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Student Autonomy and Learning Analytics: Philosophical Considerations for Designing Feedback Tools

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Abstract

LA-based feedback applications are becoming increasingly important in higher education institutions (HEIs). However, the impact of such systems on student autonomy is contested in parts of the research debate, where hopes and ambitions of learner autonomy and self-regulated learning are confronted with fears that learners are being reduced to mere numeric constructs and are caught up in neoliberal demands to self-optimize. We explore these challenges from the debate with a focus on automated, LA feedback systems in HEIs and their impact on student autonomy. As we show, such technologies must be seen within a field of tension between heteronomous (i.e., contextual and societal) demands and autonomous, self-organized learning. Aiming to bridge the critical parts of the debate with those that highlight the potential of such technologies, we build upon meaningful conceptions of limited, situated autonomy and explore what it would mean for such feedback systems to strengthen, not undermine student autonomy. To make the concept of student autonomy applicable, we propose a list of philosophical design considerations for LA-based feedback systems. We believe that this will offer a philosophically informed intellectual tool to address common concerns raised by parts of the debate and that it can encourage further discussion on recognizing, promoting, and preserving student autonomy in higher education.

Notes for Practice

- Strengthening student autonomy should be a key ethical goal in the design of LA feedback systems in HEIs. Student autonomy is also associated with improved educational outcomes.
- Designing and implementing autonomy-fostering LA-feedback systems can be guided by theoretically robust concepts and principles.
- We propose preliminary considerations for the design and implementation of LA-feedback systems.
- We explain the praxis implications that philosophical perspectives on student autonomy offer to LA, specifically concerning self-regulated learning.

Keywords

Philosophy of education, autonomy, higher education, applied ethics, artificial intelligence, feedback, self-regulated learning, self-determination

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1. Introduction

Learning analytics (LA) is gaining traction within higher education institutions (HEIs). LA is commonly defined as "the measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs" (Siemens, 2013, p. 1382). Due to the rise of digital learning tools and platforms, a lot of additional data on learning processes is being created. Although the field of LA covers a broader ambition, the development of analytics approaches and tools to leverage this data has been at the foreground of the field (Jivet et al., 2021, p. 417). The provision of personalized, potentially even real-time feedback to students for reflection and self-improvement has always been one of the core visions for LA (Ifenthaler, 2023; Simbeck, 2022; Zawacki-Richter et al., 2019) and has now become a reality. Although some automated feedback tools use rule-based feedback without machine learning (Knight et al., 2020; Matz

et al., 2021; Vigentini et al., 2020), for predictive and classificatory tasks, machine learning has become one of the standard tools used in LA (Ochoa & Merceron, 2018; cf. Järvelä et al., 2023). Thus, LA-based feedback applications seem to have the potential to strengthen the autonomy of learners in HEIs.

However, LA feedback systems are never simply neutral and objective but based on decisions and convictions about the very nature of education and knowledge (Knight et al., 2014). Consequently, every LA-based intervention should also be evaluated in normative terms and from the perspective of relevant stakeholders (Human-Centered Learning Analytics; Buckingham Shum et al., 2024). For LA feedback systems, the value of student autonomy should inform the design and implementation of systems intended for an operational, non-experimental setting. As we will see, however, perspectives from educational philosophy raise fears that learners are reduced to numeric constructs and are caught up in neoliberal demands to self-optimize. LA-based feedback schemes may thus turn out to undermine the autonomy of learners.

Unfortunately, this critique remains abstract, impeding mitigating designs of such tools. Our goal is to overcome this issue by exploring the concept of student autonomy. We build on Beate Rössler's (2017) conception of (situated) autonomy and develop this for the educational context based on John Dewey's (1980; Oelkers, 2009) conception of growth. We do not aim to contribute to the philosophical discussion of one conception or another. Rather, our concern is that (student) autonomy always implies a situational tension between the *heteronomous*, i.e., contextual and societal demands and the potential for *autonomous*, self-organized learning. The situational nature of this tension plays out differently in higher education than in other practical domains and from one education system to the next, which necessitates a contextualized approach. Our perspective is shaped by the German higher education landscape and predominantly the German discourse on autonomy and LA applications. Still, we believe that our discussion will prove useful for other educational contexts and the international debate as well.[1] We will attempt to bring together thoughts from the complex, fragmented debates about philosophical conceptions of student autonomy, self-regulated learning, and learning analytics to describe what it would mean for LA-based feedback systems to strengthen student autonomy. Finally, we propose a list of corresponding ethical design considerations.

We will start our discussion in Section 2 by introducing a normative critique regarding LA's relation to autonomy prominent in German educational philosophy. Section 3 then argues that any convincing and relevant conception of autonomy must be responsive to situational conditions and limitations. Applying this more general understanding of autonomy to higher education in Section 4, we then consider a situated understanding of *student* autonomy. Section 5 specifies this by discussing the effects of LA feedback systems on students regarding this situated understanding of student autonomy. Based on this, we then formulate ethical design and implementation considerations for LA feedback systems in the context of German higher education and contextualize them in the self-regulated learning (SRL) debate (Section 6).

