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Information Flow Solipsism in Canvas: An Exploration of Student Privacy Awareness

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Abstract

The proliferation of learning analytics (LA) in higher education has relied on data from learning management systems (LMS) like Canvas and Blackboard. Despite widespread LMS usage, students often lack clarity on what specific data is collected and who has access to it. This study explores undergraduate students' understanding of data collection practices within the Canvas LMS. We analyzed survey responses of nearly 600 students, examining students' awareness of the various roles within Canvas and their corresponding data permissions. The results reveal that students exhibit a general awareness of data collection practices but are unsure about the extent of their data's use and misinterpret the use of data analytics, highlighting a gap in digital literacy. These findings suggest a critical need for universities to enhance transparency and educate students on data privacy and LMS functionalities.

Keywords

Learning management systems, learning analytics, student privacy, privacy statements, information flow

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1. Introduction

Learning management systems (LMSs) in higher education first appeared in the late 1990s and have since become near-ubiquitous on campuses (and common in K-12 schools) across the United States. The LMS market share has evolved over the years, with rivalries between platforms such as Blackboard, Canvas, and Moodle. Although LMS use varies by campus (and by course), they primarily serve to facilitate delivering course materials and collecting student information. Indeed, some institutions require their use for recording attendance, posting syllabus documents, or turning in assignments. In both face-to-face and online courses, an LMS typically provides a more convenient and economical method for providing access to course readings and materials than course packs provided through the bookstore or a print shop. In this sense, LMSs are a clear example of technology providing more flexibility and access to students and instructors.

Another effect of the introduction of LMSs is the *datafication* of student and instructor learning behaviors. van Dijck and Poell (2018) describe *datafication* as a process by which "learning processes are translated into data processes and turned into tracking systems that continuously relate individual progress to standardized performance" (p. 579). In short, by virtue of being a technical system, an LMS allows for easily collecting data in a way that would be intrusive—even inappropriate—in a classroom setting (Eaton, 2021).This increased access to data has allowed for the emergence of methodologies such as *learning analytics* (LA), which aim to "extract useful and actionable information from large datasets" (Baker & Siemens, 2014, p. 253). Universities are now using multiple student data points—including those derived from LMSs—to predict grades, suggest classes, develop interventions, and make recruiting decisions (Brown & Klein, 2020; Jones et al., 2020).

In this study, we examine what students at a university using Canvas know about the data collection practices of this LMS. Although universities believe that students are active partners in the educational process, few university policies outline “when, where, and how data are collected and converted into educational records” (Brown & Klien, 2020, p. 1160). Even if students were reading privacy policies, they might not be able to locate data retention policies (Obar & Oeldorf-Hirsch, 2020). Thus, although these students are presumably regular users of Canvas, they may not fully understand their relationship with the system. We therefore surveyed nearly 600 undergraduate students to assess their understanding of how Canvas collects specific data points collected by Canvas and makes them available to various stakeholders.

2. Background

Generally speaking, scholars and practitioners recognize that there are important ethical implications of learning analytics (e.g., Corrin et al., 2019). Attitudes toward data ethics in

education are driven by deeper assumptions about the purpose of education and educational technologies or perceptions of quality in empirical analysis (Greenhalgh, 2023) and can therefore be difficult to disentangle. Recent studies have indicated that educational technology platforms have legitimate privacy concerns, especially surrounding consent and data ownership (Paris et al., 2022). Other concerns are related to institutional practices related to protecting personally identifiable information and how personalized education products can introduce discriminatory or limiting practices (Regan & Jesse, 2019). Furthermore, big data collection in higher education typically deploys a mandatory participation method through LMSs, which opens up student vulnerability without consent (Prinsloo & Slade, 2016); in short, educational technology platforms are an expected part of modern education, which can be confusing and challenging to end users who value privacy. In the following sections, we review selected literature on university and student awareness of learning analytics data before describing some theoretical frameworks useful for understanding these concepts.

2.1 Data Awareness

There is reason to believe that even universities do not fully understand the LMSs that they use. The Electronic Frontier Foundation (EFF) has criticized universities—including elite institutions like Dartmouth—for leveling accusations of cheating against students based on misunderstandings of data provided by Canvas (Kelley, 2021). If their institutions do not fully understand the ins and outs of LMSs' data collection, it is unsurprising that students may also lack detailed awareness of how these platforms work. Furthermore, even if the institutions understand the potential harms in the datafication of students, they continue a process of indoctrinating students to a surveillance state so long as they do not take action to better develop student understanding (Hillman, 2022). Including students as stakeholders is therefore a key

element of addressing ethical issues (Slade & Prinsloo, 2013), with transparent policy about and documentation of LMSs (by universities and the companies they work with) as important elements. Yet, even "pages upon pages of policy documentation" do not necessarily lead to informed users (Proferes, 2017, p. 11), and universities must also engage in explicit efforts to educate students about the LMSs they are required to use (Jones et al., 2020; Roberts et al., 2016).

