



Towards Supporting Dialogic Feedback Processes Using Learning Analytics: the Educators' Views on Effective Feedback

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Feedback plays a crucial role in learning. Yet, higher education continues to face challenges regarding facilitating effective feedback processes. One of the challenges is the difficulty to track how students interact with feedback and the impact of feedback on learning outcomes. Learning analytics (LA) has opened up opportunities to enhance feedback practice with a wide array of data. However, most research seeks to deliver data-driven feedback rather than understanding how students make use of feedback and how educators can use learning analytics to support students in this process. As a first step to address this gap, our study investigated educators' views of challenges and elements of effective feedback processes in addition to their perceptions of data-driven feedback. The study found that feedback design (e.g., feedback purpose, content, and structure), educator-related factors (e.g., time constraints and resource limitations), and student-related factors (e.g., disposition, self-regulation, and sense-making) can have positive or negative impacts on the feedback process. It also highlights the need for the development of student feedback literacy. Based on the findings, we proposed ideas for an LA-based feedback tool that can be used to facilitate a dialogic feedback process and address challenges with feedback.

Keywords: learning analytics, feedback literacy, dialogic feedback, traceability, feedback impact

Introduction

Feedback has a significant influence on a learner's performance and achievement (Hattie & Timperley, 2007). In recent years, studies on effective feedback tend to shift the notion of feedback from a traditional transmission-focused model to a student-centred model, which emphasises shared responsibilities between students and educators in the feedback process (Boud & Molloy, 2013). Accordingly, many scholars have argued that feedback needs to be dialogic so as to enable two-way communication, cultivate trust, and motivate students to engage with feedback (Sutton, 2009; Yang & Carless, 2013). However, various studies have highlighted students' difficulties in interpreting feedback and taking action, as well as their lack of satisfaction and engagement with feedback (O'Donovan et al., 2019; Price et al., 2010). Such challenges suggest the need to develop student feedback literacy since students' recognition of feedback value and interactions with feedback such as sense-making, action-taking, and active engagement are important components of feedback literacy (Carless & Boud, 2018). Student feedback literacy, however, is relatively low in higher education (Carless & Boud, 2018). Due to this, scaling up student feedback literacy is essential to an effective feedback process because it directly affects how feedback makes a positive impact on their learning (Carless & Boud, 2018; Sutton, 2012). On the other hand, traceability of feedback impact, including student interactions with feedback has been a lasting challenge in higher education (Winstone, 2019), which impedes educators from supporting students to develop feedback literacy or improving their own feedback practice.

Learning Analytics (LA) has received considerable attention in the higher education sector because of its potential to facilitate a dialogic feedback process and track feedback impact (Winstone, 2019). By utilising advanced computational methods and technological infrastructure, LA can collect, analyse, and report on data about students and their learning. Such data-based insights allow educators to provide personalised feedback to large-sized classes in a timely manner, which serves as a stimulus for a dialogic environment to strengthen the relationship between educators and students (Winstone, 2019; Yang & Carless, 2013). However, studies raised concerns about the lack of actionable insights and student action on feedback generated by LA tools (Pardo, 2018; Tanes et al., 2011). In addition, predominant research in the LA field focuses on using technology to

facilitate feedback delivery (transmission-focused model) with limited capacity for tracking feedback impact (Carless & Boud, 2018; Winstone, 2019). Furthermore, learning analytics is regularly criticised for its lack of grounding in educational theory (Joksimović et al., 2019).

To address these issues, this paper presents a qualitative study that explores educators' current feedback practices, including their perceptions of challenges, feedback effective elements, feedback impact and interaction traceability, and data-driven feedback. This is part of a larger study that aims to develop a Learning Analytics (LA)-based feedback tool, which aims to scaffold the development of feedback literacy and inform feedback pedagogy by addressing the challenges associated with sustainable feedback, particularly in terms of impact traceability. The findings presented in this paper are based on fourteen group or individual interviews with twenty educators in higher education. The investigation is grounded in feedback theories and attempts to answer the following research questions:

- RQ1: What do educators perceive as challenges or effective elements in facilitating effective feedback processes?
- RQ2: What kinds of data about student interactions with feedback would be useful to educators when it comes to teaching design, feedback provision, and student support?

