Learning-centred Translucence: An Approach to Understand How Teachers Talk About Classroom Data

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ABSTRACT

Teachers are increasingly being encouraged to embrace evidence-based practices. Learning analytics (LA) offer great promise in supporting these by providing evidence for teachers and learners to make informed decisions and transform the educational experience. However, LA limitations and their uptake by educators are coming under critical scrutiny. This is in part due to the lack of involvement of teachers and learners in the design of LA tools. In this paper, we propose a human-centred approach to generate understanding of teachers' data needs through the lens of three key principles of *translucence*: visibility, awareness and accountability. We illustrate our approach through a participatory design sprint to identify how teachers talk about classroom data. We describe teachers' perspectives on the evidence they need for making better-informed decisions and discuss the implications of our approach for the design of human-centred LA in the next years.

CCS CONCEPTS

• **Human-centered computing** ~ Participatory design

KEYWORDS

Human-centred design; evidence-based decision-making

1 Introduction

In the past two decades there has been a growing interest in developing evidence-based practices to help teachers decide on appropriate teaching strategies, monitor student progress

effectively, and evaluate teaching effectiveness [5]. The rapid proliferation of learning analytics (LA) innovations offer great promise in supporting these practices by providing evidence for teachers and learners to make informed decisions and transform the educational experience [21]. Learning management systems (LMSs) and other dedicated educational software provide the opportunity to track learners' activity to monitor their progress and personalise instruction. However, from a teacher perspective, learning goes beyond clickstreams and keystrokes within a system [15]. For example, the analysis of online learning systems *alone* cannot capture what unfolds in the complex environment of the physical classroom, which is an important component in most blended learning experiences [23].

Limitations of most of the current LA systems are also coming under critical scrutiny. Recent reviews identified the difficulties students have in interpreting and acting upon data to improve learning [19,26], and the same applies to teachers [22]. Many of the LA tools reviewed in these studies present data that are not relevant for the particular learning activity or which are not easy to associate with higher-order educational constructs. This not only points at poor design decisions [14] but also to a generalised lack of involvement of teachers and learners in the design of LA tools to understand their current educational practices and data needs [8,16,17]. This is aligned to Biesta's [1] critical stance regarding evidence-based practices in education, suggesting that the role that evidence can play should be subordinated to the values that constitute the educational practice. There has been a recent interest in the LA community to embrace human-centred design practices to understand the needs of educational stakeholders [3]. However, thus far, little work has proposed human-centred *methodological* approaches to engage with teachers and learners, with just a few emerging examples (e.g. [4,16,17]).

In this paper, we propose a human-centred approach to understand teachers' learning data needs through the notion of *translucence* [13]. This concept was first introduced in the field of social information processing to *'design digital systems that support coherent behaviour by making participants and their activities visible to one another'* (p. 59). We have extended this concept to learning environments in which visible traces of learning activity (beyond the LMS) can enhance awareness of teaching and learning practices while ensuring data accountability, privacy and restriction of the use of data for

particular purposes. We illustrate our approach through a short participatory workshop to identify how teachers talk about classroom data. We describe teachers' perspectives on the evidence they need to make well-informed decisions, mapping from teachers' evidence needs, from higher-order educational constructs, to low-level data that can be captured.

2   Related work

The term Human-Centred Learning Analytics was recently coined [3] to refer to the subcommunity of researchers and practitioners interested in utilising the body of knowledge and practice from design communities, such as participatory design and co-design, in data-intensive educational contexts. Although this is a recent approach in LA, preliminary work has suggested the use of rapid prototyping with teachers [25] and interviewing students to understand their perspectives on data [27].

Holstein et al. [16,17] were the first in adapting various co-design techniques to identify teachers' data needs and build prototypes of awareness tools with them. In fact, teachers have been the most commonly involved stakeholders in LA co-design studies. For example, Dollinger et al. [8] discussed implications for the use of participatory semi-structured interviews with teachers in long-term LA projects. Wise and Jung [35] combined LA interface walkthroughs and transcript analysis to make design decisions for a dashboard intended to be used by teachers. Holstein et al. [18] featured a number of co-design techniques, namely card sorting, directed storytelling, semi-structured interviews, prototyping and behavioural mapping, to co-design a classroom analytics innovation with teachers. Whilst some examples of LA design processes have focused on engaging with students, these are just starting to emerge [4,7,30].