2. LA in Higher Education: A Normative Controversy

As mentioned above, one of LA's core ambitions is the idea of giving personalized feedback to students to improve their self-reflection regarding learning processes and environments. Correspondingly, LA-based feedback applications resonate well with ideas about SRL (Winne, 2017), but one may also see a conceptual connection to the debate around learner autonomy, a concept that gained traction, especially in the fields of foreign language education and lifelong learning (Sari & Karasu, 2020; Summer, 2010). In SRL, learners "actively research what they do to learn and how well their goals are achieved by variations in their approaches to learn" (Winne, 2010, p. 472; 2017). For learner autonomy, Henri Holec's (1979) broad definition is seminal: "To say of a learner that he is autonomous is … to say that he is capable of taking charge of his own learning" (cit. in Summer, 2010, p. 7).

Understood in this sense, learners can use the feedback generated by LA applications to obtain information about their own learning processes that enables them to "learn better." Conceptually, there may be little difference with human feedback, but LA systems promise data-based, more personalized feedback (Siemens, 2013) — ideally, through automation, in real-time and within pressing resource constraints. What makes learning "better," however, is contingent on the students' goals, on them taking charge of their own learning, and optimizing towards these goals. In the best case for LA-based feedback systems, this is based on a deeper understanding that is substantially facilitated by the automatically generated feedback.

Critical perspectives towards these ambitions, however, have been raised especially as part of German educational philosophy. As some authors argue, LA's idea of optimizing the learning processes is, at its core, identical to Felix von Cube's (1965) cybernetic conception of education discussed in the 1960s and 1970s. According to them, the critique levelled against cybernetic learning must also be levelled against LA. One of the main points of the critique is that LA shares cybernetics' limited conception of learning, which is incompatible with education in a more encompassing sense that entails enriching mental and cultural faculties (Karcher, 2020; Reinisch, 2020; Verständig et al., 2022) — as in the German "Bildung" in opposition to

[1] While the concept of autonomy and expectations for higher education may culturally differ, we believe that the ambivalent dynamic of technology use described here will play out similarly for most liberal societies.

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"Ausbildung." The latter is understood as a more limited, vocational education or job training, where the students develop specific faculties, e.g., those demanded by the job market.

In the discussion around the growing relevance of data science and LA in education, these critiques intermingle with discussions about algorithmic freedom (e.g., Verständig & Stricker, 2022) and critiques of data-driven self-optimization, including self-tracking practices (e.g., Damberger, 2021). While these critical contributions belong to distinct research debates, they are united in a common perception that relates to our discussion of student autonomy in the context of LA-based feedback tools: They prominently voice the fear that, in education, data-driven practices may reduce learners with their distinct personalities to mere numeric constructs, to statistically comparable metrics surrounded by an aura of objectivity and accuracy. For example, Damberger (2021) argues from an educational theory perspective that the process of "datafication" reduces the self to statistics, especially in cases where the analysis of the tracked data is AI-based. Similarly, Karcher (2020) warns that LA's self-regulation dynamic envisions that students act based merely on the differences between actual and desired data values. In the same vein, Reinisch (2020) criticizes LA's supposed mathematization of the self through statistics that leads to self-optimization based on patterns that are communicated back to the learner in a feedback loop.

This "outside" critique resonates with "sociocritical" contributions "within" the LA debate (Slade & Prinsloo, 2013; Prinsloo & Slade, 2017) on LA as a surveillance praxis and on students as agents. However, following the initial focus, in LA research, "datafication" is often mainly analyzed in terms of privacy and consent (cf. Jones, 2023). Consequently, in a recent textbook on LA, we find the value of autonomy mentioned as a central ethical value (Mougiakou et al., 2023, p. 208), but hardly discussed further.

Connected with this limited, metricized conception of learning, one may note that cybernetics also has a different conception of machinic "autonomy," which denotes the ability of a system to "self-regulate" when interacting with the environment — like an air conditioner that maintains a target temperature in a room and starts to heat or cool depending on sensor readings. Today's AI-based systems add to this by extending the idea of self-regulation to the *adaption of rules* of how best to react to a given input to achieve the predetermined goal (Floridi & Sanders, 2004; Misselhorn, 2019, p. 77). Machine learning can thus allow a system to adapt the algorithms of the control mechanism and allow for more complex "behaviour." Thus, it may facilitate dealing with situational demands or provide personalization.[2]

What becomes clear from this is that "autonomous systems" are designed to optimize towards an authoritative set of contextually predetermined values. However, this understanding of "autonomy" in cybernetics and AI seems contrary to what most people would denote "student autonomy." One could argue that cybernetics' conception of autonomy can nominally meet a strict reading of the definition for SRL (and possibly for learner autonomy) as provided above; however, the idea that the goals are externally ascribed conflicts with a common sense understanding of student autonomy. Student autonomy cannot consist in self-regulation according to goals that *other actors assume the students should have*. Fundamentally, this means that conceptions of educational success geared towards societally prescribed norms such as "get good grades," "do not drop out of university," or "get a qualifying degree quickly" seem too limited for a meaningful conception of student autonomy. Hence, when the critics highlight cybernetics' limited conception of learning, this also implies a concern that student autonomy could be mistaken for a machinic or cybernetic conception of autonomy. LA-based feedback that optimizes towards *predetermined* norms thus introduces new external conditions that risk *undermining* student autonomy.

