

Supporting Student Agency with a Student-Facing Learning Analytics Dashboard: Perceptions of an Interdisciplinary Development Team

Anceli Kaveri¹, Anni Silvola² and Hanni Muukkonen³

Abstract

Learning analytics dashboard (LAD) development has been criticized for being too data-driven and for developers lacking an understanding of the nontechnical aspects of learning analytics (LA). The ability of developers to address their understanding of learners as well as systematic efforts to involve students in the development process are central to creating pedagogically grounded student-facing dashboards. However, limited research is available about developer perceptions on supporting students with LA. We examined an interdisciplinary LA development team's (IDT) perceptions of and intentions to support student agency, and the student-facing LAD development process. Qualitative content analysis supported by a social cognitive theory framework was conducted on interviews (N = 12) to analyze the IDT's perceptions of student agency. IDT members had differing conceptions of student agency but agreed that it manifests in strategic study progression and planning, as well as in active interpretation and use of LA-based feedback. IDT members had differing views on student involvement in the LAD development process. Communication challenges within an IDT and limited resources were mentioned, impeding development work. The results of this study highlight the importance of fostering communication among IDT members about guiding pedagogical design principles and the systematic use of educational concepts in LA development processes.

Notes for Practice

- Supporting student agency from pedagogical, ethical, and practical perspectives is central in LA. Previous literature has suggested that student agency can be fostered through aiding study-related self-reflection, study monitoring, and strategic study planning via student-facing LADs that offer targeted, timely feedback, and support.
- In the interdisciplinary field of LA, there is a need to foster conversation about the IDT members' varying perceptions of students as learners and agents to avoid theoretical isolation among team members and to develop relevant and effective student-facing tools and dashboards.
- Developers must involve students as agents in the tool development process by informing them about the use and collection of their data, as well as by creating opportunities for them to engage meaningfully in the development work.
- LA tool development work is usually restricted by the availability of existing resources, data, and information as well as communication challenges within IDTs. Hence communicating the differentiating views and expectations can easily be overlooked unless it is given a clear and strategic priority.

Keywords

Interdisciplinary development work, student agency, student-facing dashboard, ethics

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Corresponding author ¹Email: anceli.kaveri@oulu.fi Address: University of Oulu, Faculty of Education and Psychology, Learning and Learning Processes Research Unit, P.O. Box 2000, FIN-90014 University of Oulu, Oulu, Finland. ORCID ID: <https://orcid.org/0000-0002-3661-3541>

²Email: anni.silvola@oulu.fi Address: University of Oulu, Faculty of Education and Psychology, Learning and Learning Processes Research Unit, P.O. Box 2000, FIN-90014 University of Oulu, Oulu, Finland. ORCID ID: <https://orcid.org/0000-0002-2191-2194>

³Email: hanni.muukkonen@oulu.fi Address: University of Oulu, Faculty of Education and Psychology, Learning and Learning Processes Research Unit, P.O. Box 2000, FIN-90014 University of Oulu, Oulu, Finland. ORCID ID: <https://orcid.org/0000-0002-1086-1352>

1. Introduction

Research that solves the conceptual, methodological, and pragmatic challenges that become apparent when working in the interdisciplinary field of LA is sorely needed (Knight et al., 2017). Previous studies have identified the need to connect the

theoretical understanding about learning with LA tool development processes (e.g., Ahn et al., 2019; Ferguson, 2012; Jivet et al., 2017; Lodge et al., 2017; Tsai, Rates, et al., 2020). Concerns have been raised about LA tool development being too data-driven and holding the risk of data having uninformative descriptors or being wrongfully interpreted, thus not representing the reality of the student situation (Mittelmeier et al., 2018; Prinsloo & Slade, 2014; Roberts et al., 2017). Misalignment between LA tool capabilities and user needs is a barrier in adopting and using LA tools in education (Johanes & Thille, 2019; Klein et al., 2019).

LA is an interdisciplinary field of research involving gathering, analyzing, and reporting learner-related data for optimizing the student learning experience and providing them with targeted and effective support for learning (Long & Siemens, 2011; Siemens, 2013; Slade & Prinsloo, 2013). There is increased emphasis on research that goes beyond the technical features of dashboards and aims to understand how they affect students and if the dashboards meet their needs (Bodily & Verbert, 2017; Brusilovsky et al., 2015; Roberts et al., 2017; Viberg et al., 2018). One way to better understand how LADs aim to meet student needs is to investigate their interdisciplinary development process, especially how interdisciplinary development team (IDT) member perceptions of students and learning influence their development work.

As a key group between student needs and the aims, intentions, and execution of LA tools, an IDT handles the decisions and trade-offs made in the tool development process (Birch & Demmans Epp, 2015; Johanes & Thille, 2019). Transparency and clear documentation of the initial motivations, processes, and outcomes of the development work, as well as creating opportunities for students to contribute, are recommended actions for the LA tool development process (Dollinger et al., 2019). In the development work, not all user ideas or additions are incorporated into the final tool, since design choices and decisions made during the process are based on multiple factors, including impact, urgency, pedagogical meaningfulness, ease, and fit with the overall design agenda and goal (Birch & Demmans Epp, 2015; Dollinger et al., 2019). Still, only a few studies focus on what kinds of decisions and trade-offs IDTs face in their work (Johanes & Thille, 2019).