In sum, the studies presented above make it evident that there is a growing interest in designing LA systems with students and teachers. However, little work has been done in proposing the steps that other researchers or designers can use as a guidance to structure participatory sessions to understand critical aspects of the envisaged use of LA tools and the actual data needs that stakeholders may have. This paper addresses this by operationalising an approach, based on the notion of translucence, to understand teachers' practices and data needs.

3   Approach

Erickson et al. [12] coined the term *social translucence* to articulate three interconnected principles: *visibility*, *awareness* and *accountability*. Authors were particularly interested in designing *'social infrastructures that make collective activity visible'* (p. 40). *Visibility* is the most basic principle and entails the capability of clearly seeing relevant information about a specific activity. *Awareness*, which rises from *visibility*, encompasses a well-informed understanding of a visible situation in order to make evidence-based decisions. Finally, *accountability* refers to a series of *'norms, rules, and customs* [that] *become effective mechanisms for social control'* ([2] p. 62), thus making people accountable for their own actions as a result of sharing their data with others.

Echeverria et al. [10] applied the concept of translucence to provide an approach to model data captured from face-to-face collaborative group work in the context of undergraduate nursing. Authors gathered multimodal data and structured interviews with some of the students based on the three key aspects of *translucence*. By integrating multimodal traces emerging from people-artefacts interaction, as per the *visibility* principle, students re-constructed their activity and identified themselves by linking the evidence presented in a timeline with their personal experience. The principle of *awareness* enabled students reflect on their performance, individually and collaboratively, and identify the actions that would contribute to enhance their performance. Being questioned about *accountability* provoked discordant opinions by students in relation to who should have permission to access the information and for what purpose(s). Authors though did not provide a more general methodological approach about how the system can be designed considering the concepts of translucence.

Inspired by this, and previous work in the area of Interaction Design in which the notion of translucence has been applied to elicit information needs (e.g. [28]), we propose the learning-centred translucence approach to generate understanding of teachers' data needs, which includes three phases:

1- **Generative phase**. Based on the notion of generative design [33], the first step is to enable participants to externalise their ideas without constraints to understand the data-evidence needs of educational stakeholders. Generative design tools (e.g. see toolkit in [33]) or *'tools for dreaming'* can be used to ask participants to externalise what aspects of their learning and teaching practice should be made more *visible*. For example, in LA some authors have asked teachers for the 'superpowers' they would like to have in the classroom when designing dashboards [18]. Directly or indirectly addressed goals or questions include: *What information is currently available (**visible**)? How the information should be made available? What kind of metrics would be interesting to see?*

2- **Norming and prioritising phase**. Generating many ideas can bring decision-making challenges in the elicitation process. A converging phase is needed which includes *norming*, in allusion to the need for assessing and categorising ideas [29]; and *prioritising*, which involves ranking the most critical ideas or data needs to act upon [6]. Norming can be achieved by finding ideas that are related, defining categories and identifying outliers. Prioritising can be achieved through techniques such as voting, ranking or SWOT analysis.

3- **Translucence elicitation phase**. The last phase (which does not need to be conducted consecutively as the other two) is directly related to understanding participants' data needs through the lens of the principles of *translucence*: visibility, awareness and accountability. Questions that can be directly or indirectly asked include: *Which information is needed to create well-informed understanding (**awareness**) of the learning activity? What information would be useful to have before/during/after the learning activity? Which information is needed for every role to be held **accountable** for actions? Who*

should look at the information? Should the data be made available to different roles (e.g. novice teachers, students)?

The next section illustrates our approach through a short design sprint with teachers talking about classroom data.

4 Study and Analysis

This section presents the context of the illustrative study, an instantiation of our approach in the form of a design protocol and the analysis of the design sessions.