One may assume that this issue is easily solved by asking students to define aims for learning themselves. In fact, SRL has long entailed the idea that students can set their own learning goals (Zimmerman, 1990, p. 5). However, this would not really solve the issue, but rather beg the question whether, in doing so, students have merely adapted their goals to pre-existing societal expectations. Here, the feedback provided by LA is framed as oppressive, as it suggests that learners are, in effect, disciplined by comparing their numeric constructs to an explicit or implicit expectation of normal or good learning behaviour based on past data (Karcher, 2020, pp. 155–156). This resonates with Slade and Prinsloo's (2013) framing of LA as surveillance and Selwyn's (2019; 2020, p. 4) plea for fundamental revisions in LA. Damberger (2021) offers a similar critique when he warns that self-optimization activities may lead to learning activities being reduced to market values: is taking a certain university course efficient in terms of credit points received versus effort spent? What courses or professors statistically yield better grades? What seems like a way to support student autonomy, on closer look, may turn out to be a variant of disciplinary power structures that undermine it — even when students are enabled to define their own goals for optimization.

Unfortunately, the critical positions from the German debate in educational philosophy and the learning analytics debate seem largely disconnected. Furthermore, this critique fundamentally applies to *any* form of LA application since LA's core idea of coupling the collection of learning data with interventions and feedback activities (Mougiakou et al., 2023, p. 134) always introduces such effects of datafication. Hence, we could not find contributions that try to take that risk of undermining student

[2] This also leads to the so-called black-box issue, i.e. that the resulting algorithms are harder to understand and predict and consequently also harder to check against discriminatory or other unwanted impact.

autonomy seriously while also productively discussing how one may design "better" LA-based feedback applications. To overcome this, we will explore the potential for such systems to strengthen "student autonomy." As a first step, we will discuss "autonomy" as a central value of human praxis. It will become clear that while mere adaptation to societal expectations is a valid concern, any meaningful conception of autonomy also cannot simply demand the *absence* of predetermined goals, constraints, or influences.

3. Autonomy as a Central Value of Human Praxis

The concept of autonomy remains a subject of philosophical controversy. Many arguments have been brought forward to show that there is no "real" autonomy in human life due to the manyfold conditions and limitations that shape individual life. For example, educational philosopher Käte Meyer-Drawe (2015) emphasizes that situated involvement is part of the human condition and cannot be ignored when thinking about autonomy. As she argues, Kant, but also educational philosophers up to the 19th century such as Pestalozzi, Humboldt, and Schleiermacher, fully recognized the external conditioning of human development by nature as well as society. These authors, who often serve as the main reference points in educational philosophy, still struggled with the problem of how a person could develop and assert their individuality in the face of such limitations; it was, in fact, only later, 20th-century thinkers who formulated "autonomy" in today's emphatic terms of striving towards *full self-determination* (Meyer-Drawe, 1998). According to Meyer-Drawe (2015), the normative demand of absolute autonomy leads to exhausted individuals trying to fulfill neoliberal demands of self-reliance and self-optimization in their pursuit of happiness, ignoring that they often have little control over contextual limitations and societal demands. Much of this controversy forms the backdrop of the critique outlined in Section 2.

We agree with Meyer-Drawe's general assessment. However, she ultimately concludes that we need to question the usefulness of modern autonomy concepts. Instead of abandoning autonomy as such, we will show that an applied conception of *situated autonomy* can be used to critique designs for feedback applications that follow precisely such a narrow idea of self-optimization and to propose alternative designs. To understand autonomy in such a situated manner and to do justice to its importance for the educational context, we need to dive deeper into the philosophical terminology. To start, it is important to differentiate two perspectives on autonomy: 1) the *theoretical possibility* of autonomous thinking and acting; and 2) the *practical aspects* of our concrete ability to do so.

The first perspective was most prominently defined by Immanuel Kant, who understood autonomy as the ability of the will to *give itself laws according to reason* and to act accordingly. In Kant's view, aligning our will with what (pure) reason demands allows us to act morally and autonomously because then, our will is per definition not determined by biological urges and societal demands (i.e., not heteronomous). Here, Kant's famous categorical imperative[3] comes into play. It denotes the formal structure of what pure reason would suggest and, hence, functions as a criterion for moral correctness of our plans for action (Kant, 1785/2019, pp. 431–33). For Kant, the formal adherence to reason is precisely how we express our autonomy in practical terms; and if we could not determine our will through reason, morality and freedom would be logically inconceivable (Kant, 1785/2019, pp. 5–6). Influencing the will unchecked by pure reason thus undermines autonomy.[4] This is why LA appears as a threat to student autonomy.

Despite the eminence of Kant's conception of autonomy, much criticism has been levelled at his abstract and highly formal conception. This has led to a focus on the second, practically oriented perspective. The key idea here is to avoid unrealistic ideas of absolute autonomy and pure reason, and to do justice to the fact that human praxis is always relational, situated, and conditioned. Human praxis must be responsive to the limitations and dependencies that seem to fundamentally restrict autonomy. In her work, Beate Rössler (2017) has adopted a perspective that tries to connect both dimensions with each other and developed a meaningful, praxis-oriented conception of autonomy that will be more conducive for this paper's purpose.

For Rössler (2017, pp. 30–31), autonomy is a necessary structural basis for modern conceptions of individuality: it is inextricably connected to our ideas of leading an ethically good, happy, and meaningful life and it is a fundamental value of liberal democratic societies that cannot be plausibly ignored or rejected. Rössler (2017, pp. 13–14) is quite aware of the conflict between the theoretical premise and the practical impossibility of (absolute) autonomy on both the societal and personal levels. To recognize this tension and to ultimately resolve it productively is the core challenge to developing a meaningful and applicable conception of autonomy. Rössler takes Kant's theoretical, formal foundation and expands it with a relational

[3] "Act only according to that maxim by which you can at the same time will that it should become a universal law" (Kant, 1785/2019, pp. 420–421).