Communication barriers between developers expressing end-user perspectives (e.g., learning scientists, educators, or end-users themselves) and technological experts are usually a challenge when working in IDTs (Abrams et al., 2004; Birch & Demmans Epp, 2015). To avoid theoretical and methodological isolation, previous studies have suggested fostering conversation about developer assumptions of learning and learners among IDT members (Lodge et al., 2017).

LA developers should be aware of student grouping, personalization, and generalization behind algorithms and visualizations to limit researcher bias and incorrect interpretations (Mittelmeier et al., 2018; Prinsloo & Slade, 2014). For example, grouping student needs for immediate support based on their performance might disadvantage some students by excluding them from additional help and advice (Prinsloo & Slade, 2014; Tsai, Perrotta, et al., 2020). These design solutions made by the IDT might also reduce the possibilities of students making agentic choices in their studies by, for example, making decisions on their behalf (Scholes, 2016).

In this paper, we explore an IDT's understanding of student agency behind the development of a student-facing learning analytics dashboard (LAD). Since agency is a key concept in understanding how students learn and progress in their studies (Klemenčič, 2017; Zimmerman, 1995) and LA tools have the potential to support student agency by increasing the chances of making individual choices on the academic path (Bennett & Folley, 2020; Roberts et al., 2017; Silvola et al., 2021), we focused on developer views of students as agents. The IDT in this study focused on developing a student-facing LAD in the context of higher education. Therefore, IDT member perceptions of student agency provide an important window to better understand the knowledge behind and intentions in developing LADs. This can offer a valid approach for both user-centred (e.g., Abrams et al., 2004) and participatory (e.g., Birch & Demmans Epp, 2015) design processes of LAD development.

2. Student Agency

Agency is a widely used concept in learning sciences, social sciences, and psychology (Eteläpelto et al., 2013). In social cognitive theory, the core features of agency are the intentionality of one's acts and forethinking of such acts via self-consciousness (Bandura, 2001). Agency is exercised through mechanisms of self-regulation and self-efficacy (Bandura, 1997, 2001). Self-regulation refers to the process of activating and sustaining goal-oriented cognitions and behaviours (Zimmerman & Schunk, 2011). Self-efficacy refers to an individual's belief in their capacity to perform successful actions to reach specific goals (Bandura, 1997).

In an educational context, student agency is considered central in proactive goal-setting, planning, and monitoring of learning (Bandura, 1986; Martin, 2004; Zimmerman & Schunk, 2011). It is connected to student self-efficacy beliefs, decision-making, motivation, and performance accomplishments, and it actualizes itself in participatory activities in learning situations and through students' own intentional efforts to progress and improve their learning (Bandura, 1982, 1997; Zimmerman, 1995). Supporting student agency has a positive impact not only on student learning (Zimmerman, 1995) but also on their engagement (Klemenčič, 2017). Even at the policy level, student agency is highlighted as a long-lasting educational aim as we head toward 2030 (OECD, 2018).

In LA development, evaluation and implementation processes fostering student agency are pedagogical, ethical, and practical issues. For students to recognize their own agency, as well as reflect and act on it, they need self-reflection and self-regulation skills (Bandura, 1997). Feedback provided via LA tools can aid student self-reflection and self-regulation that affects their self-efficacy beliefs and aids them in seeking help and support (Jääskelä et al., 2021; Zimmerman & Schunk, 2011). By providing students with targeted supports and tools that help them reflect on their gained competencies and progress, we can enhance their agency by helping them make strategic, well-informed decisions in their study paths (Bennett & Folley, 2020). If not carefully considered, LA-based feedback risks negatively affecting student agency, self-efficacy beliefs, and motivation by, for example, providing students with unsuitable, overly negative, or ineffective feedback (Howell et al., 2018; Roberts et al., 2016, 2017; Silvola et al., 2021). It is also important to note that students might interpret feedback about their performance incorrectly or overly negatively (Howell et al., 2018).

2.1. Student Agency in Higher Education Studies

In the context of LA, supporting student agency has been approached as an ethical and pedagogical issue. The ethical perspective refers to providing students with equal access to feedback and support, informing them about data usage, and providing them with data ownership and the ability to opt out of data collection if desired (Scholes, 2016; Slade & Prinsloo, 2013). When using tools that collect and reflect personal information, the student participates in both the collection and interpretation of the data (Li et al., 2010). Besides students, teachers and academic advisors can usually access and use data about students, which raises concerns regarding student privacy and vulnerability, unequal power relations, possible misuse, and ownership of student data (Howell et al., 2018; Pelletier et al., 2021; Prinsloo & Slade, 2016). Thus, when using LA tools, students should be informed about and involved in decision-making about what information about them is shared, for what purposes, and under which conditions (Khosravi et al., 2021; Prinsloo & Slade, 2016).

From a pedagogical perspective, student agency manifests as active interpretation and sensemaking of the information, visualizations, and features of LA tools (Bennett & Folley, 2020). There is variation between student interpretations of different visualizations and needs for support that should be considered when developing LA tools for them (Bennett & Folley, 2019; Tsai, Perrotta, et al., 2020). The customizability and opportunity to decide how and which tools students use have been seen as features that may support student agency (Bennett & Folley, 2020; Silvola et al., 2021).