Literature review

Feedback is an essential part of the learning process. It aims to help students close the gap between their current and desired understandings by providing clarification of misconceptions and identifying issues with their learning strategies and skills (Sadler, 1989). However, studies have shown that students can struggle to make sense of feedback or respond to it (Price et al., 2010). This issue can be worsened in a traditional feedback model which considers that feedback is transmitted one way from the educator to the student instead of facilitating a two-way process that invites students to take an active role in sense-making and taking action based on the feedback (Yang & Carless, 2013; Nicol, 2010). In this regard, Yang and Carless (2013) proposed a framework of triangular feedback dimensions, namely *cognitive*, *social-affective*, and *structural*, to facilitate a dialogic feedback process in order to promote students' productive learning. In the *cognitive* dimension, the feedback content is the key element to improving students' ability to cope with disciplinary problems effectively and increase their self-regulated learning skills (SRL) to utilise the feedback productively. For feedback to be effective, the content of the feedback should have clear purposes and serve to answer three questions: Where am I going (feed up)? How am I going (feed back)? Where to next (feed forward) (Hattie & Timperley, 2007)? The first notion of *feed up* is about clarifying learning goals and objectives; the second notion, *feed back*, is about reporting on a learner's progress toward goals and objectives; and the third notion, *feed forward*, is about setting the stage for future learning opportunities. Each feedback question works at four levels: task level (FT), process level (FP), self-regulation level (FR), and self level (FS). The feedback about task (FT) focuses on how well the task is performed, while the feedback about process (FP) focuses on how it was completed. The feedback about self-regulation focuses on providing cues or prompts to encourage self-monitoring, directed and regulated learning, and feedback about self (FS) is about learner's personal evaluations, which is irrelevant to students' performance on the task. Feedback is most effective when it targets at the appropriate level based on the needs of the students, especially when it moves from the tasks (FT) to the processes (FP) or self-regulation (FR) to lead students to engage and develop effective skills to learn more. The feedback about self (FS), on the other hand, is the least effective form of feedback according to Hattie and Timperley (2007).

In the *social-affective* dimension, feedback is perceived as a social and relational process that impacts learning through emotional management. The management of emotions can foster trust and balance the power relationship between educators and students, which could encourage them to share meanings and resolve misunderstandings through dialogues (Steen-Utheim & Wittek, 2017). Boud and Molloy (2013) also emphasise the importance of educator and student relationship in learning, which is an enabler of dialogues between two agents and can make feedback more effective and sustainable. As part of dialogic feedback, students can engage with feedback actively and therefore learn from it in a trusted relationship because positive and negative emotions affect their willingness to participate in and engage with given feedback. However, many concerns arise about how to strike the right balance between support and criticism with an appropriate tone while not discouraging, demoralizing, or demotivating students, because the emotional impact of the feedback is crucial for promoting positive learning dispositions, self-regulation, and feedback effectiveness (Robinson et al., 2011).

The *structural* dimension concerns the way in which feedback processes are organised and administered by educators and institutions. The feedback timing, frequency, technology, and modes are the key components associated with the resources to generate and provide feedback. Feedback is now acknowledged as an integral

part of learning design (Harvey, 2003). However, students often find it difficult to receive timely and helpful feedback due to educators' availability to provide and sustain support on a timely basis, especially when students are looking for the following elements of feedback: helpfulness, timeliness, individuality, specificity, clarity and quality (Bailey & Garner 2010; Jonsson, 2013; Winstone, 2019). In many cases, the issue is less about educators' availability, but the learning design. For example, integrated multi-stage assignments is an essential element for delivering timely and continuous feedback to students; in turn, this promotes their uptake of feedback (Carless & Boud, 2018; Gibbs, 2006). Nevertheless, tracking feedback engagement and impact is an inherent challenge in the feedback process in terms of understanding how students exactly interact with the feedback (e.g., reading, making sense, taking action, etc.) (Winstone, 2019). Therefore, the feedback loop remains open when we fail to understand how students interact with feedback and how this process can be used to inform teaching and further support students. In this feedback process, student feedback literacy is essential because it brings students' active roles in facilitating their own learning by actively seeking feedback and making effective use of it (Carless & Boud, 2018).