The literature repeatedly demonstrates that universities do not appear to be doing so. Greenhalgh and colleagues (2023) have suggested that students may conflate educational technology platforms, focusing on utilitarian similarities rather than considering privacy and ethical aspects of different platforms. More specifically, Roberts and colleagues (2016) found that "students... had little, if any, knowledge of learning analytics" (p. 8). Of course, this pattern is not limited to educational platforms: Proferes (2017) defines as *information flow solipsism* "the subjective position of the user who is familiar with the facets of a platform for which the interface provides informational feedback mechanisms, but who remains unaware of how the technology operates at a broader techno-cultural or socioeconomic level" (p. 10).

However, student unawareness should not be misunderstood as student apathy. Studies have shown that student perceptions of privacy are highly contextual and that they often feel powerless to control the amount of information required to participate on required platforms (Jones et al., 2020). Students are aware they are being tracked but are not clear on what personal information they are giving up while using educational platforms. Jones and colleagues (2020) found that students' perceptions of LMS data use were largely altruistic, believing that institutions are using the data to improve the educational experience. In contrast, Ifenthaler and

Schumacher (2016) found that if given the choice, students would not be willing to share all usage data with an LMS.

2.2 Theoretical Foundations

As we have demonstrated, student awareness is a key factor in evaluating ethical considerations related to learning analytics. In this paper, we understand this awareness in terms of Pangrazio and Selwyn's (2021) *critical data education*, which they suggest can "support and develop young people's understandings of how to manage and protect their personal data." (p. 433). These authors' proposals are broad, extending beyond concerns specific to educational technologies, but include the following components germane to this study: understanding of "what becomes a 'data object', how it is processed and used", critical reflection "on the importance of metrics", and awareness of platforms' "capacity to track, profile, and predict" (p. 436). These understandings could also collectively be understood in terms of *critical data literacy*; however, we employ the term *critical data education* both to accurately represent Pangrazio and Selwyn's work and to emphasize the agency and responsibility of educational institutions in developing these understandings.

However, this is not to downplay the importance of student agency in responding to ethical issues related to learning analytics. Indeed, we understand a second theoretical pillar of our study—*privacy*—as "the right to *appropriate* flow of personal information" (Nissenbaum, 2010, p. 127, emphasis in original). This understanding is important because while universities may be largely interested in "useful and actionable information from large datasets" (Baker & Siemens, 2014, p. 253), the question of appropriateness more fully centers students. (We acknowledge that this is a bit of an oversimplification, in that universities may have legitimate claims to what is appropriate in terms of data flow just as students may reasonably ask what is useful and

actionable from their perspective). Because evaluations of appropriateness are necessarily dependent on awareness, we argue that student *privacy* cannot be fully accounted for until *critical data education* is first present.

2.3 Purpose

Our purpose in this study is to explore Proferes's (2017) *information flow solipsism* in the context of the Canvas LMS. That is, we expect that students are generally familiar with how to operate the platform but lack understanding of the sociotechnical underpinnings of the platform. This lack of understanding highlights gaps in critical data education, and both draw attention to an absence of student privacy. We add to previous research that has already documented students' general lack of awareness related to learning analytics by exploring their understanding of fine-grained details that are present in LMS documentation but may remain opaque to students (and other users, such as instructors). We anchor our exploration of information flow solipsism around the following questions:

1. What do students understand about user roles and permissions in Canvas?
2. What do students understand about explicit analytics features in Canvas?

3. Methods

To learn more about student knowledge of data flows in Canvas, this exploratory study collected data through a survey distributed to undergraduate students. We collected this data during the Spring 2023 semester at a large southeastern research university. Participants were recruited through the College’s student research requirement, where they opt in to studies of their choice and receive research credit upon completion of the study, which counts toward their grade. Studies are shared through a college-wide SONA platform. There were multiple studies available for participation, and students had the option to complete a writing assignment instead

of participating in research projects. The survey (see Appendix A) included four parts: a brief demographic section to learn the participants' year in school, number of years' experience with Canvas, and current major; general Canvas data collection questions; more detailed Canvas data collection questions related to user roles and permissions; and awareness of Canvas analytics. We developed these questions in consultation with the Instructure Privacy Policy, the Canvas Community Knowledge Base (https://community.canvaslms.com/t5/Canvas/ct-p/canvas) and our local campus Canvas policy. As Canvas has customizable roles which differ by institutions, certain details in our survey—the permissions for the Observer user role and the presence of the Librarian role—are based on our specific university. However, data collection and analytics at follow university standard uses present in Canvas documentation.