4.1 Context and participants

A short study was conducted in the context of a post-graduate program of teacher education, i.e. Master of Teaching, in a large metropolitan university. Participants were six mature aged female pre-serviced high school English teachers enrolled in the unit of study *English Teaching Methods* which focused improving teachers' knowledge of the English curriculum and their digital skills, including evidence-based teaching. Participants had just returned from a recent six-week placement in real classrooms. The coordinator of the unit of study organised, as part of the regular classes, a 50-minutes participatory workshop on the use of evidence, based on participants' previous experience. Two researchers collaborated with the coordinator to use the translucence approach to script the session. The study obtained ethics approval (UTS ETH17-1415) and all participants consented to being audio-recorded and collecting artefacts from the session.

4.2 Design protocol

Participants were divided in two groups of three teachers each (T1-3 in group A and T4-6 in group B). They were provided with markers, and a block of post-it notes each of a unique colour to identify participant individual contributions; and stickers. Two researchers and the coordinator of the unit facilitated the workshop. The procedure included the following three tasks:

Task 1. Individual brainwriting (25 minutes): The coordinator and one researcher introduced the topic by asking the following question: "*What aspects of the classroom or the learning activity happening in the classroom you would like to make more visible?*" to encourage teachers to talk without any constraint. The brain writing technique [20] was used to trigger individual creativity. Teachers were asked to individually, and in silence, write down as many ideas as possible (minimum three) responding to the above question.

Task 2. Sharing and norming (15 minutes): Teachers, within each group, were asked to discuss and further explain the rationale behind each idea to other members of their group. Participants could cluster similar ideas and identify unique ideas (e.g. see Figure 1). Each teacher was then asked to vote for the best three of all the ideas generated (see green dots in the figure).
Task 3. Plenary discussion (10 minutes): The two groups joined in an un-structured group discussion about classroom usage, accountability and potential privacy concerns.

The conversations within each group (Task 2) and the plenary discussion (Task 3) were audio recorded and transcribed

for further analysis. The researchers took pictures of the final outputs of the participants and each of the ideas generated.
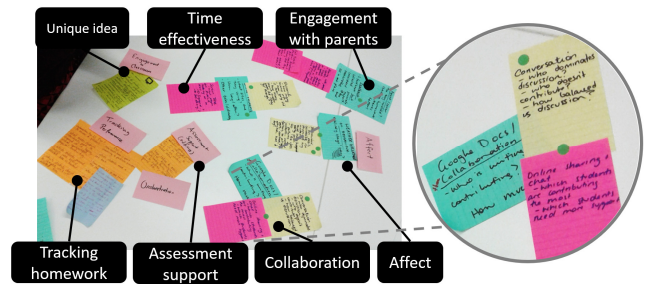

Figure 1: Some of the ideas generated and categorised teachers of Group A.

4.3 Analysis

The analysis was divided into two parts. The first part consisted in organising the ideas generated during the session. Only Group A clustered their ideas into categories (see Figure 1). Immediately after the design session, a post-hoc debrief was performed by two researchers who conferred to cluster the ideas from both groups using the affinity diagram technique [18]. The categorisation (based on categories proposed by Group A) was latter examined by the authors of this paper who had several discussions to generate the idea map presented in Figure 2.

The second part of the analysis was conducted with the purpose of illustrating the proposed approach. The sessions were analysed using the pre-defined codes in relation to the three principles of translucence: visibility, awareness, and accountability. Given the direct alignment between the study protocol and the analysis themes, statements of interest from the transcripts were jointly coded [2] by the same two researchers. Resulting coded statements were then examined by the authors of the paper who discussed and selected instances that effectively illustrate teachers' perspectives on the evidence they need for making better-informed decisions.

5 Results

This section presents our findings organised according to three principles: visibility, awareness and accountability.