Many studies have highlighted that student feedback literacy affects the impact and uptake of feedback (Carless & Boud, 2018; Sutton, 2012). However, students with a low level of engagement and satisfaction, along with high variability in their expectations, beliefs, and interpretations of feedback have been raised as the main barriers to effective use of feedback (Boud & Molloy, 2013; O'Donovan et al., 2019; Price et al., 2010). This is mainly due to the low level of student feedback literacy, which involves understanding and managing feedback effectively; developing capacities and dispositions to make use of the feedback productively; and appreciating feedback. More specifically, students should be able to recognise the value of feedback and understand their active role in the feedback process (*Appreciate feedback*), make judgements about their own works (*Making judgements*), be emotionally capable of dealing with feedback (*Managing affect*), and know the strategies necessary to act on feedback (*Taking action*). In order to make feedback effective, learners' sense-making and action-taking are critical in the feedback process, which requires students to have a certain level of feedback literacy and the educator to facilitate a dialogic feedback process that encourages students to take active roles in making sense of feedback and benefiting from this process (Price et al., 2010). On the other hand, a recent study argues that learner-centred feedback can enhance the sustainability of the feedback by placing learners as a key agents in the process (Ryan et al., 2020). The authors proposed three key conditions to be met in order to make the learner-centred feedback effective: sense-making, agency and impact.

Technology-enabled feedback, such as LA-based feedback has been introduced since it can address some of the above-mentioned challenges, especially timeliness and frequency, in addition to providing opportunities for a meaningful dialogue between educators and students (Hattie, 2012; Tsai, 2022; Yang & Carless, 2013). As an example, OnTask is an LA-based feedback tool that provides personalised feedback to large cohorts of students on a timely basis throughout the semester (Tsai et al., 2021). However, their pilot study on OnTask has shown that it lacks learning strategies to improve students' domain knowledge and self-regulation skills despite showing evidence of improving students' overall experience and appreciation of data-driven feedback by facilitating continuous dialogues. Similarly, several studies have shown that LA fails to effectively provide students with actionable knowledge or effective learning strategies, resulting in their apathy to take action based on the feedback given to them (Matcha et al., 2020; Pardo, 2018). The implication is that the LA-based feedback does not only require attention to foster a trusting relationship between educators and students in a dialogic process but also constructs feedback in a way that captures feedback effective elements (e.g., feedback purposes and levels, two-way process) to target students' individual learning.

Using learning analytics to facilitate an effective feedback process requires purposeful design grounded in feedback theories that may enable opportunities for further learning, including facilitating dialogue between educators and students and scaffolding the development of feedback literacy among students. To this end, our study is framed by the feedback theories discussed above with the goal to develop an LA-based feedback tool that allows educators to better track students' interactions with feedback, scaffold feedback literacy, and enable a dialogic feedback process.

Methodology

In this study, a qualitative research method is adopted with interviews to investigate the educators' perceptions of the challenges in feedback processes and what kind of learning data or information educators desire for a better understanding of students' interactions with feedback. Twenty educators (7 females, 13 males) from higher education worldwide consented to participate in a one-hour-long semi-structured focus group or individual interview. The participants were recruited from those who consented to participate in a previous

survey study¹ on educators' views of feedback effectiveness and impact in addition to additional recruitment through the researchers' professional networks. This research received ethics approval from the ethics committee at Monash University and consent from each participant was obtained before conducting interviews. In total, we conducted six focus groups (two educators per group) and eight individual interviews. Participants were from different universities in the following countries: Australia (9), China (4), Brazil (1), Canada (1), Ethiopia (1), Indonesia (1), Pakistan (1), and South Africa (2). The interviews were facilitated with 7 main semi-structured questions along with corresponding prompts or follow-up questions to explore educators' perceptions of various aspects: current practice, challenges for educators and students, effective feedback elements, impact and action tracking, desired data/information, perception of data-driven feedback approach, etc. (Interview questions are accessible [here](#)). All interviews were transcribed verbatim.