Most of the questions related to data collection asked students to identify which kinds of data were either collected by the Canvas platform or made available to specific kinds of users. The majority of items in these questions were retrieved from the sources identified above as true examples of data types collected by Canvas (but not necessarily available to all users); however, we sometimes rewrote information to translate "legalese" into phases more easily understood by students. In particular, we provided specific examples of data being collected instead of using vague terms that lacked actual interactions with the platform. For example, "submitted content" is listed as "course assignments" in the survey. In addition to these answers retrieved from Canvas documentation, we added incorrect datatypes not collected by Canvas at all. For questions related to Canvas analytics, we referenced both Canvas documentation and the EFF's reporting on aspects of analytics that have been misunderstood by universities in high-profile controversies (e.g., Budington, 2021; Kelley, 2022; Kelley, 2021).

3.1 Participants

A total of 591 students consented to and completed our survey. Table 1 shows the distribution of these respondents by their year in school, and Table 2 shows the distribution of these respondents by the number of years of Canvas experience that they reported. Both tables include a "correct response rate" column that indicates the percentage of questions across the survey that respondents in those categories answered correctly (leaving out questions that they did not answer at all). We have included these columns to demonstrate that there is no clear pattern of difference between students in these categories; that is, we have no reason to believe that increased experience with either higher education in general or with Canvas in particular systematically leads to significantly better understanding of how Canvas works.

Table 1: Comparison of Participants by Reported Class

class	number of participants	percent of participants	correct response rate
freshman	311	52.62%	48.61%
sophomore	90	15.23%	46.82%
junior	118	19.97%	49.63%
senior	71	12.01%	50.27%
did not answer	1	0.17%	46.55%

Table 2: Comparison of Participants by Reported Canvas Experience

Canvas experience	number of participants	percent of participants	correct response rate
0-1 years	228	38.58%	47.74%
1-3 years	177	29.95%	47.57%
3-5 years	136	23.01%	51.45%
more than 5 years	49	8.29%	50.04%
did not answer	1	0.17%	46.55%

Students who completed the survey represented 74 different majors. To simplify reporting, we organized these majors into twelve colleges (and two other categories), as seen in

Table 3. While the correct response rate in Table 3 does vary by college, there is no evident pattern in this relationship; for example, although colleges such as Communication and Information or Engineering host more of the technically oriented majors on campus (whose students might be expected to receive more *critical data education*), colleges such as Arts and Sciences or Education saw higher correct response rates than either of them.

Table 3: Comparison of Participants by Reported Major College

college	**number of participants**	**percent of participants**	**correct response rate**
Business and Economics	193	32.66%	47.10%
Communication and Information	128	21.66%	48.67%
Arts and Sciences	52	8.80%	52.31%
Engineering	49	8.29%	49.91%
Agriculture, Food, and Environment	37	6.26%	46.54%
Nursing	32	5.41%	49.49%
Education	29	4.91%	50.76%
Health Sciences	24	4.06%	47.38%
Fine Arts	16	2.71%	52.49%
Design	11	1.86%	50.31%
did not answer	10	1.69%	48.62%
exploratory student	4	0.68%	53.08%
Public Health	3	0.51%	44.54%
Social Work	3	0.51%	59.42%

Across all three tables, it is rare to see a correct response rate above 50%. Indeed, in Table 3, the highest correct response rates are associated with colleges with low numbers of participants, making those averages particularly vulnerable to outliers. We report these numbers here to provide important context for the more detailed findings presented later: In general terms,

the participants in our study did not show high levels of understanding of the Canvas LMS, despite the importance of this software as part of their university experience. However, echoing Proferes (2017), it is important to note that we are "not denigrating users" for "failing to parse a sometimes opaque platform" (p. 11). As we will elaborate on later, this is a far more complex phenomenon than user ignorance, and our emphasis on *critical data education* underlines our university's responsibilities rather than our students' lack of awareness

3.2 Limitations

We acknowledge limitations to this study that provide opportunities for further research in this area. For example, this study relies on self-reported survey data, which includes the risk of participants misrepresenting their knowledge on the subject. Furthermore, while we collected over 500 responses, this a small sample size when compared to the undergraduate student population—and is limited not only to students on this campus but also those who were currently enrolled in courses that required research interaction. While our participants were able to choose from a variety of studies on the SONA platform, we do not know why they chose this study. We also note that terms used in a technical sense in Canvas documentation resemble terms that are used in everyday conversations by Canvas users to refer to other phenomena. However, as we will note later, we understand this limitation to be less an issue of instrument design and more a deeper problem characterizing user understanding of the Canvas LMS.

4. Results

In the following sections, we follow our research questions in reviewing the findings associated with the two major areas addressed in our survey. First, we describe students' understanding of the roles that are present in the Canvas LMS and the access to student data that

different roles have. Second, we describe students' understanding of the analytics features that are described in Canvas documentation.