LA-based interventions should not just be assumed to empower students (Tsai, Perrotta, et al., 2020). Concerns have been raised about feedback delivered through LA tools being unsuitable and even paralyzing students by having a negative impact on their motivation, agency, and engagement in their studies (Howell et al., 2018; Roberts et al., 2016, 2017; Silvola et al., 2021). These tools can prevent the development of student agentic skills by “parenting” them and shifting from empowerment toward control and surveillance (Howell et al., 2018; Roberts et al., 2016, 2017; Tsai, Perrotta, et al., 2020). Overly influencing the student — for example, by setting goals on their behalf — runs the risk of constraining and pressuring students to perform in a specific way rather than inspiring them to manifest their own agency (Bandura, 1997). Fostering understanding about the possibility of LA having negative effects on student agency as well as investigating how developers consider and balance the possible advantages and risks of tools are central for developing future relevant LA tools for students.

2.2. Involving Students in LA Development Processes

In the LA development work context, student agency is mostly viewed practically, through student participation and involvement in tool design and data usage-related decision-making (Prinsloo & Slade, 2016; Sarmiento & Wise, 2022; Slade & Prinsloo, 2013; Veiga, 2016). Providing opportunities for students to participate and be involved in the LA development process is crucial for manifesting their ownership of data and their overall agency in LA (Prinsloo & Slade, 2016). Additionally, involving students in development processes is essential to successfully implementing and maintaining usable, effective, learner-centred LA tools and dashboards that best support student agency (Ahn et al., 2019; Howell et al., 2018; Klein et al., 2019; Roberts et al., 2017). Involving students in the development process also results in a higher willingness to adopt LA tools (Dollinger et al., 2019). For learning scientists and LA researchers, a common way to approach the tool design process is to start from one’s own theoretical assumptions and then invite end-users into the design process by interviewing them to gain an understanding of the user, context of use, and phenomenon at hand (Ahn et al., 2019).

Although there is a consensus on the importance of involving students in LA tool development work (Dollinger et al., 2019; Sarmiento & Wise, 2022), prolonged student participation in different LA development processes has been considered missing or challenging (Birch & Demmans Epp, 2015; de Quincey et al., 2016; Prieto et al., 2019; Roberts et al., 2017; Tsai, Rates, et al., 2020). A key challenge in involving students in LA tool development is the technical expertise required to contribute meaningfully (Dollinger et al., 2019). Developers must find points in the development process where students can test tools or offer ideas and feedback without requiring baseline knowledge or expertise. Developers should also consider how these participatory activities, such as interviews and tool testing pilots, are promoted, and whether they are accessible to all students and align with their lifestyles and interests (Dawe, 2007; Dollinger et al., 2019). Equally important is using and incorporating student ideas and wishes into the actual design of the LAD (Birch & Demmans Epp, 2015).

There is also an ethical motive in involving students in LA tool development processes, since students have a moral right to influence technological decisions that affect them (Bergvall-Kåreborn & Ståhlbrost, 2008; Sarmiento & Wise, 2022). Providing students with transparency and involvement in the decision-making of their data collection and usage are important ethical aspects in supporting student agency in LA (Pardo & Siemens, 2014; Prinsloo & Slade, 2016; Roberts et al., 2016, 2017; Silvola et al., 2021; Tsai, Perrotta, et al., 2020). In the tool development process, developers face challenges with data availability, accessibility, and the decision-making behind what data are being used and shown to the end user (Klašnja-Milićević & Ivanović, 2018). There is also a need to develop practices for keeping students continuously informed about institutional data collection and data use (Howell et al., 2018; Prinsloo & Slade, 2016; West et al., 2016). Several studies have raised concerns in the LA field regarding student data ownership and their awareness of data collection (e.g., Roberts et al., 2016, 2017; Silvola et al., 2021; Tsai, Perrotta, et al., 2020).

Student participation in the design process and decision-making of student tools is crucial in enabling student agency in LA. Providing students with sufficient information and transparency regarding their data usage would enhance student agency, we argue, by strengthening their role as influencers in the decision-making regarding their data collection and usage. This active participation is possible only if students are given the chance to contribute to the development work. This obligates developers to create opportunities for students to participate, pay attention to student needs regarding the tool, facilitate transparency, and keep students informed.

3. Research Questions and Goals

In this study, we explore the IDT member views and decision-making processes behind a student-facing LAD from the perspective of supporting student agency. We examine IDT member understanding of student agency in the context of higher education studies (e.g., Jääskelä et al., 2021; Zimmerman & Schunk, 2011) and in the LAD development process (e.g., Slade & Prinsloo, 2013; Veiga, 2016). To gain a broad understanding of the phenomenon, we also attempt to clarify what IDT members think supports or undermines student agency.

In this study, we aim to answer the following questions:

RQ1. How did the IDT members perceive student agency?

RQ2. How did the IDT members envision the developed LAD to support student agency?

RQ3. How did the IDT members perceive the role of students within the LAD development process?

4. Methodology

4.1. Study Context

This study was conducted by interviewing an IDT involved in a four-year project where LA tools were developed and researched in the context of higher education. During the project, a student-facing LAD was designed to support student decision-making in personal study planning of degree program courses and self-evaluation of progress. The developed dashboard used student-registry data and visualized personal study plans (PSPs) and the completed, failed, and ongoing courses within it. The LAD had three pages with different visualizations. The first page included the student PSP, a bar chart of the course distribution within semesters, and an estimation of the time to graduation. The second page had a radar plot of the student grades with an option to include comparative data about peer grades. The third page contained a bar plot of courses in the student PSP and the completion rate of that course among peers. All visualizations were customizable so that students could choose which of their courses and subjects it showed. Previous research has provided similar examples of student tools that provide descriptive, predictive, and comparative visualizations based on data about grades, credits, and courses in the student study program (e.g., Gutiérrez et al., 2020).