Following the completion of the data collection phase, a thematic analysis was conducted using the NVivo software. A coding scheme comprising seventy-two codes in total was developed based on relevant literature and emergent codes from interview data (Grbich, 2012). These were further grouped into four levels of themes, with the top-level themes being **feedback impact & interaction tracking**, **data-driven feedback**, **perception**, **feedback design**, **student-related factors**, and **educator-related factors** (The coding scheme is accessible [here](#)). The main coder conducted three rounds of inter-rater reliability tests with two other coders; one of them was involved in the first two rounds, and the other coder was involved in the final round. Cohen's Kappa results for the three rounds of inter-rater reliability tests were 0.62, 0.52, and 0.66 respectively. The second round resulted in a Kappa score lower than that of the first round due to a major change in the coding scheme; more specifically, we added the **perception** theme in order to differentiate references that were related to challenges and effective elements. After the coders resolved disagreement over the coding scheme with some revision of code descriptions, the third-round of inter-rater reliability test reached Cohen's Kappa 0.66, which is considered a 'good' agreement (0.61 - 0.80) according to Mabmud (2010). Following that, the main coder carried out the coding process for all interview transcripts.

In the following section, quotes from the participants are labelled as Int (interview), with a number to differentiate between interviews, followed by P (participant) with a number to distinguish between participants in the same group. For example, Int1P1 indicates participant 1 from individual interview/focus group 1. All the numbers cited in the findings (e.g., n=10) represent the number of participants who expressed a given idea, unless it explicitly states the number of *references* (e.g., *f* = 12), meaning the frequency of a particular code being applied in all interviews. Lastly, codes are bolded in order to improve readability.

Findings

In this section, we present our findings in response to the two research questions based on high-level themes. The first sub-section presents educators' perceptions of challenges and effective feedback elements in facilitating the feedback process, including feedback impact traceability, feedback design, educator-related and student-related factors. The second sub-section presents educators' perceptions of data-driven feedback based on their current feedback practices and what types of data they are interested in learning about in order to support students better.

Educators' perceptions of challenges and effective feedback elements

Feedback impact and interaction tracking

Tracking the feedback impact and interaction has been raised as one of the main challenges in the feedback process. About half of the educators (55%, n=11) stated that they either did not track or did not have a way to track students' interactions with feedback, making it impossible to determine whether their feedback was effective. It led to a challenge in providing further support to students. As a result, educators desired data or information that shows students' interactions with feedback, including whether they read and understood it, how they felt, and what actions they took.

'Basically, it's very difficult to tell what students have done with feedback because it lives within their own minds...I would definitely like to know things like what they feel, it was clear to them, it gave them direct guidance, and it felt like it was about them. And to a sense, whether they feel confident in taking the next steps?' – Int10P1

¹ The survey study was distributed broadly to educators in all sectors via social media and the researchers' networks, whereas our interviews focus on educators in the higher education sector.

The most commonly used method for understanding how students interact with given feedback was investigating **student engagement** (90 %, n=18), either online or in class. The first method was to observe students' **class participation**, which includes their attendance, class engagement, online engagement (LMS metrics and forum posts), and changes in their attitude and behaviour in the classroom through direct observation. Another approach was to observe **student inquiries**, whether they were seeking additional feedback or clarification. Although student engagement has a broad definition, we describe it as a category that emerges from interview data.

More than half of the educators (55%, n=11) tracked students' **direct feedback** and **follow-up activities** (e.g., subsequent assignments) in order to understand students' improvement and their interactions with feedback. In most situations, students' evaluations on the educators were embedded in the course design to allow students to comment on their educators' teaching and feedback practice in higher education settings. However, it could be challenging for educators to determine students' real needs due to anonymity and a lack of details, timeliness and response rate. Thirty-five percent of educators (n=7) also utilised **students' performance** data to track feedback impact and interaction, such as their improvement of assessment results or the correction of errors based on feedback. Despite using a variety of data sources to determine whether their feedback made an impact on students' learning, educators were still dissatisfied with their current practices due to their limitation to provide an accurate representation of how students interact with feedback. Due to this, educators were keen to have a more frequent and direct way to receive feedback from students on their feedback. For example, Int9P1 commented that the standard course survey at the end of a semester was not effective in soliciting detailed feedback from students and suggested instead: *'we could get feedback on the feedback that we give, like each assignment or each test.'* (Int9P1)