4.1 RQ1: Roles and Permissions

Like many technical systems, Canvas assigns different users to different *roles* within the system. These roles are important for distinguishing users from each other in terms of what they are authorized to do within the system; for example, although both professors and their students are legitimate Canvas users, students should not be able to assign grades in the same way professors can. More pressingly for the context of our study, roles determine which data collected by Canvas a given user can access.

In our survey, we listed ten user roles and asked participants to select which of those roles was present in the Canvas system (see Table 4). Four of the listed roles (those not shaded in the table) were plausible but fake roles that we created. It is important to note that the *librarian* role is not a standard Canvas role but one that is common on university campuses and exists at our university. Table 4 indicates the percent of respondents who correctly identified whether that role exists in Canvas. Vast majorities of students recognized *student* and *teacher* as legitimate roles in Canvas and rejected *coach* as a non-existent role. A majority of students likewise recognized *TA* as a real role and rejected *grader* and *advisor* as fake ones. Only a large minority of students correctly assessed that *admin* was a fake role; however, although there is no course-level Canvas role called admin, we acknowledge that some students may have recognized that there are necessarily administrators for any given Canvas system.

In contrast, only small minorities of students correctly recognized *observers*, *designers*, and *librarians* as users who might be present in their classes. We note with interest that in a follow-up question, 18.61% of participants claimed to have experience with an observer (i.e., a

parent, advisor, or other individual who is supervising a student's class performance) in one or more of their Canvas courses; this suggests that there is a small number of students who have experience with this user role but did not initially recognize them as a formal part of the Canvas system.

Table 4: Participant Recognition of Canvas Roles

question	percent correct
student	96.79%
coach	93.57%
teacher	90.52%
TA	74.11%
grader	61.08%
advisor	52.79%
admin	45.85%
observer	15.57%
designer	6.43%
librarian	4.06%

As suggested above, one of our reasons for measuring students' understanding of user roles in Canvas is because different users have access to different kinds of data. Early in our survey, we listed twenty-three kinds of data and asked participants to identify which of them were actually collected by the Canvas system (all but two: mother's maiden name and student's astrological sign). We repeated this item three times in the survey, these times asking whether a specific user role had access to the kind of data in question; unfortunately, due to an error in survey design, one kind of data (Canvas login and associated email address) was omitted from the version of this item for the teacher user role. Table 4 lists the percent of respondents' answers that was correct for each kind of data within each version of this survey item; shaded cells designate "correct" answers (in that the system does collect—or the user role does have access

to—that type of data). We note that participants could select "yes," "no," and "unsure" for each of these types of data but that a response of "unsure" always counts as incorrect for the purposes of Table 4.

Table 4: Participant Recognition of Data Accessible by Different Stakeholders

	Canvas	teacher	observer	TA
student's name	95.45%	94.41%	56.38%	90.19%
Canvas login and associated email address	93.36%	*NA*	13.04%	57.78%
student's grades	91.33%	93.55%	39.66%	72.23%
files student uploaded to assignments	91.19%	92.53%	7.17%	80.10%
student comments on discussion boards	90.49%	92.36%	37.03%	79.42%
teacher's comments on student assignments	90.46%	91.98%	34.19%	68.88%
course assignments	89.98%	93.88%	46.51%	83.22%
course modules	89.30%	93.71%	46.25%	83.76%
course syllabus	89.08%	94.22%	46.76%	83.65%
messages between teachers and students	81.86%	79.80%	13.80%	18.94%
student's mother's maiden name	61.22%	57.29%	37.84%	52.14%
messages between students	61.05%	32.37%	26.42%	39.25%
student's astrological sign	60.96%	51.21%	35.57%	48.87%
number of times student participated in a particular activity	48.12%	47.71%	15.64%	26.32%
students' total activity within a course (as a comprehensive time)	46.18%	42.52%	13.48%	20.31%
student's browser type, settings, and preferences	39.73%	20.44%	19.93%	25.98%
student's operating system	37.69%	20.92%	20.72%	27.05%
content student clicked on	37.12%	33.50%	14.31%	17.38%

when student was last active in the course	39.49%	40.03%	13.33%	19.52%
student's pronouns	35.08%	51.96%	24.91%	43.05%
number of times student viewed particular content	34.30%	41.67%	15.87%	21.77%
when student last viewed particular content	33.39%	36.52%	14.33%	18.60%
student's location when accessing content	29.93%	23.85%	20.03%	30.55%