4.2. Participants

We interviewed twelve team members who had experience working in the interdisciplinary LA development and research project and thus were familiar with the student-facing LAD being developed. Invitations were sent via email to all team members. The experience of interviewees in working with LA varied from a few years to around 10 years. The experts of the IDT were from the fields of educational psychology, information technology science, and natural sciences. Their experience of working in the IDT varied from around six months to over two years. The IDT members had different roles on the project. Some coded the LAD's features, some provided theoretical knowledge and interview data about student needs regarding the LAD, and others worked at the project management level. Most participants also had other duties in the institution, such as academic advising, teaching, research, and university management. Two participants were higher education students working on the LA project. The team members were interviewed during the third year of the LAD development project when prototypes were being developed and the first pilot studies were being conducted.

4.3. Data Collection and Procedure

Data gathering was carried out in semi-structured interviews, and the key themes and questions were determined in advance (Punch & Oancea, 2014). Since our interviewees had varying backgrounds and roles in LAD development, the chosen method offered us the flexibility to adapt to different responses and ask refining questions, if needed. The qualitative interview data consisted of 12 interviews held online via Microsoft Teams, each lasting approximately 45 minutes. Interviewees were informed about the data collection and usage. They signed a consent form to participate in the study and agreed to have their interviews recorded. Ethical review and approval were not required for the study on human participants in accordance with local legislation.

There was a short introduction at the beginning of each interview to familiarize the participants with the study and the structure of the interview. The interviewer and researchers had been closely involved in the LAD development project and were familiar with the participants, which aided the design process of the interview questions. We arranged the interview questions into three main themes concerning the IDT member perceptions of the following:

1. LA research and development practises and ethics in the higher education context.
2. Student agency and supporting it with LA.
3. The LAD development process and student participation.

4.4. Data Analysis

The recorded interviews were transcribed, and qualitative content analysis (Chi, 1997) was carried out using NVivo (Lumivvero, 2020). A meaningful part of the text segment was chosen as a unit of analysis; there were 613 segments in total. The units of analysis varied from half a sentence to a few sequential sentences. No overlapping between units was allowed.

An analysis framework was formulated, building on the social-cognitive theory of student agency (e.g., Bandura, 1977, 1982, 2001) and previous literature on student involvement in LA development processes (e.g., Bennett & Folley, 2020; Dollinger et al., 2019; Slade & Prinsloo, 2013). Thus, student agency was viewed as self-driven actions such as reflection, monitoring and planning of studies as well as willingly participating in the LAD development. The framework was further refined by what the IDT members emphasized. The IDT members discussed ethical aspects of supporting student agency as integrated to other topics discussed during the interview. Thus, ethical aspects were not analyzed as their own category, but they were incorporated into the subcategories 3a–3b and 4a–4b of the analysis framework.

The final analysis framework consisted of four categories: 1) characteristics of agency, 2) acts of agency, 3) ways to facilitate agency, and 4) obstacles to agency. Categories 1 and 2 describe the IDT member conceptions about what student agency is whereas categories 3 and 4 describe their perceptions of what facilitates or prohibits student agency. The categories were divided into two main themes based on the context in which student agency was discussed: a) student agency in higher education studies and b) student agency in the LAD development process. This resulted in four subcategories under each theme (see Table 1).

Table 1. Category Analysis of IDT Member Perceptions of Student Agency

	Perceptions of student agency	Descriptions of student participation in the LAD development process
1. Characteristics of agency	Understanding of student agency.	Student roles in the development work.
2. Acts of agency	Manifestation of agency in student behaviour.	Active participation and involvement in the development process.
3. Ways to facilitate agency	IDT member efforts to support student agency on study paths.	IDT member efforts in enabling student involvement.
4. Obstacles to agency	Exterior limitations and negative influences on student agency.	Limitations in involving students and their ideas.

Sources: Bandura, 1982, 1997, 2001, 2002; Bennett & Folley, 2020; Howell et al., 2018; Prinsloo & Slade, 2016; Zimmerman, 1995.

1. Characteristics of agency include IDT member descriptions of student agency as a concept (subcategory 1a). These include self-observation and self-reflection, proactivity, self-regulation, and the belief in one’s efficacy, which are also mentioned in previous research of agency from a social cognitive perspective (e.g., Bandura, 1982, 1997, 2002; Zimmerman, 1995). Subcategory 1b describes characteristics of student agency in the LAD development context. It consists of student roles in development work and agentic characteristics such as motivation and knowledge that students needed to meaningfully contribute to the development work.
2. Acts of agency describe concrete acts of student agentic behaviour. These are related to student participation and decision-making in one’s studies, such as engaging in one’s studies and strategic, proactive study planning, proactive