Educator-related factors

Educators expressed various challenges they encountered during the feedback process in their teaching experience, including challenges that are related to **feedback design**, **student-related factors** and **their own factors**. In terms of educator-related factors, the most common challenge that educators face was **time constraints and resource limitations** (65%, n=13) due to an unmanageable workload, the volume of the feedback, and their multiple roles in the institution. As a result, many educators (60%, n=12), particularly in China (20%, n=4), expressed a desire for a feedback tool that would assist them in automating or semi-automating feedback in order to deal with a large number of students. On the other hand, educators also perceived that their **time constraints and resource limitations** (25%, n=5) hindered students' learning by not being able to provide enough support and attention to their students, especially in a hectic clinic environment. Int11P1 would like to spend more time on helping individual students regarding their performance, but he stated that: *'I would like to talk longer to a student about things that went wrong and right and whatever but then there's another student waiting, the attention is sort of shared between or amongst the different students.'* (Int11P1)

In terms of **feedback design**, educators expressed their difficulties aligning feedback with learning design to allow students to benefit from feedback. From educators' perspectives, the **learning design** (50%, n=10), including issues related to the marking rubric, the inability to apply feedback further and receiving inconsistent feedback from multiple educators could be barriers for students. For example, Int8P2 commented that: *'Other times, there are multiple people giving them feedback, and those people might not agree.'* In other words, students might not be able to benefit from feedback if the learning design does not consider the feedback as a reciprocal process for clarifying their misconceptions and practising feedback further.

Student-related factors

Student-related factors have been raised as challenges for educators in facilitating the feedback process, such as **student attitude** (60%, n=12), **personality** (40%, n=8) and **self-regulation ability** (35%, n=7). Students' lack of engagement and motivation towards learning was one of the biggest challenges for educators, as they observed students making repetitive mistakes that were highlighted in the feedback and were unwilling to take the second chance to submit their works that educators allowed. Consequently, Int3P1 expressed his disappointment and irritation after putting so much effort into the feedback: *'I have already given them [feedback], but they didn't take it seriously. This is also my concern, because why should I give you feedback if you are not going to take the feedback seriously in the end? They even didn't read it.'* (Int3P1)

On the other hand, the educators believed that **student-related factors** can be main barriers that prevent students from benefiting from feedback. For example, **Student self-regulation capability** (70%, n=14) has been

highlighted as the most essential ability that students lack. This includes time management skills and the ability to adopt strategies to take actions based on given feedback. Additionally, **students' attitudes** (55%, n=11), such as a lack of engagement and interest in their learning activities, have been considered as a major challenge for students to make use of feedback in their learning processes. Furthermore, **sense-making** (50%, n=10) was a common issue in their learning processes as well. Eight of them believed that students were unable to understand feedback due to a lack of understanding of the assessment requirements and marking criteria. In some cases, students even carried out tasks in a completely wrong direction: *'And then they're surprised when they get this score back that they didn't get the mark they want, but because they didn't look at the criteria, they went the completely wrong direction.'* (Int1P1)

Feedback effective elements

The concepts of challenges and effective elements are intertwined because some challenges that educators or students face during the feedback process can also be seen as feedback effective elements on the other hand. As an example, **learning design** (50%, n=10) was one of the prominent barriers that prevent students from benefiting from feedback if it is not planned properly for effective feedback process; however, 14 educators (70%) considered it a critical element for making feedback effective through subsequent assessments, allowing students to have the opportunity to improve. Besides the above-mentioned challenges that were perceived as effective elements, **feedback on process** (90%, n=18), **feedback on self-regulation** (85%, n=17) and **feedback forward** (85%, n=17) were commonly identified as elements of effective feedback. The participant Int1P2 emphasised on the feedback content to improve students' self-regulation by guiding students to reflect and make further improvements: *'You have to ask the question, 'what do you think is wrong?' so that the student starts to reflect on why? After a while, they start thinking why they are struggling and how to improve it.'* (Int1P2)