Multiple patterns of interest are present in Table 4. In terms of Canvas's collection of data, students had the best understanding of data that is most intuitively associated with the basic logistics and activity of higher education, including student identifiers, course content and assignments, and student activity. In contrast, with a single exception (student's pronouns), the data types least understood by students are associated with analytics, including both technical analytics (such as those tracking operating system, browser type, and location) and learning analytics (including how often and when students completed activities). The table is sorted according to student understanding of the entire Canvas platform's relationship with data, but other columns seem to generally follow a similar pattern—that is, when students have a better understanding of Canvas's relationship with a given data type, they tend to better understand specific users' relationship with that data type. However, there are important exceptions to this rule. For example, while about a third of respondents correctly identified that Canvas collects data associated with students' pronouns, over half of them correctly identified that teachers can see students' listed pronouns. Similar increases between the Canvas and teacher versions of a question exist on a smaller scale for several data types. This raises the possibility that students broadly recognize that their teachers have *access* to certain kinds of data but are not as aware that the Canvas platform necessarily *collects* this data as part of its delivery to teachers. We also note

that students showed less understanding about the TA and observer roles (especially the latter) than the teacher role. This may be due to less experience with teaching assistants and observers—or because their roles and responsibilities within higher education are more ambiguous.

4.2 RQ2: Analytics

We also asked participants to answer items related to three categories of Canvas analytics. We listed seven possible Canvas analytics functionalities—five taken from Canvas documentation and two invented for the survey—and asked respondents to identify which Canvas was capable of. As seen in Table 5, students acknowledged that they were unsure about Canvas analytics. At least 30% of students marked "Unsure" for each question, and as percentages of correct answers (marked with shaded cells) decreased, rates of "Unsure" answers increased. Indeed, for the last two capabilities (also the two false ones), there were pluralities of "Unsure" answers that approached flat-out majorities. Nonetheless, important minorities of respondents for each of these two capabilities attributed to Canvas abilities that are unlikely from either a practical-technical (in the case of comparing students' grades to social media activity) or policy (comparing students' performance across classes) perspective. We note, however, that although students are directly affected by Canvas's analytics capabilities, most students (with the possible exception of those hired as undergraduate TAs) will never directly access them. Thus, it is perhaps unrealistic to expect students to be familiar with these capabilities; indeed, it is noteworthy that students best understood the capability that involved directly sending them messages—and therefore most involved students in the process.

Table 5: Participant Understanding of Canvas Analytics Capability

analytics capability	Yes	Unsure	No	did not answer

send a message to students based on specific course grade or participation criteria	397 (67.17%)	180 (30.46%)	12 (2.03%)	2 (0.34%)
view and download reports on missing, late, or excused assignments, class roster, and course activity	346 (58.54%)	233 (39.42%)	11 (1.86%)	1 (0.17%)
view online participation analytics for an individual student	344 (58.21%)	237 (40.1%)	8 (1.35%)	2 (0.34%)
view course average weekly online participation	339 (57.36%)	237 (40.1%)	14 (2.37%)	1 (0.17%)
compare the course average weekly online participation with an individual student	287 (48.56%)	277 (46.87%)	22 (3.72%)	5 (0.85%)
compare an individual student's grades and online participation analytics with student's activity on major social media platforms	195 (32.99%)	288 (48.73%)	105 (17.77%)	3 (0.51%)
compare an individual student's grades and online participation analytics in one class to grades and online participation analytics in other enrolled classes	237 (40.1%)	292 (49.41%)	61 (10.32%)	1 (0.17%)

Based on U.S. federal law, Canvas's analytics features automatically track certain student behaviors as official measures of participation in online courses. We provided students with a list of three activities that Canvas does track as participation as well as three Canvas or Canvas-adjacent activities that could plausibly be understood as participation (see Table 6). We then asked them to select which "are considered as 'participation' by Canvas analytics." Students' answers to this question suggests a gap between how "participation" is popularly understood by

participants in online education and how it is operationalized by Canvas in this specific context. For example, the three activities that Canvas logs as participation are likely to also be understood by instructors and institutions as participation according to local or informal policies. In contrast, joining a web conference to attend class is widely understood (and even described) by instructors as participation, and may be why so many students expected—incorrectly—that Canvas would, too. Students were less sure about whether simply opening Canvas counted as participation (with a plurality marking "Unsure"), though that is also a reasonable conclusion if students are thinking about this in terms of how instructors measure activity.

Table 6: Participant Understanding of Canvas Measurement of Participation

participation activity	**Yes**	**Unsure**	**No**	**did not answer**
submitting an assignment	495 (83.76%)	88 (14.89%)	3 (0.51%)	5 (0.85%)
starting or submitting a quiz	486 (82.23%)	92 (15.57%)	9 (1.52%)	4 (0.68%)
posting a new comment or reply in a discussion	481 (81.39%)	97 (16.41%)	8 (1.35%)	5 (0.85%)
joining a web conference through Canvas	410 (69.37%)	159 (26.9%)	18 (3.05%)	4 (0.68%)
opening Canvas	228 (38.58%)	232 (39.26%)	118 (19.97%)	13 (2.2%)
joining a web conference through Zoom	329 (55.67%)	197 (33.33%)	63 (10.66%)	2 (0.34%)