5.1 Visibility

Visibility refers to the capability of seeing relevant information that enhances people's understanding of the activity under scrutiny. Figure 2 presents an overview of the categories that emerged from the ideas generated by teachers about the evidence they would like to *see* to support their teaching. The branches in the figure represent sub-categories, and the leaves quote the ideas as they were written by teachers. The final categories were related to the following aspects: tracking students' (reading and writing) behaviour, collaboration, affect, engagement, orchestration, learning modalities, feedback and assessment. The first three categories received a high number of votes and are emphasised in Figure 2 (in blue).

Tracking (reading a and writing) behaviour emerged as an important overarching theme in terms of visibility in both groups, at individual and collective levels. *Time/effectiveness*, *research* and *homework* appeared as sub-themes. For example, in relation to homework, teachers wanted to gather information about what resources students were reading during the process of completing a certain task, how much of a set text they read, which students completed their homework, when exactly students completed it and, finally, which students struggled to complete the work within the allotted time. T4 highlighted the above ideas as it follows: "*[it would be great to] have some kind of log as to where kids are in their studies, how many pages have they read this week, which page they are actually on, so you can build a lesson around. Having that kind of analytics to see where exactly your class would be particularly useful. It is something that analytics would do it for you*". T2 provided a more specific opportunity for making evidence of student's learning behaviours visible as follows: "*I use google classroom to allocate tasks. You can then see which students accessed certain tasks and those who have submitted it*". These quotes suggest the importance of *making visible* students' current behaviour and certain aspects of the classroom to be able to monitor them.

This brings design implications as to how teachers can usefully adopt this information to orchestrate their teaching practice and build a lesson around students' needs. It appears that once teachers have relevant data, they may be able to better support students' learning experience, personalise their learning and develop more efficient teaching practice by leveraging what some LA tools can do rather than manually doing "*at the expense of teachers' time and effort*" as T4 added.

Collaboration was another important theme in relation to group class activities. Teachers indicated they would like to know which students collaborated, to what extent they collaborated, or whether they pretended to be collaborating. T1 reflected on this as follows: "*there is a lot of group work and one of the big problems is that students complain: 'oh, I am doing all the work, he does not do anything, am I going to get a different mark [...] but for me, as a teacher, I can't check. It would be useful to have a function [that tells me if] they are collaborating and who has done most of the work*". A teacher also indicated the importance of detecting unwanted behaviours such as free-riding as follows: "*[I would like to see] if they mock around and*

they write stuff and delete it, and they mess around, and you can't check... [it would be great to know] who is doing little work and who is not and why*" (T5). Teachers were also interested in monitoring who dominated a discussion. For example, Teacher 3 mentioned the following: "*[it would be good to know] who dominates the discussion or how balanced the discussion is*". When discussing about students' *Engagement*, teachers agreed that it would be useful to make student engagement level visible. T2 stated she would like to gain understanding of a number of aspects such as "*screen time; what pages are students looking at; are they engaged or are they socialising*".

In sum, teachers pointed at aspects that are for them critical. Notably, although they mentioned some specific tools (e.g. Google docs/classroom), much of the evidence they want was not tied to a specific platform or physical learning space (e.g. online platforms, the classroom, home) and interaction modality (e.g. text, verbal communication or contributions in a specific system). Moreover, teachers wanted to see how external factors, such as the weather or individual experiences, may impact affective states of some students or their whole class. From a design perspective this is important since a LA innovation tied to a specific educational tool would weakly support teachers' authentic needs, or at least not their most urgent data needs. This confirms the importance of human-centred approaches to understand the design space for a LA innovation and identify the problems that should be addressed first.

In the next section, we describe how teachers articulated the actions they would take as a consequence of seeing aspects of the classroom that they cannot currently see.