[4] Beware of a too simplistic reading: Kant clearly recognizes that we exist both in a world of reason, in which we are autonomous, and in the sensual world of nature, in which we are heteronomously determined. The attempt to resolve this contradictory relationship can be seen as one of Kant's core concerns in moral theory (Kant, 1785/2019, pp. 442–445; cf. also Meyer-Drawe, 1998, p. 47).

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perspective to describe autonomous life in practically realistic terms (Rössler, 2017, pp. 31–34). She particularly emphasizes the role of obstacles and options for action and personal development: autonomous action can become impossible in practical terms if too many of the situational circumstances oppose the desire for self-determined judgment and action, or if the range of realistically feasible and desirable options is simply too small (Rössler, 2017, p. 43). But neither does the realization of an autonomous way of life take place in a bubble that is void of limitations and conditions.

To be able to make decisions based on one's "autonomous" desires and convictions means to navigate this field of tension. This complex and partly opaque system of conditions that describes our (social) reality inevitably produces self-contradictions and ambivalences. However, these are not seen as fatal for autonomous thinking and action. On the contrary, one should consciously integrate them into one's own self-conception and reflective action. A person is autonomous precisely when they can deal with such ambivalences in a self-determined manner (Rössler, 2017, p. 65) — not when they are fully absent. An important part of this process is to have reliable information to act upon. Beliefs without such epistemic basis lose their power and persuasiveness as soon as we become aware of their problematic status and hence undermine our potential for autonomous action (Rössler, 2017, pp. 109–12).

One can conclude that while LA feedback applications will indeed introduce new forms of conditions for student learning, this does not necessarily imply that it undermines their autonomy. Especially when they meaningfully improve the informational basis, LA may contribute to student autonomy by improving learners' situational self-reflection. But more conditions need to apply for this to be the case.

In psychology, Richard Ryan and Edward Deci's (2002) widely recognized Self-Determination Theory (SDT) resonates well with Rössler's situated conception of autonomy. It is particularly helpful for connecting the philosophical conceptions of autonomy with LA's more psychology-oriented stance. SDT is aimed at explaining motivation and well-being. For this, SDT identifies three fundamental psychological needs assumed to be inherent to all people and essential for human flourishing: 1) competence, i.e., the general feeling of self-confidence and effectiveness in action; 2) relatedness, i.e., the natural tendency to connect with others and the importance of feeling connected and secure in social relationships; and 3) autonomy, i.e., the perception of being the origin of one's own behaviour, based on one's own interests and integrated values. Here, too, autonomy does *not* denote the absence of limiting conditions, but "psychologically integrated behavior," i.e., behaviour that is both genuinely desired and in accord with the demands of others (Ryan & Deci, 2002).

SDT thus supports the philosophical notion that autonomy is a fundamental value by positing it to be a basic psychological need and that inadvertently undermining it through new technologies is a significant risk. In the field of education, SDT-based studies have shown that strengthening this situated autonomy is linked to increased well-being in learners and teachers, as well as to improved learning and teaching motivation (Ryan & Deci, 2020). SDT also inspired an operationalized framework in which the three psychological basic needs are criteria for general technological design processes and decisions (Peters et al., 2018).

As this section has shown, the critical positions outlined in Section 2 fall short in that an individually and societally productive conception of student autonomy in higher education cannot posit a learner free of constraints and limitations but suggests a positive recognition of the many different contingencies and dependencies of learning — from individual constraints and competences through institutional rules and roles to social and economic structures. But neither can it be one that relegates the learner into a passive role regarding what goals and values should be formative for their own learning processes. While there is considerable disagreement in the details of the conceptions of "autonomy" (or their proposed alternatives), most conceptions agree in that we need to move beyond a stark opposition between full self-determination and self-optimized conformity (cf. also Verständig & Stricker, 2022).

In the next section, we will explore a conception of autonomy in education that is responsive both to limiting conditions in HEI and to the critique of LA-based feedback tools outlined in Section 2. This conception is based on John Dewey's educational philosophy.

4. Student Autonomy as Growth

As we have shown in Section 2, critique has been prominently voiced in (German) educational philosophy regarding the idea of providing students with automated, LA-based feedback on their learning processes out of fear that this may negatively impact student autonomy. At the same time, Section 3 has shown the concept of autonomy to be itself highly contested. As became clear, any practically relevant conception of autonomy needs to be a *situated* conception, i.e., one that recognizes contextual limitations and one that highlights the students' active role in grappling with these limitations and in integrating them as part of their learning. So far, the concept of student autonomy remained highly abstract, however.

As Gabi Reinmann (2010) notes, there is great need for conceptual differentiation to grasp the various aspects of (situated) self-determination in education more concretely. She suggests differentiating three levels (Ebenen) of what she calls self-organized learning (Selbstorganisation):

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1. **Self-regulated learning** (selbstreguliertes Lernen), which is not identical to but takes up many of the core ideas from SRL; it denotes the competence of dealing with *inner constraints* of learning, i.e., of exerting cognitive and metacognitive control like focusing our attention, creating a suitable environment, deciding when to stop, and of motivating ourselves to keep learning.
2. **Self-directed learning** (selbstgesteuertes Lernen), which denotes the leeway offered and used in adapting to *contextual constraints* like institutional demands of a university (e.g., choice between a range of courses to complete a necessary module or between different types of exams).
3. **Self-determined learning** (selbstbestimmes Lernen), which denotes a *harmonization of personal goals and values with external* demands, in the sense of Ryan and Deci's self-determination theory outlined above. On all three levels, tension between the potential for autonomy and heteronomous conditions play out (Reinmann, 2010, pp. 80–81).