Our final items related to Canvas analytics were focused on important details about their fidelity. Both items were written to be plausible-but-false (Canvas discourages use of mobile logs in use of cheating investigations, and analytics reports are refreshed every 24 hours). For both items, outright majorities of students acknowledged being unsure, though the items were plausible enough that considerably more students answered "Yes" than "No." As before, we note that very few—if any—students have direct experience with Canvas analytics; furthermore, if entire institutions have been shown to misunderstand these aspects of the platform, it is unreasonable to expect individual students to show their own understandings. Nonetheless, it is often students who are most directly affected by the use of Canvas analytics, and their understanding remains salient.

analytics statement	Yes	Unsure	No	did not answer
in cases of suspected cheating, Teachers are encouraged to see when students accessed Canvas materials from a mobile device	213 (36.04%)	349 (59.05%)	24 (4.06%)	5 (0.85%)
analytics reports available to Teachers are refreshed every 15 minutes	136 (23.01%)	438 (74.11%)	15 (2.54%)	2 (0.34%)

5. Discussion

We have previously argued that information flow solipsism (Proferes, 2017) has implications for critical data education (Pangrazio & Selwyn, 2021) and that both must be addressed before Nissenbaum's (2010) understanding of privacy can be said to be present. In this section, we go beyond the specifics of our research questions to consider how our findings relate to this argument. We address information flow solipsism and critical data education separately, drawing connections to privacy in both sections.

5.1. Information Flow Solipsism

Proferes (2017) uses the term *information flow solipsism* to describe the experience of a platform user who is familiar with those aspects of the software "for which the interface provides informational feedback mechanisms" (p. 10) but who nonetheless lacks deeper understanding of how the platform functions. Proferes's focus on flow demonstrates the connection between this concept and Nissenbaum's (2010) understanding of privacy, which also emphasizes appropriate flow of information (indeed, his work cites hers). In short, if privacy is dependent on informed evaluations of whether information flow is appropriate, this solipsism necessarily constrains privacy. While his research focused on the social media platform Twitter—and gaps between its users' knowledge and details found in its extensive documentation—we find that this term also effectively describes our participants' understanding of Canvas.

Indeed, we found that students have an intuitive understanding of the basic logistics and activities of higher education and can correctly identify them as data points collected by Canvas. For example, students best understood those data collected by Canvas that are most obviously connected with their higher education experience (e.g., students' names, assignments, and discussion board posts), and the analytics feature they best understood (sending messages based on course grade or participation criteria) is the one that they are most likely to have seen in action. In contrast, those data types and features that students least understood included those that are primarily instructor-facing (e.g., how long a student has spent in a course or how many times they have clicked on content).

Students' responses also highlighted gaps between the lived experience of Canvas users and specific details about the platform. Although our respondents are students, these "lived experiences" may extend beyond this population; that is, instructors may experience their own

form of solipsism with its own implications for student privacy. For example, a majority of students identified "joining a web conference through Zoom" as an activity that Canvas would count as class participation; while this is not the case, students may well have participated in online synchronous courses where their instructors counted Zoom attendance as participation. This gap is further complicated by the fact that this is not just a technical decision made independently by Canvas but rather a response to federal U.S. policy related to participation in online courses. Other examples further emphasize this pattern. Students recognized that course instructors could see students' listed pronouns but did not necessarily understand that the Canvas platform also collected and stored that data. Likewise, students' misunderstandings about Canvas roles like admin, observer, or advisor may, frankly, be a question of semantics, where users' vocabulary and activity differ from how technical documentation represents these phenomena.

5.2. Critical Data Education

Students showed less understanding of some of the more technical aspects of Canvas's data collection. While this further emphasizes the solipsism present among our respondents, it also emphasizes the need for critical data education within universities. For example, students showed little understanding of the fine details of Canvas's analytics platform; while this is understandable, it is also worrying in that they could bear the consequences of their instructors and institutions' similar misunderstandings (see Budington, 2021; Kelley, 2022; Kelley, 2021). We argue that it is critical that instructors and institutions confront their own solipsism that both diminishes the likelihood of these misunderstandings and empowers them to provide critical data education that makes students more active agents in the learning analytics process. Our data suggest that experience with LMSs does not indicate mastery of their technical functionality. This disconnect between classroom experience and technical expertise not only further

challenges the idea that undergraduate students can be described as *digital natives* (Selwyn, 2009) but also indicates a need to provide critical data education regarding Canvas and make the implicit, explicit. Additionally, the findings indicate a need for universities and instructors to be transparent on how they are utilizing LA data in the classroom and to make organizational interventions and decisions. Learning analytics introduces several student privacy issues and ethical implications; higher education administrations should review these implications as they deploy LMSs, consider when and how students are notified of how their personal data informs LA, and allow students to opt out of systems to protect their privacy (Ruble & Jones, 2016). LMS data are recognized as data that are valuable and vulnerable and should be protected strategically (Brown & Klein, 2020); it is therefore particularly important that students be involved as "full partners" (p. 1159; see also Corrin et al., 2019; Corrin, 2021) when drafting university policies. Yet, given that most of the questions in our survey are already answered in Canvas's technical documentation, it is clear that policy documentation alone will not solve this problem.