- contextualization, and reflection on the provided feedback (subcategory 2a; e.g., Jääskelä et al., 2021; Martin, 2004; Zimmerman, 1995). Subcategory 2b describes student agentic acts in the LAD development context. It includes concrete student acts of participation in the LAD development process, such as self-driven participation in the pilots and giving feedback about the LAD.
3. Ways to facilitate agency involve the ways in which IDT members described how they could support student agency. IDT members described perspectives for support from their positions as members of the LA development team or from their other positions as members of academic staff; for example, as teachers and academic advisors. Subcategory 3a describes how IDT members try to support study progression, strategic study planning, and student engagement via supportive, reflective, personal feedback (Jääskelä et al., 2021; Prinsloo & Slade, 2016; Zimmerman & Schunk, 2011). Subcategory 3b describes IDT member ways to support student agency in the LAD development context. It consists of ways that IDT members try to enable student agency, participation, and influence in the development process. These include ensuring transparency and informing students about the process, using knowledge about student agency, and support needs in one’s work, as well as finding points where students can meaningfully contribute to development work.
 4. Obstacles regarding agency describe issues that IDT members mention as challenging their efforts in supporting student agency. Comprising subcategory 4a, these include external limitations and prohibitors of student agency, such as degree structure-level inflexibility to personalize and plan one’s studies. This category also contains the uncertainty and possible ineffectiveness of interventions and feedback offered to students via the LAD. Subcategory 4b describes challenges in the LAD development context. It consists of the challenges IDT members mention regarding involving students in the development process as well as resource, technical, and data limitations that restrain IDT members from designing dashboards they think would best support students. This category involves notions of unequal power relations and student exclusion from decision-making in the LAD development process that have also been recognized as concerns regarding student agency in literature (Birch & Demmans Epp, 2015; Howell et al., 2018; Tsai, Perrotta, et al., 2020).

The categorization of the analysis units was carried out through many iterations of discussions and clarifications, and the category descriptions were redefined accordingly. Next, a Cohen’s kappa coefficient summary agreement calculation was conducted for 10% of all codes to measure the inter-rater agreement of two independent researchers within the subcategories. The Kappa coefficient value was 0.922, suggesting a “very good” level of rater agreement (Altman, 1990, pp. 403–408; Fleiss et al., 1969). Since we as LA researchers were also closely related to the LAD development project, our familiarity with it influenced how we approached the data collection and analysis. In the interviews we focused on the individual participant perceptions and contributions to the LAD development process. We did not specifically ask the members to describe the IDT’s collaboration or possible power relations. This allowed us to focus on the varied conceptions of student agency among team members.

5. Results

5.1. IDT Member Perceptions of Student Agency Characteristics

IDT members described their perceptions of student agency through student roles, skills, and abilities. They also described the ways and contexts through which student agency manifests itself (see Table 2). Most of the IDT members emphasized the active student decision-maker role and ownership of their studies. This was also connected to study-related student motivation and sense of meaningfulness. One of the IDT members mentioned passivity or “drifting” as the opposite of having control and ownership of one’s study situation.

Table 2. Characteristics of Student Agency (Subcategory 1a)

Subcategory	Commonly mentioned themes
1a	Ownership of one’s studies. Sufficient self-regulatory abilities and level of motivation to proceed in one’s studies. Ability to acquire and use information and feedback to optimally plan one’s studies.

Student agency was mostly described as occurring through having self-reflective and self-regulatory skills as well as interest in proceeding in one’s studies or having a so-called motivational attitude toward them. IDT members recognized the belief of one’s self-efficacy being connected to agency: “*The students sort of believe in themselves, that they can study successfully, that they can make career choices successfully and progress with their studies and careers.*” One of the IDT members mentioned autonomy as an important characteristic of student agency and proceeded to discuss its possible connection to agency.

IDT members defined student agency as having a malleable nature and recognized individual variation, and even a possible lack of agentic skills and abilities in some students. There were varying perspectives on what levels of agentic skills the students should acquire to proceed and act as decision-makers in their studies, and to use feedback about them effectively. The lack of self-regulatory skills and information regarding one’s studies was seen as related to suboptimal study planning.

Some IDT members were skeptical about whether students should act as agents in deciding all aspects of their studies. They argued that if students are given less freedom in planning their studies and are handed predetermined plans, they are likelier to succeed and proceed in their studies than become passive: *“So when students were more or less assigned with timetables, so that ‘Here it is, now go,’ it seemed to ease those who would have otherwise been prone to drift, so that they didn’t have to decide for themselves. So, in a way, contradictory... that the less freedom, the better it is for some people in their studies.”*

IDT members had varying knowledge about the concept of agency. IDT members with educational science backgrounds mainly defined student agency as similar to social cognitive theory (e.g., Bandura, 2001). When asked about agency, five of the IDT members stated that it was an unfamiliar term to them. They mostly appealed to agency being an educational and psychological concept and thus not being talked about in their field: *“So, well, this is probably this kind of maybe an educational science term and unfamiliar to me, so I will not start guessing what it means at this point, so I’ll say that it is an unfamiliar term to me.”* Two of the IDT members proceeded to search for the definition online. Regardless of the IDT members not having a definition for agency as a concept, they later proceeded to discuss it on a more practical level, as portrayed in section 5.2.

5.2. IDT Member Perceptions of Acts of Student Agency

IDT members described study monitoring, goal setting, strategic study planning, and proactive information-based decision-making of one’s studies as acts of agency (see Table 3). Furthermore, active engagement in one’s studies and participation in learning situations were brought up. For example, there were mentions of students trying out different learning techniques in finding what works best for them and seeking help with their studies, if needed.

Table 3. Acts of Student Agency (Subcategory 2a)

Subcategory	Commonly mentioned themes
2a	Engaging in one’s studies. Monitoring and active decision-making of one’s studies. Strategic study planning and progress. Using reflective feedback provided by the LAD.

Describing how students would use feedback provided via the LAD was mentioned multiple times as an important act of student agency: *“If a course is such that there is a quite wide grade distribution or even many have failed it, it meant that the course is difficult and then you take a right stance to it so that you dedicate time, and when you want to complete it and learn, you invest in it right from the start.”* Additionally, active decision-making about which feedback students viewed and used to plan their studies was described as an important act of student agency. This included, for example, deciding if students wanted to use comparative or descriptive information to monitor their progress.