Additionally, educators also placed an emphasis on the social-affective dimension, such as **feedback tone** (60%, n=12), **educator and student relationship** (40%, n=8), and **reciprocal process** (40%, n=8). In terms of student-related factors, educators perceived that **student appreciation** about the feedback (30%, n=6), **self-regulation capability** (30%, n=6) and **sense-making** (20%, n=4) also play an important role in making feedback work for students. Int3P1 showed his preference for using face-to-face feedback to have a discussion with students and ensure that students understand the feedback: *'I always try to meet them via Zoom, and then we discuss the feedback so that they can understand from the humanistic side, because if it is in writing, sometimes it's lost the non-verbal cues.'* (Int3P1). On the other hand, Int10P1 stressed the importance of balanced power between educators and students in order to better manage students' emotions and encourage feedback uptake.

'And I think ideally, you want it to be something where the students feel like they can actually continue the discussion. I would say if they feel like there's a flatter hierarchy where they feel like they are kind of on the journey together.' – Int10P1

Overall, there were a variety of challenges that have been raised by educators, including feedback design, educator-related and student-related factors, and impact traceability, which impede students making use of feedback. On the other side, challenges can turn out to be effective feedback elements if they are taken into consideration and addressed properly.

Data-driven feedback

- *Perceptions and current practice*

Over half of the educators (55%, n=11) believed that data-driven feedback was **useful** in their current feedback practice, because it not only allowed them to better understand their students with various data sources, but also increased students' appreciation for the feedback that they receive:

'When I was teaching in the physical classroom, I tended to provide feedback based on their behaviours and other data, which was very helpful for students to learn better. Students appreciated this kind of data-driven feedback, and they were surprised, felt special because you know them, and about them.' – Int14P1

On the other hand, about one-third of the educators (35%, n=7) perceived that data-driven feedback was only **semi-useful** because of concerns about **accuracy, ethics and privacy, bias, and security**. The **accuracy** issue (20 references out of 40) of the data-driven feedback approach was a major concern. The participants were not only aware that data cannot thoroughly represent one student's performance and status, but were also concerned about the quality of the data models and algorithms being used.

Furthermore, the concerns about **ethics and privacy**, and **bias** were raised twelve times ($f = 12$) among participants respectively. For example, educators may unconsciously provide biased feedback and make personal judgements about a student based on the data that they have. Similarly, Int7P1 emphasised the issues with the data-driven feedback approach due to a negative experience with a student who was strongly opposed to being judged by data and believed the data collected by educators was not an accurate representation of their actual engagement. Therefore, the educator proposed student-led data-driven feedback, believing that it could facilitate the feedback process by allowing students to play an active role in the process and engage in dialogue about their learning.

‘So, if the student collects that information of her or his own accord and brings it to me, we have a conversation around that. That can be very powerful. You see, this is the other way around.’ – Int7P1

Student acceptance

In terms of how students responded to the data-driven feedback approach, several educators (40%, $n=9$) indicated that most students accepted or trusted the feedback they received based on their learning data, such as attendance, log activities, engagement matrix from learning management systems and so on. Occasionally, students expressed their appreciation for data-driven feedback because they felt their educators were caring and attentive to them, ‘*So I think generally students do know that the tutor cares and is noticing their performance, even if it is a bit of a poor performance.*’ (Int1P1)

In contrast, four educators stated that a handful of students showed resistance to data-driven feedback due to its inaccuracy and unreliability. It was argued by students that the online learning data is unrepresentative because they used many offline resources, including reading, researching, and searching for alternative materials online. The result was that educators avoided collecting data and using it to provide feedback, despite the fact that they believed data-driven feedback to be valuable in their teaching practice. For example, Int7P1 believed that postgraduates have their own time management strategies, and it is important to provide data-driven feedback with caution as he observed that some students responded offensively: ‘*I did it on a couple of occasions, but I kind of regretted doing it, I was collecting information like especially from Moodle about engagement. But again, I haven't...That was a negative experience because he was a [sic], that wasn't done in the right way.*’ (Int7P1)

Desirable data

The interview questions also asked for data or information about students that educators would like to have in order to better understand whether students took actions in response to feedback or how they exactly interacted with it. More than half of the educators (55%, $n=11$) strongly expressed a desire for information about the **students' interactions with the feedback**, including how well they read and understand it, whether they accept or reject it, how they engage emotionally, and implement it accordingly.