Dewey's educational philosophy offers insights into how one can think about this tension productively. Just like Meyer-Drawe, Dewey abstained from the term "autonomy" (Wilson & Ryg, 2015, p. 132), probably due to the problematic suggestion of learning being context independent. In his pragmatic educational philosophy, the concept Dewey proposes in lieu of autonomy is growth. As Jürgen Oelkers (2009, p. 86) writes in his seminal book on Dewey's educational philosophy, this concept is not to be mistaken with traditional educational theories of growth, where the end state or goal of personal development is predetermined (i.e., the goal of educating a student). Such a predetermination risks undermining *self-determined learning* in the above sense and relegating student autonomy almost exclusively to Reinmann's level of *self-regulated learning*.

In accordance with his larger philosophical stance of pragmatism, Dewey is highly skeptical of any formulation of absolute or predetermined ends in education. Hence, for him, the *direction of growth* remains unspecified. As he writes, "'in reality there is nothing to which growth is relative save more growth'. And this implies that 'there is nothing to which education is subordinate, save more education'" (Dewey, 1980, p. 56; Oelkers, 2009, p. 88, here and following: our translation). Since Dewey sees no external end to education, human learning never comes to a definite conclusion: "education means the enterprise of supplying the conditions which insure growth, or adequacy of life, irrespective of age" (Dewey, 1980, p. 56; Oelkers, 2009, pp. 88–89) — one of the first formulations of lifelong learning.

When the direction of growth is undetermined and the process is to be seen as open-ended, this may at first glance seem to overemphasize *self-directed learning* in the sense that any curriculum and institutional demand would seem like a hindrance to growth, i.e., that learning should be as informal as possible. This is not the case, however, as Dewey's concept of education aims at developing abilities to competently and innovatively deal with future situations that are experienced as problematic. Hence, the hallmark of education is not the accumulation of some fixed quality over time, but a process of active and intelligent adaptation to ever new challenges (Dewey, 1980, p. 56; Oelkers, 2009, pp. 86, 88–89).

This gives education a normative orientation that neither results in a cybernetics-style conformity to societal demands, nor in the idea of some unhindered "unfolding" of supposedly innate student potential. As Oelkers (2009, pp. 189–190) argues, Dewey positions himself between those two extremes in educational philosophy, between extremely open conceptions of education (where the role of the teacher cedes to the background and contextual demands are minimized) and extremely closed forms of teacher controlled, highly formalized learning. Learning is seen as a guided process of adaptation that enables a conscious *self-transformation* (Sari & Karasu, 2020) to meet situational demands. Correspondingly, this conception of growth in education tries to overcome the problematic dichotomy outlined above between autonomy and heteronomy in education. Just as Meyer-Drawe and Rössler, Dewey conceptualizes self-determination within the bounds of what is realistically possible. This includes institutional demands that prepare students for challenges they will likely face in their future. But it also includes adapting environmental conditions to meet individual needs, just as it is conceptualized in the SRL literature.

Furthermore, Dewey highlights that a truly democratic society needs to foster social mobility and adapt to, but also shape technological change (Oelkers, 2009, p. 99). Consequently, education cannot focus on some elites but must be conceptualized as broadly as possible. It is part of the societal function of higher education and of student autonomy to prepare students for this not only in the sense of economic success, but also to contribute as part of political, work-related, or scientific communities. "There is a need for citizens to be educated (*gebildet*) not for humans to be trained (*erzogen*). The one demands freedom, the other authority" (Oelkers, 2009, p. 99). Hence, as Pape and Kehrbaum (2019, pp. 22–23) write, Dewey's idea of education cannot be "streamlined" to serve economic efficiency or some other limited societal function, e.g., by putting an exclusive focus on what is necessary for a certain job or vocation. It thus resonates with the risk outlined in Section 2 of technologically reproducing neoliberal conditions in education.

5. Growth and LA-Based Feedback Systems

From the above, we can now develop more concrete observations regarding how to generally maintain or strengthen student autonomy in designing LA feedback applications before we move to concrete design considerations in the next section. First, such feedback systems should not try to nudge or push students towards a limited but quick course of study. This is especially

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true when predetermined metrics reflect politically motivated ambitions rather than educational reality — like the German "Regelstudienzeit" ("standard study time" institutionally allotted to complete a study program, irrespective of the time typically needed by students). At the same time, for students whose data profiles statistically match a pattern of past students who expressed feeling "stuck," "overwhelmed," or who were likely to struggle academically, it seems sensible to implement *interventions* to motivate students to reflect on ways to improve learning and continue to progress their education.

Since interventions introduce new constraints, it seems prudent to implement such interventions as opt-in. In principle, however, continuation of learning (in the sense of growing) may also justify opt-out designs, if it is clearly communicated that learning can take place *within* but also *without* the students' current educational institution. Hence, interventions should focus on the idea of continuing learning and growing towards a competent future self — not necessarily towards achieving the formal diploma for which students are currently enrolled. This not an easy design goal to pursue: HEIs have a clear incentive to keep students enrolled and finishing their degree; and students need to understand that continuing one's program may often be the best avenue into a situation that allows for further learning, e.g., through more complex and demanding jobs in the future.

