small-to-medium effect sizes for behavior. These interventions target at least one of the four established sources of self-efficacy (Bandura, 1977). For student feedback engagement specifically, researchers developed a confidence-building toolkit (Winstone et al., 2019). However, the toolkit's (quantitative) effectiveness on FSE remains unexplored in a sufficiently large sample.

Overall, the present study's results show that the TPB provides a favorable theoretical framework in the feedback context, allowing for student characteristics to be considered in explaining student feedback engagement. The path analysis was instrumental in uncovering the specific contributing role of FSE in the relation between received feedback, IFE and BFE.

4.3. Strengths, limitations and future research

The present study offers valuable insights into student feedback engagement (i.e., IFE and BFE), its determinants and underlying mechanisms within higher education, based on a TPB-model. In addition to the favorable longitudinal data collection before the first exam period, we acknowledge that the responses to the surveys originate from self-report. A more objective behavioral outcome measure, especially relevant for BFE, is currently not present and recommended for future research, as the relationship between perception and action in feedback processing is not always straightforward (Farrokhnia, Taghizade, Ahmadi, Papadopoulos, & Noroozi, 2025). Still, according to the TPB, behavioral intention is one of the strongest predictors of future behavior (Ajzen, 2020).

Future research into feedback engagement and feedback self-efficacy should also consider different theoretical models like models on motivation (i.e., self-determination theory, Ryan & Deci, 2020), and self-regulation (Yang & Zhang, 2023) in order to further support, adjust, or refute our findings. Moreover, these models can complement the dimensional approach of feedback engagement, also addressing the cognitive and affective dimensions of feedback engagement. These dimensions were beyond the scope of the present study as we exclusively addressed the behavioral dimension of feedback engagement. Although based on standardized judgments of subject matter experts, the feedback in this study was computer-generated, raising the question of potential disparities compared to other kinds of human feedback sources like teachers (Cui et al., 2022), peers (Gao et al., 2024) or tutors (van Ginkel et al., 2017). In addition to these alternative human sources, future research can also focus on more advanced generative artificial intelligence in order to conduct follow up research to explore feedback source differences (Banihashem et al., 2024). Nonetheless, meta-analytic

evidence suggests that the quality and depth of feedback, rather than its source, are critical for improving learning outcomes (Van der Kleij et al., 2015). For student feedback engagement specifically, such empirical research is still understudied.

Also, we did not use the full TBP as attitude and subjective norm were not included, which may explain the limited explained variance in IFE (4 %). Noteworthy however, attitudes and norms may be more trait-like, making them less amenable to change. By contrast, PBC (i.e., FSE) is more state-like (Bandura, 1977), rendering this determinant more practically relevant. Incorporating attitude and subjective norm in future research may likely provide a more comprehensive understanding of the factors influencing IFE. Similarly, one could explore the underlying contributing beliefs for the antecedents of behavioral intention, as well as the influencing background factors for these beliefs (Ajzen, 2020; Ajzen & Fishbein, 2005).

On a related point, we thus applied a concise (and partial) TPB model with only a specific number of components to address our research question. Also important to note is that within the scope of the current study, we included FSE as a determinant of intentions and behavior, not as the primary outcome measure. Future research can focus on elaborating the model with the antecedents or determinants of FSE like prior feedback experiences (Hattie & Timperley, 2007), feedback literacy (Carless & Boud, 2018), and social and cultural context (Ajzawi & Boud, 2017). Bandura (1977) specifically identifies four key sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. Mastery experiences, or successful past performance, contribute to self-efficacy through prior achievement. Verbal persuasion, including encouragement and feedback from others, can also enhance self-belief, and is for example provided by tutors, parents and/or peers. Previous research shows that these four sources are associated, but also demonstrates unique contributions of each source to (the development of) self-efficacy (e.g., Gill, Osborne, & McPherson, 2022; Kiran & Sungur, 2012; Phan, 2012; Phan & Ngu, 2016; Tschannen-Moran & Hoy, 2007). Moreover, future research can also expand our model with other (possible) mediation effects of (other) student characteristics like gender (Ajzawi & Boud, 2017), motivation (Gan & Wang, 2025), cognitive ability (Daniel et al., 2025), personality (Kerman et al., 2024), interests (Alemayehu & Chen, 2023), prior knowledge (Zong et al., 2023), cultural background (Ranjbaran et al., 2023), attitude towards feedback (Van der Kleij & Lipnevich, 2021), and feedback literacy and tolerance (Nieminen & Carless, 2023) on the relationship between feedback self-efficacy and feedback engagement. Still, the absence of these student characteristics and effects does not seem to affect our TPB model fit, which affirms our model as a robust basis for future research. Nevertheless, we acknowledge that the explained variance for predicting IFE is quite low ($R^2 = .04$), indicating a small effect size. To answer future research questions, new investigations can explore how these other student characteristics and (mediation) effects contribute to student feedback engagement. Adding these (related) variables or effects to the model can also try and replicate our small but robust effect sizes in order to affirm or correct our findings where needed. We anticipate that the inclusion of additional student characteristics will contribute incremental validity to the model. As we built the present study on well-established theoretical frameworks and prior findings regarding feedback self-efficacy and engagement, this explanatory enhancement is expected to complement rather than diminish the mediating role of student self-efficacy in predicting student feedback engagement.

Finally, we also did not include (in)direct feedback loops between variables in the present study, as we relied on the TPB in which reciprocal relationships are not addressed. Nevertheless, understanding such feedback loops between various variables (e.g., direct feedback loop between feedback and FSE) is another interesting avenue for future exploration.

³ An extra linear regression on these students who received feedback indicating a (very) low chance of study success reveals a significant effect of FSE on IFE ($F(1, 163) = 7.58, p = .007, R^2 = .04 B = .23$). Within the group of at-risk students, those with higher FSE thus demonstrate higher IFE ($M = 2.52, SD = 0.85$) versus at-risk students with lower FSE ($M = 2.21, SD = 0.79$).

5. Conclusion

The present study advances feedback research by presenting a TPB feedback model to research the behavioral component of feedback engagement. More specifically, the present study emphasizes the importance of feedback self-efficacy on which interventions can focus to enhance student feedback engagement. Such insights are vital in an education context, especially enabling at-risk students to receive more optimal support for the benefit of their study trajectory.

CRedit authorship contribution statement

Mona Bassleer: Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Stijn Schelfhout:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Lot Fonteyne:** Writing – review & editing, Validation, Methodology, Investigation, Data curation, Conceptualization. **Wouter Duyck:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Nicolas Dirix:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language and readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of Competing Interest

None.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.stueduc.2025.101520](https://doi.org/10.1016/j.stueduc.2025.101520).

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