5.2 Awareness

Awareness entails a well-informed understanding of a visible situation. A system can endorse visibility but make it hard to support awareness [11]. This means a LA system may effectively summarise and show activity traces, but teachers may not be able to gain a deep understanding of their meaning in educational terms in order to make these data actionable. This difference became evident for teachers that discussed about *Support*. Teachers highlighted how they would proceed having information about the writing skills of their students.
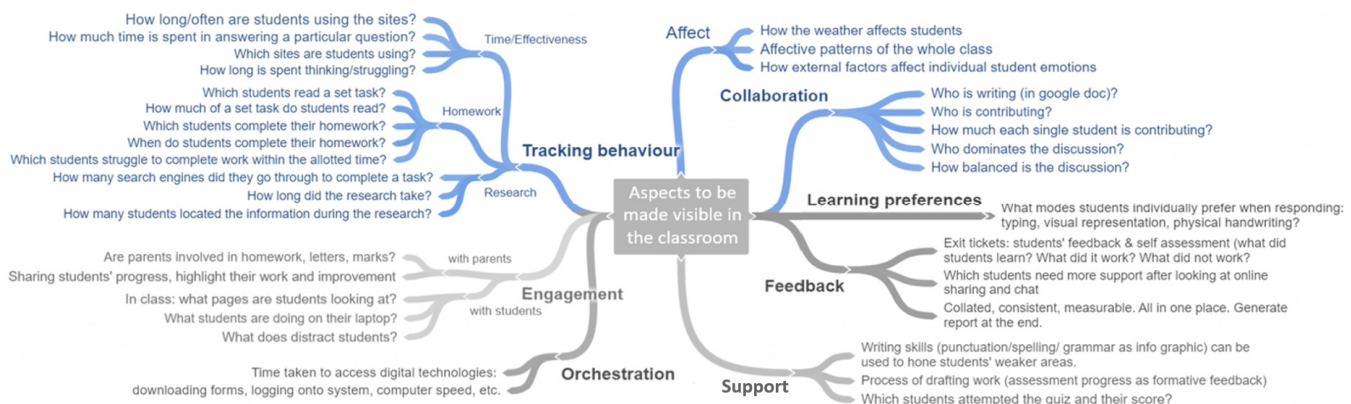

Figure 2: Map representing some of the aspects that teachers in the workshop would like to make visible in the classroom.

For example, T4 explained this as follows: "*[it would be useful having information about] writing skills, such as punctuation, spelling, grammar as an infographic, [to monitor] the struggling [process] and their writing skills, (if you can see that) they can't spell these words … you can tell them how to work on their grammar and we can focus on the story, on the narrative. We spend so much time editing*". This kind of reflection articulates not only what can become visible but also what a teacher can do with such information. Another example was illustrated by teachers who talked about data to assess collaboration. T5 discussed her idea of "*online sharing chat [to identify] which students are contributing the most and which are contributing the least*". This idea was further expanded by T4 who foregrounded the value of online sharing chat for making teachers aware of those "*kids who do not contribute in class but do contribute online or vice versa*".

From the above quotes it can be inferred that by making students' information visible teachers may (or may not) be able to formulate strategies to help teachers more effectively by discerning what are the weaknesses and strengths of their students. When teachers talked about evidence needed to support the assessment of writing and collaboration skills, they were able to articulate what data would be needed and also what higher-order constructs they would be able to assess.

5.3 Accountability

Accountability is about the implications of sharing educational data on teachers' or learners' responsibility. For example, T2 referred to the importance of an "*exit ticket (of) what students learnt*" as a form of self-assessment which would help them reflect on their progress. As such, a self-assessment worked as a tool to make students accountable for their learning. T6 indicated: "*[it would be useful to] see the progress of students' work, not in a summative but in a formative way*".

T5 highlighted the importance of making visible some form of evidence of students' work, so they can demonstrate the progress besides the final outcome of their own work: "*They do not have to submit the draft to me but I want to see the work they are doing and that they know I can see how much they have done*". The above quotes suggest the potential of information about students' progress for students to reflect on their work and be responsible for their learning process.

Another aspect that emerged was teachers' responsibility in supporting students using evidence to help them construct their own knowledge ethically. For example, T6 explained: "*students may be in a group task and be distracted. You as a teacher do not want to control… say no to youtube … knowing whether they are on task, it is not control but you are not on task… You do not want to limit it, but you want to encourage good behaviour*". The latter quote illustrates the persistent tension between monitoring practices for educational purposes and potential privacy issues. It also suggests that when teachers are confronted to talk about accountability, privacy and ethical issues can immediately appear in the discussion.