Furthermore—and inadvertently echoing Pangrazio and Selwyn's (2021) emphasis on a broad "awareness... of digital platforms" (p. 436), participants showed a lack of understanding about how web services generally work: for example, that they typically collect information about users' operating systems and web browsers or can infer users' location based on IP addresses and other data. In other cases, students did not recognize the implausibility of certain data collection techniques (e.g., Zoom communicating user attendance to the Canvas platform or that Canvas collecting students' social media data). This raises broader concerns about students' data literacy and privacy awareness beyond the university. While universities have obvious responsibilities in terms recognizing how the software they use may impact students' privacy,

those responsibilities do not end there. We agree with scholars who call on universities to educate students about how learning analytics are employed (e.g., Jones et al., 2020; Roberts et al., 2016), but our findings—and Pangrazio and Selwyn's (2021) work—emphasize that a broader attention to critical data education would both provide important context for understanding LMS use and prepare students for similar privacy concerns outside of educational institutions.

6. Conclusion

The data types students had the most difficulty identifying correctly were related to learning analytics. Transparency about data collection and use of learning analytics is vital when using the data to make decisions. Students need to be made aware if and when LA is used for grading purposes and how institutional decisions are informed by the data. Eaton (2021) has argued that faculty would be less comfortable with the privacy aspects of learning analytics if students were able to evaluate their instructors' work. Indeed, instructors may soon have cause for concern, if not in the way that Eaton described. In March 2023 Instructure, the maker of Canvas, announced Canvas Admin Analytics that provides institution wide data on course outcomes, interactions, and student activity that can be filtered by account, instructor, or course (Instructure, 2023). Institutional administrators have the ability to track instructor behavior while using Canvas, and as this becomes more commonplace, future research should focus on instructor awareness of learning and administrative analytics.

We argue that students, instructors, and institutions need to better understand the information flows of student data as they make interventions and decisions based on LMS data collection. This gap between classroom experience and technical expertise not only further challenges the notion that undergraduate students can be considered digital natives, but also

highlights the need for critical data education on Canvas, bringing implicit knowledge into the open. The need for critical data education at all levels will produce institutional policies at the institution level and develop a greater sense of trust with students and instructors. The results of this study can guide institutions and instructors in educating students about data collection practices when using Canvas or other educational technologies.

The implications of greater critical data education impacts students their time at university to when they enter the workforce. They will be more adept at not only understanding their own organizational information flows but be skilled at making enterprise decisions that can impact others. Organizations are collecting similar data on their employees through the use of several enterprise systems that make workflows efficient. Similar to learning analytics, organizations are deploying business analytics to predict performance, increase productivity and create interventions for their employees (Hasan et al., 2024). Improving critical data education and institutional transparency can empower students to better navigate and understand the data ecosystems that underpin their educational, and future professional, experiences.

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Appendix A

Beliefs About Canvas Privacy - Students

Start of Block: Consent

C1
I consent to participate in this research project. (1)
I do not consent to participate in this research project. (2)

Skip To: End of Survey If Click to write the question text = I do not consent to participate in this research project.
End of Block: Consent

Start of Block: Demographic Information

D1 Which of the following best describes you?

freshman (1)
sophomore (2)

junior (3)
senior (4)

D2 How many years of experience do you have with Canvas (including during your time at UK as well as any previous experience)?

0-1 years (1)
1-3 years (2)
3-5 years (3)
more than 5 years (4)

D3 What is your current major?

[drop down of 106 majors]

End of Block: Demographic Information

Start of Block: Data Collection

DC0 Please answer the following questions to the best of your current knowledge, without looking up the answers.

DC1 Digital platforms collect information about their users. Is the following student or course information collected by Canvas?

	Yes (1)	Unsure (2)	No (3)
name (1)			
Canvas login and associated email address (2)			
pronouns (3)			
astrological sign (4)			
mother's maiden name (5)			
messages between students (6)			
messages between teachers and students (7)			
files uploaded to assignments (8)			

student comments on discussion boards (9)

teacher comments on assignments (10)

number of times they viewed particular content (11)

number of times they participated in a particular activity (12)

when they last viewed particular content (13)

last time they were active in the course (14)

content they clicked on (images, people, assignments, discussions, pages, grades downloads) (15)

total activity within a course (as a comprehensive time) (16)

browser type, settings, and preferences (17)

the operating system the student is using (18)

the location of the student when they accessed the content (19)

student grades (20)

course syllabus (21)

course modules (22)
course assignments (23)

End of Block: Data Collection

Start of Block: Roles and Permissions

RP1 Software like Canvas often has many users, and those users may be assigned to different roles, which give them different levels of access to functions and collected data. What roles are available in Canvas? Select all that apply.
Admin (1)
Designer (2)
Teacher (3)
Teacher Assistant (4)
Student (5)
Observer (6)
Librarian (7)
Advisor (8)
Coach (9)
Grader (10)

RP2 Is the following student or course information viewable by a Teacher (for one of their own courses)?