5.3. IDT Member Perceptions of Facilitating Student Agency

IDT members expressed overall interest in and intentions toward supporting student agency. They reflected on their efforts to make the LAD relevant for students (see Table 4). They discussed ways in which the LAD could support students by describing the features they had added to the dashboard. These features were chosen with the assumption that they aided student reflection and monitoring to strategically plan and proceed in their studies and to avoid burnout, dead-end, and dropout situations. The features mentioned included timely, personal, encouraging, and possibly comparative feedback, which was based on data about personal progress and workload: *“[The first page] tries to support student planning; So, study planning activities that consider credit distribution, some kind of planning about when you’re going to graduate, what kind of courses you’re going to take before graduation, when you’re going to take them.”*

Table 4. Ways to Facilitate Student Agency (Subcategory 3a)

Subcategory	Commonly mentioned themes
3a	Aiding study-related self-reflection, study monitoring, planning, and progression. Providing students with relevant, easily interpretable, and customizable LAD visualizations and timely feedback. Academic advisor–student interactions.

Nine IDT members reflected on ways to support student agency through the roles of academic advisors. They talked about aiding study planning and progression in academic advising meetings: *“So that one gets to discuss and juggle their own thoughts and future plans with the advisor too.”* Thus, academic advisors were seen as important in providing information and supporting student reflection and study planning.

IDT members also reflected on how they wished LA tools could better support student agency in the future. They described different course recommendation systems to aid in study planning and more tailored and customizable LAD designs for students. Two IDT members also brought up the possibility of teaching students how to use LA tools to avoid unjust interpretations and to maximize the benefits and support the tools could give to study-related reflection and planning.

5.4. Perceived Obstacles Regarding Student Agency

IDT members discussed the different obstacles and external limitations of supporting student agency (see Table 5). They raised concerns about the possibility that LAD feedback has negative effects on student agency and self-efficacy beliefs. They also mentioned the overall uncertainty of the effect of the visualization on students, since there is not much previous research on this subject, and IDT members had received contradictory feedback on some of the visualizations. Low self-efficacy beliefs were mentioned in this context as a risk factor for students in interpreting feedback, especially comparative information on them, in an overly negative way and letting it affect their self-image and self-efficacy beliefs: *“If there is information presented that, for example, all the time compares you with your peers and so on, and you are not one of the best students, then, of course, it will influence your efficacy belief.”*

Table 5. Obstacles to Student Agency (Subcategory 4a)

Subcategory	Commonly mentioned themes
4a	Uncertainty of the LAD’s effects on students. Resource, technological, and data challenges that constrain developing LADs that best support student agency. Degree structure-level restrictions prohibiting active decision-making.

There was a discussion about whether the LAD’s feedback affected students at all since some of the IDT members described it as being mostly retrospective and thus not relevant to students. Most of them mentioned the dichotomy of LA-based feedback as being useful for some but, through various compromises, ineffective for others. They also mentioned the possibility of the LAD’s data not representing student situations and thus giving students ineffective or inaccurate feedback.

Uncertainty concerning the LAD’s effects on student agency was mentioned as being connected to IDT members being restricted by the available data, financial resources, and technology in developing dashboards they thought would best support students. IDT members mentioned how the lack of data about students restricted what they could analyze and interpret about them. These informational and technological limitations restrained what kinds of visualizations IDT members could construct and what feedback they could give. Data limitations were seen as being connected to existing student information systems and databases in the institution. Some data challenges were connected to students not actively producing data by, for example, not making their PSPs.

IDT members brought up degree structure-level restrictions that constrained student self-driven decision-making in their studies. Mostly, they talked about some study programs not giving students chances to make decisions about their studies via optional courses. Thus, in this context, external restrictions related to study-planning were seen as prohibiting student agency through limiting their chances to individualize their studies.

5.5. IDT Member Descriptions of the Student Role in the LAD Development Process

Student roles in the LAD development were mainly described through conditions that needed to be met for students to meaningfully contribute to the development work (see Table 6). IDT members emphasized that students should be motivated and interested in participating, and they should have sufficient information and knowledge about LA. Most of the IDT members described student involvement in the development process as being important and they wished that students would participate more. They described student roles as being the main feedback sources and the end-users of the designed LAD. IDT members described some students as being unmotivated to participate or as not seeing the meaningfulness of their contribution and thus choosing not to participate: *“I don’t know whether students fully see the added value that it would bring if they were more actively involved in the designing.”*

Student understanding of the LAD as well as their abilities to use it were mentioned in the context of using their feedback and ideas. IDT members mentioned that student capabilities to use the LAD and interpret its visualizations could influence their user experience and thus their feedback about it. One IDT member also stated that students sometimes wished for features

that they thought would be “fun” but that the IDT member thought would not benefit students in any way. This was also described as an important consideration when assessing student ideas and feedback.

Table 6. Characteristics of Student Agency in the LAD Development Process (Subcategory 1b)

Subcategory	Commonly mentioned themes
1b	Motivation to participate. Meaningfulness of one’s input. Knowledge and information about LA. Data ownership. Student understanding and capabilities to use LADs.

There were contradictory statements about whether students were involved in the decision-making of their data collection and usage. Three IDT members described student agency as students having ownership of their data. One emphasized the importance of having permission from the students directly when using their data, but there were also mentions of the possibility of collecting student data without them being aware of it.