‘That's what we need to learn from it, I think the biggest thing for me is to see whether the students actually go and engage with the feedback that's available on the computerised system and actually see whether they look at it and they reflect and say: Well, can I improve in this area or what should I do to improve my independence or what can I do for the next step?’ – Int11P2

However, three educators were interested in knowing **students' offline activities** so they could understand how much time they spent on completing the assignment and understanding a certain content of their unit, how many articles they read, and how they digested them. In addition to that, three educators were interested in **students' background information**, especially their language level, cultural nuances, and more personal information. In terms of personal information, they were particularly interested in knowing whether students have any disabilities (e.g., hearing impairment), since they believed that feedback could harm students with disabilities in some situations when not considered.

Overall, the interview data revealed that educators perceived the importance of data-driven feedback with its related concerns in their feedback practice. Educators showed their desire for more data about students, especially their interactions with feedback, in order to facilitate the feedback process and support students more effectively.

Discussion

Twenty educators from higher education participated in this study, which aimed to gain a deeper understanding of their current feedback practices. The study intended to interrogate educators' views on challenges in the feedback process, their perceptions of the data-driven feedback, and the types of student data they need for effective feedback. In response to the RQ1 (*What do educators perceive as challenges or effective elements in facilitating effective feedback processes?*), our data highlights that various factors might hinder an effective feedback process, including feedback design, educator-related and student-related factors, and feedback impact traceability. Considering student-related factors, several educators believed that students were reluctant to engage with feedback due to negative learning dispositions towards learning, such as different expectations in the feedback or results, grade-oriented personality, a poor attitude towards learning, and lack of engagement and motivation. This implies that **appreciation** plays a critical role in engaging students in the feedback process through the recognition of the feedback value and their active participation in its process (Carless & Boud, 2018; Sutton, 2012). The participants believed that their students' inability to make sense of feedback was mainly due to a misunderstanding of assessment criteria and requirements, which further led to different expectations between educators and students regarding feedback and results. The issue is also related to the challenge of aligning the feedback mechanism with the learning design, where the learning design should enable students to understand the purpose of feedback, develop **evaluative judgement**, and apply feedback in the following tasks (Carless & Boud, 2018). In addition, the educators expressed their concerns that their feedback might discourage students, particularly those who are shy, introverted, and afraid of criticism (student personalities). This implies that the disposition to **manage feedback affect** should be developed because studies have shown that students' disposition to interact with feedback is often not optimal in higher education, and feedback tones can easily provoke affective emotions, which directly affect students' participation and engagement in the feedback processes (Carless & Boud, 2018; Steen-Utherim & Wittek, 2017). Moreover, participants in our interviews reported that some students tend not to **take actions** despite receiving repetitive feedback. They perceived that students lacked self-regulation capability to manage their time productively and apply strategies and tactics to resolve issues that were identified in the given feedback. This highlights the importance of student feedback literacy as it can help students to develop their dispositions and capabilities to act upon the feedback and make use of feedback effectively.

In terms of educator-related factors, educators' time constraints and limitations were the most commonly highlighted issue in their teaching practice. In our study, we found that the increased volume of feedback and unmanageable workload due to the large class sizes and their multiple roles (teaching and researching) in the institution resulted in insufficient student support. This is also aligned with Yang and Carless (2013) who emphasise the structural constraints that impede educators from providing effective feedback to their students. In light of this, technology-enhanced feedback could be the potential solution to provide timely and personalized feedback in a non-labour-intensive way through a dialogic feedback process. Additionally, educators have expressed challenges related to the feedback design, such as constructing feedback content to enhance students' learning as well as aligning feedback with learning design, and more importantly, pinpointing effective feedback elements including clearly defined purposes, and appropriate levels with clarity to foster engagement and self-regulation. In other words, if the feedback content is not constructed in alignment with the learning design (e.g., marking rubric, subsequent assignments, meaningful dialogues), the feedback might not be effective enough to influence students' learning (Hattie & Timperley, 2007).