This is also supported from the perspective of the self-determination theory: there may be different realistic avenues of reaching a certain educational goal in a student's situation; designing interventions to support them in reflecting and choosing such an avenue based on one's own values (not externally prescribing it) may lead to the feeling of being the origin of one's actions and to more integration with one's interests and values. To make use of LA-based feedback systems to support student autonomy through encouraging reflection would then also imply that such technologies can in fact be meaningfully integrated as tools of personal growth.

Second, introducing autonomy maintaining or supporting interventions does *not* require that students need a deep *technical* understanding of how such systems work to make informed decisions. It does mean, however, that feedback systems need to be transparent enough so that students have a decent understanding of potential (privacy, discrimination, etc.) risks, but also of what the realistic potentials and limitations of such tools are in certain situations. This has implications for how students should be taught to use such data-driven feedback tools (demanding student feedback literacy [Molloy et al., 2020] across all of Reinmann's levels, rather than technical expertise). It is equally important to think about what kinds of usage patterns they afford (correspondingly demanding teacher feedback literacy for setting up automated feedback; cf. Buckingham Shum et al., 2023; Boud & Dawson, 2023): does the design of a user interface, feedback dashboard, or intervention message afford patterns of personal growth or of self-optimization towards predetermined values? Contrary to the fundamental critique outlined in Section 2, however, this also means that it is not a problem *per se* if students change their learning practices in fundamental and diverse ways by responding to LA-based feedback tools. Much depends on how *LA tools and their affordances tie into self-reflection* across Reinmann's levels of self-organized learning.

We can therefore conclude that feedback forms like interventions, personalized suggestions, or even "scary messages" regarding a bad prognosis do not necessarily limit the autonomy of students. The relevant questions to be asked from an autonomy perspective are instead: how conducive is the feedback for learners to understand the implications of their current trajectory within their specific situation? How visible are alternative options on how to react to the feedback? Is the feedback presented in a way that makes it clear that there may be a lot of middle ground and that options need to be weighed based on the preferences and interests of the student, not of the feedback system?

Third, as future members of scientific, work-related, and political communities, students should not be nudged away from taking a critical stance towards their future profession, towards their study programs or towards their current and future roles in society. One could even think about the opposite: LA-based feedback systems could be leveraged to make suggestions for students who are on a strong trajectory to spend time on reflective tasks and engage with critical views. This may strengthen the identification of students with their own discipline and strengthen relatedness: feedback systems could suggest reflecting about the role the discipline should play in society, what scientific progress means for the field, what competences this could require outside of the strict requirements of their study program and how corresponding learning could fit into their program. This would realize ideas of the German Higher Education Rectors' Conference (Hochschulrektorenkonferenz), who proposed as part of their Qualification Framework for German Higher Education Degrees to strengthen "communication and cooperation" and "scientific self-understanding/professionalism" (Bartosch & Hiller, 2019, p. 12).

As Reinmann (2010, p. 86) notes, a meaningful conception of self-organization (or, in our terms, student autonomy), poses a lot of reflective and cognitive demands on learners, but also on the institutions that need to give leeway and tolerate or even reward self-direction and value-based critique. It is a fallacy to believe that there will be an immediate surge in student autonomy when new digital technologies become available — this would mistake freedom and autonomy for mere feel-good cliches (Reinmann, 2010, p. 86). In this sense, we should recognize and meet the technical and educational challenges to design LA-based feedback tools to facilitate this reflection, not impede it.

6. Design Criteria for Student Autonomy in LA-Based Feedback Systems

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Based on the above arguments for the context of German higher education, the question arises of what normative considerations should guide the design of LA-based feedback systems to sustain or even strengthen student autonomy. While it seems impossible to formulate a comprehensive list of check-box items that would guarantee student autonomy, we believe that it is possible to normatively orient the design of operational tools through the following sets of ethical considerations. As has become clear throughout our paper, many aspects of student autonomy have already been discussed as part of the SRL literature, and we will contextualize our philosophical perspective through corresponding cross-references.

6.1. Stimulation of Self-Reflection

As noted above, regarding student autonomy, the importance of self-reflection across Reinmann's three levels can hardly be overstated. Unsurprisingly, on the level of self-regulated learning, this resonates well with SRL's vision of self-regulation as "the processes whereby students activate and sustain cognitions, affects, and behaviours that are systematically oriented toward the attainment of personal goals" (Zimmerman & Schunk, 2011, p. 1). As Cui et al. (2019, p. 305) put it, "Reflection is a key activity in … SRL." Hence, to improve student autonomy, designers should create affordances that incentivize self-refection and the use of LA promises to play a crucial role in this (Cui et al., 2019; Renner et al., 2020; Viberg et al., 2020). However, in a meta-study of 54 papers on LA-based SRL between 2011 and 2019, Viberg et al. (2020, p. 524) found little evidence that the expected improvements materialize as part of current conceptions of LA applications — mainly because the systems were primarily used for *measurement*, not for helping students by giving *feedback*.