	Yes (1)	Unsure (2)	No (3)
name (1)			
pronouns (2)			
astrological sign (3)			
mother's maiden name (4)			
messages between students (5)			
messages between teachers and students (6)			
files uploaded to assignments (7)			
student comments on discussion boards (8)			

teacher comments on assignments (9)

number of times they viewed particular content (10)

number of times they participated in a particular activity (11)

when they last viewed particular content (12)

last time they were active in the course (13)

content they clicked on (images, people, assignments, discussions, pages, grades downloads) (14)

total activity within a course (as a comprehensive time) (15)

browser type, settings, and preferences (16)

the operating system the student is using (17)

the location of the student when they accessed the content (18)

student grades (19)

course syllabus (20)

course modules (21)

course assignments
(22)

RP4 Athletics works with Center for Academic and Tutorial Services counselors to assign Observers to students in their Canvas classes. Have you ever had an Observer in one of your courses?
Yes (1)
No (2)

RP5 Is the following student or course information viewable by an Observer assigned to that student?

	Yes (1)	Unsure (2)	No (3)
name (1)			
Canvas login and associated email address (2)			
pronouns (3)			
astrological sign (4)			
mother's maiden name (5)			
messages between students (6)			
messages between teachers and students (7)			
files uploaded to assignments (8)			
student comments on discussion boards (9)			
teacher comments on assignments (10)			
number of times they viewed particular content (11)			
number of times they participated in a particular activity (12)			
when they last viewed particular content (13)			

last time they were active in the course (14)
content they clicked on (images, people, assignments, discussions, pages, grades downloads) (15)
total activity within a course (as a comprehensive time) (16)
browser type, settings, and preferences (17)
the operating system the student is using (18)
the location of the student when they accessed the content (19)
grades (20)
syllabus (21)
modules (22)
assignments (23)

Q16 Some Canvas courses have Teaching Assistants (TAs) assigned to them in addition to the Teacher. Have you ever had a TA in one of your courses?
Yes (1)
No (2)

Q15 Is the following student or course information viewable by a Teaching Assistant (TA)?

	Yes (1)	Unsure (2)	No (3)
name (1)			
Canvas login and associated email address (2)			

pronouns (3)

astrological sign (4)

mother's maiden name (5)

messages between students (6)

messages between teachers and students (7)

files uploaded to assignments (8)

student comments on discussion boards (9)

teacher comments on assignments (10)

number of times they viewed particular content (11)

number of times they participated in a particular activity (12)

when they last viewed particular content (13)

last time they were active in the course (14)

content they clicked on (images, people, assignments, discussions, pages, grades downloads) (15)

total activity within a course (as a comprehensive time) (16)

browser type, settings, and preferences (17)
the operating system the student is using (18)
the location of the student when they accessed the content (19)
student grades (20)
course syllabus (21)
course modules (22)
course assignments (23)

End of Block: Roles and Permissions

Start of Block: Canvas Analytics

CA1 Like much educational software, Canvas collects "analytics" about student activity for instructors to review. Which of the following do Canvas analytics allow Teachers to do?

	Yes (1)	Unsure (2)	No (3)
view course average weekly online participation (1)			
view online participation analytics for an individual student (2)			
compare the course average weekly online participation with an individual student (3)			
send a message to students based on specific course grade			

or participation criteria (4)	
compare an individual student's grades and online participation analytics in one class to grades and online participation analytics in other enrolled classes (5)	
compare an individual student's grades and online participation analytics with student's activity on major social media platforms (6)	
view and download reports on missing, late, or excused assignments, class roster, and course activity (7)	

CA3 One of the functions of Canvas analytics is to determine when a student in an online class has "participated" in class. Which of the following activities are considered as "participation" by Canvas analytics?

	Yes (1)	Unsure (2)	No (3)
opening Canvas (1)			
submitting an assignment (2)			
joining a web conference through Canvas (3)			
joining a web conference through Zoom (4)			

posting a new comment or reply in a discussion (5)	
starting or submitting a quiz (6)	

CA2 Are the following statements about Canvas analytics true?

	Yes (1)	Unsure (2)	No (3)
analytics reports available to Teachers are refreshed every 15 minutes (1)			
in cases of suspected cheating, Teachers are encouraged to see when students accessed Canvas materials from a mobile device (2)			

End of Block: Canvas Analytics