Another key finding is that educators encountered challenges to track feedback impact and interactions, which is essential for providing effective and sustainable feedback to students (Winstone, 2019). A lack of synthesis of multiple feedback processes, invisibility and inaccessibility of feedback impacts, as well as diversity among students, may cause difficulties in tracking feedback impacts and interactions (Winstone, 2019). To tackle those issues, effective learning and feedback design with technology-enhanced feedback (LA-based feedback) could be implemented (Yang & Carless, 2013).

In response to RQ2 (*What kinds of data about student interactions with feedback would be useful to educators when it comes to teaching design, feedback provision, and student support?*), our data showed that educators desire to have a data-driven feedback tool to track student interactions with feedback and whether their feedback is effective in student learning. Specifically, the information about students' emotional responses, their detailed action-takings, types of additional support they need would be desirable in assisting educators to identify students' real needs and provide individualized support. Similarly, Winston (2019) argued that making feedback impacts and interactions tangible can facilitate a holistic and ongoing feedback process, which would encourage students' engagement and uptake of feedback. However, teaching staff also expressed their concerns regarding data-driven feedback: accuracy, ethics and privacy, bias, and security, which should be taken into consideration

when designing an LA-based feedback tool, otherwise, it will lead to students' resistance to making use of LA-based feedback (Tsai et al., 2020).

Based on all of the above findings, we argue that dialogic elements and student feedback literacy are important to an effective feedback process. In this process, LA can be leveraged to enable dialogue between students and educators and provide opportunities to scaffolding feedback literacy. For example, we may seek to use LA to improve students' *appreciation* through timely and personalised feedback (Carless & Boud, 2018), as well as improving student ability to *make judgement* by aligning LA with learning design (e.g., learning outcomes), *manage affect* by cultivating a trust relationship (e.g., balancing power relationships), and *take action* by guiding students to make sense of feedback and reflect on further learning opportunities. All of these rely on a two-way feedback process in which educators can better understand students' interactions with feedback and provide support accordingly.

In light of all findings, we posit that an LA-based feedback tool for educators should address challenges in the feedback process with the ability to scaffold student feedback literacy by facilitating dialogic feedback processes (User cases have been identified in this [mapping table](#)). We thereby designed a low-fidelity prototype of an LA-based feedback tool that consists of three main interfaces to realise five major functionalities: feedback content construction (A), communication enhancement (B), impact traceability (C), student feedback literacy development (D), and feedback scalability (E) (Full view of the prototype is available [here](#)).

The first interface is intended to provide timely feedback by overviewing students' feedback with the status and urgency levels, which could encourage students to actively participate in the feedback process (B, D). In the second interface, students' individual needs can be visualised by providing a more detailed understanding of their interactions with feedback (e.g., read, understand, feelings) (B, C). In addition to that, students' detailed future action plans with their progress will be presented, which allow ongoing dialogues between educators and students based on data (A, B, C, D). The third interface is intended to help educators to manage feedback effectively by dealing with feedback in bulk (A, B, E). In all areas (The second and third interfaces) for educators to provide feedback, a natural language processing system will be integrated to assist in composing feedback with an appropriate tone, thus facilitating feedback process (A, B).

Conclusion

In this qualitative study, we synthesised the challenges and effective elements that inhabit feedback processes, along with educators' perceptions and concerns about data-driven feedback, which were then used to inform our LA-based feedback tool. The tool can potentially contribute to scaffolding student feedback literacy by encouraging dialogues and their active role in the feedback process, along with an opportunity to track feedback impact and interactions. Our next step is to validate the prototype by seeking further feedback from both educators and students, including the need for training to ensure ethical and effective use of data in facilitating feedback processes.

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