This raises the question of how designers can improve self-reflection through affordances offered by LA-based feedback applications. An obvious step would be to pose questions that require active self-assessment at crucial points (e.g., after completion of modules or before important exams). Especially for relatively open programs with a lot of choice, tools should encourage students to formulate what competences and expertise they hope to develop by the end of the program and help them plot corresponding plans on how to shape their completion of modules and so on. LA could then be used to see such plans in relation to current trajectories and present alternative options rather than presenting visualized measurements and "progress bars" towards formal course or program requirements. Although challenging, designers should also enable students to adapt the feedback including the LA component to their individual situation so that members of salient groups like part-time students find adequate reference points. Finally, as mentioned above, students on a strong trajectory could be incentivized to critically reflect on their discipline's role in society and see themselves as early career members of their field rather than explicitly or inadvertently nudging them away from non-required, "merely optional" activities. Self-reflection can thus support integrating students' own values with the demands and limitations of the field, approaching Reinmann's level of self-determined learning.

Table 1. Stimulation of Self-Reflection

FROM CYBERNETIC FEEDBACK…	…TO FACILITATING STUDENT AUTONOMY
Limit feedback to "measurements" based on learning data generated on the platform.	Ask students questions that help them to self-assess their situation in light of current data-based trajectories.
Effectively predetermine the students' desired competences by adapting feedback to existing formal study requirements.	Encourage self-reflection regarding individually desired competences.
Generate trajectories or compare students across fundamentally different study situations.	Allow for adapting feedback to individual situations (e.g., part-time study, care obligations).
Discourage students from spending extra time; present non-required activities as "merely optional."	Encourage reflection activities of the student's own role as an early career member of the field, especially for stronger students.

6.2. Support Planning Own Learning Process and Study Progress

The process of individual education is too complex and too dependent on social change to predict it or plan sufficiently precise and personalized feedback based purely on past data. Nonetheless, we cannot ignore the potential of LA systems to provide valuable insights into learning processes and study planning based on data generated on learning platforms. Epistemically robust findings on cognition, affect, metacognition, and motivation ("CAMM"; cf. Järvelä et al., 2023) may enable students to make more informed choices regarding their course of study in an autonomous way. Therefore, designers should enable students to set or adapt goals and timeframes individually, even for automated feedback systems ("open feedback"; Buckingham Shum et al., 2023, p. 5). While self-directed learning is largely dependent on institutionally granted leeway, feedback systems should encourage students to make choices in light of their own goals where possible, instead of reflecting institutional or political ambitions like lowering drop-out rates and semester counts.

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While difficult to design, feedback systems should offer a meaningful form of adaptation of components to these personalized goals, rather than presenting feedback irrespective of them. Ideally, LA could sketch out how past students have succeeded in reaching similar goals. Encouraging students to use their university's support resources and programs as part of this seems easy to implement; doing so as part of targeted interventions to avoid overwhelming students with many suggestions can be tricky, however. Here, LA could be used to identify the salient groups, e.g., non-traditional students likely to profit from interventions that reduce social identity threat and increase their sense of belonging (Froehlich & Weydner-Volkmann, 2024) — thus also strengthening identification and value integration for those groups.

Table 2. Support for Planning Own Learning Process and Study Progress

FROM CYBERNETIC FEEDBACK…	…TO FACILITATING STUDENT AUTONOMY
Use common goals or political and institutional ambitions to define student goals.	Give students room to set individual goals.
Ascribe institutionally or politically desired timeframes.	Allow students to set their own timeframes.
Give options to define goals but fail to meaningfully adapt the feedback metrics to them.	Design tools to adapt the feedback to subject-specific goals and timeframes.
Suggest the "optimal" way to reach goals.	Sketch out different ways with different emphases to reach goals.
Encourage and suggest the use of support resources indiscriminately as part of the feedback.	Identify students likely to profit from using specific support resources of the university.

6.3. Feedback Literacy and Risk Transparency

As Buckingham Shum et al. (2023, p. 4) note, digital learning literature predominantly conceptualizes feedback "as something performed on students rather than a process in which their agency is exercised." However, recent SRL literature has noted that this is insufficient and has highlighted that students play an active role, requiring what has been termed *student feedback literacy*, i.e. "students' ability to understand, utilise and benefit from feedback processes" (Molloy et al., 2020, p. 528). Consequently, feedback needs to be generated in such a manner that students can actively use it to improve their learning, requiring *teacher feedback literacy* (Boud & Dawson, 2023, p. 159). Buckingham Shum et al. (2023) have adapted relevant additional dimensions of teacher feedback literacy for automated feedback generation.

Table 3. Fostering Feedback Literacy and Risk Transparency

FROM CYBERNETIC FEEDBACK…	…TO FACILITATING STUDENT AUTONOMY
Rely on the existing competences of students and teachers to make use of automated feedback.	Encourage students and teachers to develop feedback literacy and offer corresponding resources.
Show information on limitations and biases in places where the user needs to actively look for it.	Highlight specific limitations and biases of automated feedback in pertinent places.
Present assessments in a way that can be misread as objective.	Explain the basic reasoning behind the assessment.
Communicate risks as legally required for data protection and similar regulations in typical agreement dialogues.	Openly communicate potential risks to privacy and other potential negative impacts in an understandable language.