6. Discussion

Wise et al. [34] suggested that the LA community needs to move from the analysis of low-level data alone, to the mapping from activity traces to educationally meaningful higher-order constructs that educators and students can understand. In the ideation and discussion workshop with teachers presented above, teachers mostly referred to constructs that are meaningful for their own practice. By articulating the kind of evidence that would be useful to support their practice, teachers referred to learning happening in multiple places with students interacting with other students or with artefacts directly or through multiple tools. This suggests the need for LA innovations that consider learning happening across different physical and digital spaces, which is very underrepresented in the research agenda of the LA community (see recent discussion in [24]).

Teachers also emphasised the need for meaningful evidence beyond counting clicks and session logs. This emerged particularly in discussions about *Assessment* and *Collaboration*. For example, the *Collaboration* branch in Figure 2, ramifies into more specific leaves, such as *Contribution at an individual level*, *Dominance*, and *Balance*, which are sub-constructs of collaboration (e.g. they can become branches pointing at different sources of evidence). For example, teachers referred to some evidence they would use to assess individual contribution (e.g. logs from a google document). However, they also articulated interest making evident which student plays a dominant role or how balanced collocated discussions are.

This points at recent conceptual research aimed at trying to create a mapping between traces of activity (such as both the presence and content of the communication between team members and individual contributions) and higher constructs of teamwork [10]. Much more work is needed to create infrastructure that can automatically perform this mapping, but we also need methodologies to understand the pedagogical implications of such mapping.

In sum, the small workshop analysed through the notion of 'translucence' enables to make a distinction between making salient aspects of activity just **visible** (e.g. just visualising data) and communicating insights that are pedagogically relevant (**awareness** of the meaning of the underlying data). While there are several guidelines that suggest different strategies to ensure the ethical use of LA systems (e.g. [9,32]), **accountability** is a concept that can be enable discussion about the form and purpose of disclosing data to different stakeholders. We envisage that guiding the discussion of stakeholders' in terms of accountability for LA design can provoke deeper discussion about the ethical dilemmas and productive uses of student data.

7. Conclusion, limitations and future work

In this paper, we propose a human-centred approach that provides designers and researchers the means for generating a deeper understanding of how specific cohorts of teachers talk about their data needs through the lens of three key principles of *translucence*: visibility, awareness and accountability. The approach is generic and includes three steps: 1) a divergent

ideation phase to provoke reflection on current and potential evidence-based practices; 2) a convergent phase to narrow down the design space and prioritise ideas; and 3) a phase in which stakeholders are directly prompted to think in terms of higher-order educational constructs and how evidence provided by LA systems can promote students' accountability. The order and the specific ways in which these phases can be enacted by others should be adapted to the particularities of their learning context and design goals. This is a common practice in design disciplines in which design processes are not rigid and give freedom to designers to take the best aspects of a co-design methodology.

The qualitative study has limitations. The study served to illustrate how our approach can serve to elicit teachers' perspectives on data based on their current practice. It also illustrates how by letting teachers to freely ideate on potential ways in which the use of evidence can enrich their teaching, LA designers can gain a better understanding of the actual needs that would most likely go beyond the use of a single LA system. Moreover, the converging task allowed teachers to prioritise specific topics and elaborate on them in terms of higher-order constructs (such as the assessment of writing and collaboration in our study). However, more work needs to be done, besides this single small study, to propose and evaluate more robust human-centred methodologies in LA. Similar approaches can be followed to engage students in the co-design process of LA innovations, which is work we are conducting in parallel [31]

The ultimate aim of this paper is to provoke productive discussions around the need of design methodologies, particularly tailored to craft LA innovations, to shape LA as a learning-centred discipline. We envisage that more human-centred approaches will emerge in the near future, as evidenced by the recent interest in human-centred learning analytics [3], which will contribute to shape the future of the field.

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