5.6. IDT Member Descriptions of Acts of Student Agency in the LAD Development Process

Students actively participating in pilots, providing feedback about the piloted dashboard, and working in the development project were described as the main dimensions of student acts of agency in the LAD development process (see Table 7). “*At best, they specifically participate via trying out tools and giving feedback about them, and, [through] providing perceptions of their own user-needs, further deepen [our] understanding.*” IDT member perceptions about student participation varied among participants. Some mentioned low student participation in the development process; others were pleased with their contributions.

Table 7. Acts of Student Agency in the LAD Development Process (Subcategory 2b)

Subcategory	Commonly mentioned themes
2b	Active participation in pilots. Using the LAD and providing feedback about it. Participation in the decision-making of student data usage. Working on the development team.

Some IDT members said that the students who worked part-time on the project provided important contributions to the development process by influencing the decision-making of LAD features and student data usage: “*[Name of student] has here implemented this visualization for [the LAD]. So, we with [the student] have gone through every single part of this together so that [we reviewed] where it could belong, how it should be presented and does the colour matter and would a list be better or should we put there something else.*” Thus, students were closely involved in the LAD’s development process by giving their opinions and contributing to the work as IDT members themselves.

5.7. Ways IDT Members Try to Facilitate Student Agency in the LAD Development Process

IDT members discussed facilitating student agency in the LAD development process mainly through describing methods they had used or could use in encouraging student participation (see Table 8). They talked about creating opportunities for students to get involved: “*You have to at least create these kinds of opportunities so that we could get the students involved [in the development work].*” These included involving students in multiple phases of the work, promising rewards for active participation, and including tool-testing as a part of courses. There was also an emphasis on involving students by using their feedback and ideas. For example, one IDT member described how they had collected and used information about student wishes regarding the LAD’s features when deciding what types of visualizations to implement.

Table 8. Ways to Facilitate Student Agency in the LAD Development Process (Subcategory 3b)

Subcategory	Commonly mentioned themes
3b	Creating opportunities for students to participate meaningfully throughout the development process. Exterior motivators and rewards for participation. Actively using student ideas and feedback.

IDT members discussed ways they could motivate students to participate more actively in the development work in future as well as how they could better use student feedback. These included both material incentives for participation as well as

merging LAD designing tasks into courses: “You can give [the LAD] to someone in industrial engineering and management for them to review it from the project management perspective or something similar, or [give the LAD] to economics, [to think] how to make it an interesting client case, or actually [give it] to educational sciences students to analyze how they think this matches with these kind of theoretical models.” Creating future tools more iteratively was also suggested in using student feedback better through the development process. One IDT member suggested that better informing students about LA and the benefits of participating in development work could increase student participation.

5.8. Perceived Obstacles Regarding Student Agency in the LAD Development Process

IDT members mentioned obstacles and limitations to student participation (see Table 9). Additionally, they mentioned students not being involved enough or at all in some phases. These were mostly decisions and design choices that IDT members had to make based on existing resources, data, and technology. Some technological and resource challenges were mentioned that connected to the inability to use and incorporate student ideas into the LAD.

Table 9. Obstacles to Student Agency in the LAD Development Process (Subcategory 4b)

Subcategory	Commonly mentioned themes
4b	Resources to involve students and use their ideas. Unequal power relations in the decision-making of the LAD. Stakeholders being side-tracked from supporting students.

Some IDT members discussed ethical concerns about key stakeholders in LA having different goals regarding using student data. They mentioned stakeholders “being side-tracked” from supporting students, LAD development being too data driven, and the main goal being to use all the mechanisms and student data available: “So many people I have met ... want to have student data. This is like, something they are so interested in, but again how that would support students for learning in university, how that would be actually useful for [students] ... is a very unclear question.” Some also mentioned communication challenges between IDT members from different fields that impeded the development process.

6. Discussion

6.1. How Did the IDT Members Perceive Student Agency? (RQ1)

IDT members described pedagogical aspects of student agency similar to literature (e.g., Bandura, 1982, 1997; Zimmerman, 1995). These included ownership of one’s studies, motivation, and engagement, supportive self-efficacy beliefs, the ability to strategically plan one’s studies, and the use of reflective feedback and information. IDT members also recognized variations in these aspects among students. Five IDT members admitted unfamiliarity with the concept of agency. Others, most of whom had an educational science background, gave thorough descriptions of the concept of agency. Some IDT members revealed communication difficulties between team members and had adopted the role of mediator in conversations between IDT members from different faculties. Previous literature has found that IDT members typically hold different skill levels in collaborating, learning from others, and sharing knowledge (Derry et al., 2005). Similarly, members usually have unidentified overlaps and gaps in their knowledge (Derry et al., 2005). This requires systematically fostering mutual knowledge sharing to better connect different understandings of student agency throughout the LA development process.

Previous literature has highlighted the risk of LA over-supporting students and thus limiting the ways that LADs support student agency (e.g., Tsai, Perrotta, et al., 2020). The results of our study indicate that shared conceptions of student agency could help IDTs ensure that their development work and actions taken to support students are scientifically aligned. While it is important to ensure common theoretical understandings, it is equally important to consider the practical involvement of students in the LAD development process. This ensures that the theoretical knowledge held by the IDT is adapted to the context of the LAD development. Our study raises the need for additional efforts to foster communication between IDTs and users, as well as ensuring the adoption of theoretical knowledge to the LAD development contexts.