Regarding Reinmann's level of self-regulated learning, these frameworks provide reference points for designing necessary accompanying resources to develop feedback literacy. To do justice to the envisioned active role of students, transparency in LA-based feedback generation must be a central factor — especially when they incorporate machine learning methods. As noted above, this refers less to the technical operation, but to making limitations and potential biases of feedback visible and to explain the reasoning behind assessments, scorings, or categorizations. A good example would be a disclaimer provided by the writing feedback tool AcaWriter that highlights that the tool "does not really understand your writing, the way people do. You may have written beautifully crafted nonsense" (cf. Buckingham Shum et al., 2023, p. 30). The appearance of "objective, precise assessment" needs to be actively demystified so that learners are encouraged to critically engage with the reasoning of the generated feedback to improve their own learning processes.

As with any technical system, feedback systems may inadvertently create negative impacts. Hence, being transparent about the risks to students should be considered an ethical design requirement. The need for minimizing and openly communicating

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privacy, discrimination, and connected risks have long been identified as crucial for LA research (Slade & Prinsloo, 2013; Drachsler & Greller, 2016) and corresponding suggestions should be heeded in the design to minimize undermining student autonomy through privacy and other risk impacts.

6.4. Stimulate Individual Growth and Value Integration

Universities are pivotal sites where Dewey's normative conception of growth can become manifest — but they are not exclusive in this. On Reinmann's level of self-determined learning, feedback systems should therefore reflect the idea that learning is open-ended and can take place within as well as without the curriculum, online and offline, formal and informal. Special care should be taken to acknowledge the openness and relativity of the goals of higher education. Furthermore, while it could happen through different means, automated feedback tools offer the potential to strengthen student autonomy by pointing out opportunities for students to reflect on the discipline's role in society, what scientific progress means for the field, and what competences this could require outside of the strict requirements of their study program. In any case, through these tools, it is important to make it visible that change and diversity in individual educational pathways are a genuine part of higher education.

On the level of self-directed learning, LA-based feedback should avoid optimizing mainly towards better grades. This could encourage students in programs that give much leeway in the selection of courses or exam types (as is often the case in the humanities in Germany) to choose according to what they already have a high proficiency in. Instead, the relevance of grades as an indicator of competence in diverse fields should not be overemphasized, and diversity in course selection should be encouraged, especially for course material and exam types that students have *not* yet mastered. On the level of self-regulated learning, student preferences for content progress indicators in feedback dashboards (Jivet et al., 2021, p. 425) should, therefore, be taken with skepticism and countered through other elements in the design of user interfaces that reinforce that learning is open-ended and should continue even after completing a course or module.

Table 4. Stimulating Individual Growth and Value Integration

FROM CYBERNETIC FEEDBACK…	…TO FACILITATING STUDENT AUTONOMY
Suggest that acquiring relevant competences is part of the program and nudge students to remain on the learning platform.	Allow for the possibility of extracurricular continuation and offline learning as part of the feedback.
Implicitly take the field's current characteristics for granted.	Encourage spending time on critiquing the field.
Tune feedback towards getting better grades.	De-emphasize the relevance of grades and highlight the importance of taking challenges for learning.
Streamline the selection of courses.	Encourage diversity in the selection of courses.
Overuse progress indicators that suggest completing a module means completion of learning.	Actively communicate learning as open-ended.

Overall, LA-based feedback systems must be understood as auxiliary systems that support and rationalize reflecting and improving learning processes but do not determine or control them on any of Reinmann's three levels of self-organized learning. Read through the lens of Dewey's concept of growth, we believe the three levels allow for a good approximation of student autonomy. While SRL literature has contributed a lot of insight into how automated digital feedback and LA components could be designed, student autonomy goes beyond these ideas, especially regarding the more abstract levels of self-directed and particularly self-determined learning. We believe the four sets of ethical design considerations outlined above offer a normative orientation in the design of automated feedback tools based on this understanding of student autonomy.

7. Conclusion

As LA-based feedback applications (which typically make use of machine learning methods) are becoming increasingly important in higher education, we argued for considering student autonomy to be recognized as a central value that should be sustained or strengthened, especially as part of the design of such systems. As we have seen in the German context, the impact of such systems on student autonomy is contested. In the corresponding research debates, the hopes and ambitions of learner autonomy and self-regulated learning (SRL) are contrasted with fears of learners being reduced to mere numeric constructs, of learning being reduced to a cybernetic adaptation to a "normal" course of study, and of learners being caught up in neoliberal demands to self-optimize.

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To better grasp in what ways student autonomy may be affected by LA-based feedback systems, we have analyzed the philosophically contested concept of autonomy and argued that it is a central normative characteristic of human life and well-being as well as for liberal democratic societies. Following Beate Rössler, we argue that any applicable conception of autonomy needs to reflect that full self-determination is a misleading idea, i.e., that autonomy denotes activities of self-reflection and engagement with options within the situational bounds and conditions — something that is also reflected in Self-Determination Theory in psychology.

In the context of student autonomy, this points towards a self-determined, process-oriented, self-reflective character of education, one where automated feedback actively avoids further entangling learners in heteronomous demands and limitations by having students self-optimize towards them. As becomes clear, John Dewey's concept of growth allows for a situated conception of student autonomy in the sense of comprehensive personal development through education that can be applied to LA-based feedback systems.

Based on this, we have proposed preliminary design and implementation considerations for LA-based feedback systems for strengthening the normative idea of student autonomy and contextualized them in the self-regulated learning (SRL) debate. We believe that this list may serve as an intellectual tool grounded in educational philosophy and ethics for addressing the criticism voiced in German educational philosophy literature. We hope that this can encourage further discussion on how we can recognize, promote, and preserve student autonomy in higher education while, at the same time, harnessing the potentials offered by automated feedback tools.

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