6.2. How Did the IDT Members Envision the Developed LAD to Support Student Agency? (RQ2)

IDT members expressed interest in and intentions to support student agency. They described how the developed LAD was intended to support student self-reflection and study planning by providing them with information and visualizations of their progress, study plans, and grades. It was important that the information and feedback were timely and easy to interpret. Previous literature on LA-based tools has also noted that timely feedback from LADs can boost student agency (e.g., Tsai, Perrotta, et al., 2020).

Ethical concerns were raised regarding the uncertainty of the LAD’s influence on student agency. As with previous literature (e.g., Howell et al., 2018; Roberts et al., 2017), these concerns were mostly connected to the possibility of misinterpreting the dashboard, especially its comparative information having a negative effect on student self-efficacy beliefs

and motivation. More information about the LAD's effects on students of varying data-literacy skills and provided with various interpretations, as well as more financial and technological resources, are required for further development work.

6.3. How Did the IDT Members Perceive the Role of Students Within the LAD Development Process? (RQ3)

IDT members described the students as being involved in development work mostly through participating in pilot studies, voicing their needs regarding LADs, and giving overall feedback. However, IDT members had contradictory perspectives on the level of student involvement in the LAD development process.

IDT members attempted to create opportunities for students to participate in the development work, which is a recommended action in co-creating LA-based tools (Dollinger et al., 2019). Some members highlighted basing the whole development work on student needs by starting with gathering first-hand information from them, as well as reviewing previous literature about them. There were also examples of using exterior incentives and incorporating pilots into courses. Existing resources were mentioned as a limitation in involving more students.

IDT members discussed using student feedback and noted that students sometimes ask for dashboard features or information that IDT members thought would not support them. In previous literature, there have been similar findings regarding student skills and understanding how to support their study-related actions in developing LADs (e.g., Birch & Demmans Epp, 2015; Wise et al., 2016). The IDT members also stated that lack of student knowledge might affect their prejudices and interest in participating in the development work. This affected how the IDT members could use student feedback. It is arguably useful for students to have some level of understanding about LA when being involved in the decision-making of its complex data and technical aspects. However, division between students who are and are not tech savvy enough may compromise inclusive practices and result in overlooking the support and information needs of some students. IDT members should consider ways to involve students with varying interests and knowledge and thus enhance their agency in LA development.

6.4. Limitations

This interdisciplinary work in the field of LA offers insights into the expertise and experiences behind LA development. Thus, some specific findings that arise within it might be context- or group-specific. Our results align with previous research on interdisciplinary LA development work characteristics, such as challenges with data, resources, and common understandings about learners as well as efforts to make informed ethical decisions and design choices that ultimately serve students (Abrams et al., 2004; Bergvall-Kåreborn & Ståhlbrost, 2008; Ferguson, 2012, 2019; Johanes & Thille, 2019).

Our study addresses different IDT views on student agency and involvement but is limited to description only. It could have been beneficial to further interview the IDT members regarding their own contributions to the LAD development process to gain better insight into how their roles and tasks might have influenced their conceptions of students and their participation in knowledge-sharing regarding student agency. This would have helped especially in identifying how the students who worked on the project were situated within the IDT and whether there were any power dynamics associated with their involvement. Future studies could interview multiple teams to gain a broader view on how teams share and use their knowledge in different phases of the development process.

7. Conclusion

Regardless of their viewpoints, we concluded that the IDT expressed pedagogical and ethical motives to consider and enhance student agency. In the study context, student agency was mostly viewed pedagogically as proactive study-related reflection, decision-making, and progression. In the context of the LAD development process, the descriptions of student agency were limited to student involvement and participation. This difference reveals a gap in IDT member thinking regarding student agency in relation to its sociocultural settings. Similarly, ways to support student agency were seen through different lenses when describing supporting students in their study paths and in LAD development work.

Ethical aspects of supporting student agency were not discussed as their own theme by the IDT members; instead, they were viewed more as part of the practical aspects of supporting student agency. For example, the IDT members discussed how they could gain information on whether the LAD supports student agency, as well as ways that students could better be informed about LAD development and data-usage. Thus, the IDT members expressed caring about the ethical aspects of their work but viewed it as more of a practical issue rather than the abstract one that the literature portrays (e.g., Bergvall-Kåreborn & Ståhlbrost, 2008; Howell et al., 2018).

Our results suggest that the theoretical views that IDT members hold can influence their practice. Pedagogical and ethical perceptions of student agency influence the ways they consider how agency can be supported on a practical level and how much they value supporting student agency and involvement in practice. Future research could develop systematic practices that enable IDTs to adjust their conceptual thinking in the development process from one context to another. This could lead to better connecting the IDT members' theoretical perspectives with the practice and goals of their work.

This study contributes to the conversation about the drivers of LA development processes and their relation to educational theoretical knowledge (e.g., Ahn et al., 2019; Ferguson, 2012). We discovered that IDT members hold varying views on how and if the developed LAD would affect student agency. To support student agency with LADs, IDT members must make informed and theoretically grounded decisions that foster student involvement (Prinsloo & Slade, 2016). This leads to the need for IDT members to be able to gather, communicate, and combine information and knowledge about the user of the tool. Similar notions of needs for communication support and knowledge sharing in LAD development have been recognized in previous studies (e.g., Birch & Demmans Epp, 2015). It is central for effective and creative collaboration to foster discussion regarding the IDT members' metastructures and epistemic approaches (Gardiner, 2020). To support the design and development process, a targeted intervention to contrast and clarify key conceptual questions or theoretical assumptions could be included. This could be studied, for example, by viewing the IDT members' epistemic fluency: the ability to combine and adapt to different ways of knowing (Markauskaite & Goodyear, 2017).

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