Mapping Learner-Data Journeys: Evolution of a Visual Co-Design Tool

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ABSTRACT

In this paper we present a three-phase process for crafting Learner-Data Journey maps and using them as communication tools to involve other stakeholders in the co-design of a data-intensive educational tool. The three phases in this process are i) scaffolding groups of learners to collaboratively co-create a Learner-Data Journey based on their own experience, ii) distilling key insights from these journey maps, and iii) providing the means for multiple stakeholders to integrate and synthesise key insights from these journey maps to suggest design requirements. We illustrate the process and the kind of tools that can support the co-creation of Learner-Data Journeys in two educational scenarios where learners have become partners of their own 'surveillance'.

CCS CONCEPTS

• **Human-centred computing → Collaborative and social Computing**; Collaborative and social computing design and evaluation methods

KEYWORDS

User journey, Co-design, Educational technologies, Participatory surveillance.

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1 INTRODUCTION

There is a growing interest in supporting data-informed decision making in educational contexts. Data-intensive educational innovations (also known as *Learning Analytics)* are attracting the attention of researchers, designers and practitioners as means for enhancing evidence-based formative or summative assessments [3, 7]. Some of these innovations have been used for providing personalised learning experiences [29], tracking learner improvement [13]; promoting reflection and metacognition [8, 26]; and better understanding social aspects of learning [8]. However, there is a growing concern that most of these emerging learning analytics tools are not aligned with the educational context where they will be used by learners or educators [12] Although it is getting common to find data-intensive technologies into the hands of learners [5], their design has mainly relied on consulting educators [9], and sometimes learners themselves [20, 28] via interviews and surveys. This may be a good start for integrating learners' voice in the design of the interfaces they or their educators will use, but *consultation* alone may fall short if the intent is to involve learners and other stakeholders in the design process as active collaborators [14].

From a user experience (UX) perspective, there is a body of research and development (R&D) work that has focused on generating understanding of people's needs and making end-users into partners in the design process. R&D in human-centred design areas, such as Participatory Design [24], Co-design [14] and Design Thinking [4, 15], have proposed a range of methods and techniques to facilitate user inclusion [25]. It is thus sensible to expect that participatory tools may provide with practical means to bring learners into the design process of data-intensive solutions aimed at supporting teaching and learning. However, researchers and designers of educational technologies may find particularly challenging to understand the different scenarios where learning commonly happens or is intended to occur, and to extract and communicate insights to stakeholders (e.g. teachers, learners, administrators) in an understandable way [11]. Particularly, gaining understanding about *places*, *timing* and *actions* associated with learners' experience is important if the goal of the technological innovation design is to provide feedback to learners where and when they need it.

User journey mapping is a visualisation technique that has been widely used for representing the process that a person goes through to complete a certain task (e.g. a customer in a store wanting to buy some products, or a user interacting with an interface to accomplish a goal) [10]. This visual representation is commonly crafted as a timeline of events or steps by a facilitator, based on feedback collected systematically (via observations, interviews, focus groups, etc). As a result, the technique usually

*Produces the permission block, and copyright information
†The full version of the author's guide is available as acmart.pdf document
[1]It is a datatype.

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serves to identify users' *places*, *stages* and *actions* while engaging in an interactive process. The aim of designers in using journey mapping commonly is to generate understanding of people's needs and *'pain points'*.

Inspired by the use of user journey maps in other contexts, we introduce the notion of *Learner-Data Journey* as a collaborative mapping tool for understanding the context in which learning happens (the learning spaces, and the main stages in the learning processes) in order to discover data interaction opportunities. In this paper we present a three-phase process for crafting Learner-Data Journeys and using them as communication tools to involve other stakeholders in the co-design of a data-intensive educational tool. The three phases in this process are the following:

- The first phase (divergent) consists in scaffolding groups of learners to collaboratively co-create a Learner-Data Journey to externalise situated aspects of their experience in learning spaces.
- The second phase (transition) step consists in distilling key insights from these journey maps.
- The third phase (convergent) consists in providing the means for multiple stakeholders (educators, researchers, and learners themselves) to integrate and synthesise insights from the journey maps to suggest design requirements.

We illustrate the process and the kind of tools that can support the co-creation of Learner-Data Journeys in an educational scenario in which learners have become partners in designing for their own 'surveillance' [1] in which their activity is being tracked, and fed back to (for instance) themselves, peers and educators. In short, the contribution of this paper is the *mapping process* and two associated tools (*Learner-Data Journey templates* and an *interactive journey explorer*) that serve i) to represent and generate understanding of learners' concerns about learning and data; ii) as communication tools to share insights with other stakeholders to support further ideation and design decisions.

The rest of the paper is structured as follows. Section 2 presents related work, the foundation of user journeys, and their application in education. Section 3 presents our Learner-Data Journey process and two associated tools. Sections 4 and 5 describes an illustrative study conducted with learners and other stakeholders crafting and using the tools we propose. The paper concludes with some recommendations and discusses opportunities for future work in Section 6.

2 BACKGROUND

2.1 Foundations of User Journey Mapping

User journey mapping has become popular among practitioners when it comes to representing user actions occurring in different spaces and across time. A journey map is a visualisation that represents the process that a person or group of people go through in order to accomplish a goal tied to a particular situation in a specific context. When applied in early stages of the design process, user journeys can provide practitioners and stakeholders with a resource to enhance context awareness by combining storytelling and visualisations. Complex versions of user journeys can also be used for collaborative ideation as generative probes that allow users to describe their personal experiences [18]. The intended outcome of a user journey is to summarise paths and current experiences as a map for other stakeholders to identify pain points and opportunities for supporting interaction [16]. These tools have mostly been used for customer experience design (e.g. to understand how costumer moves through the process of first-time engagement into a long-term relationship). Journey maps are commonly crafted by a facilitator [10], sometimes, in collaboration with the intended users [6].

2.2 User Journeys for Learning

Educational contexts are good examples in which learners commonly become active users of many technological innovations but are rarely involved in the design process of them. Involving learners in the design process requires for facilitators to put emphasis on providing practical tools that not required special training, also, they must deal with the intrinsic problems of communications between teachers, learners and developers.

In education, there are only a few examples in which user journey mapping has been used as a representation tool and as a shareable object to facilitate communication between the design team, academics and developers. IDEO [11] proposed a design thinking toolkit for educators in which journey mapping was suggested as an effective tool for identifying critical pain points that learners may commonly face while engaging in learning activities, However, no attempt was made to involve learners as collaborators, making this a map aimed at supporting the designers or teachers as designers. Other examples in education include user journeys being adapted to support learners to reflect on time and money required for their academic projects [23], or as templates to track the cost-benefit trade-offs of the different courses that can be part of their degree [22]. Journey mapping has also been used for marketing purposes for academic institutions to improve the processes for learners to select units of study and pay their tuitions [17].

Most of the examples listed above have reported cases in which journey mapping was used by the design team to better understand learners' activities. In most cases, the final journey maps were entirely crafted by the facilitator without involving learners. A notable exception of this is reported by Montero [22] who proposed a template for learners to generate their own journeys in terms of their curriculum pathways. The other cases mostly relied on questionnaires and interviews as the main resources to collect evidence to build the journey maps.

Our work goes beyond previous work in two ways. First, we specify a process for co-designing journey maps with learners to identify the opportunities of interaction that learners could have with future intelligent feedback systems that exploit digital traces of learners' activity. Second, we report the design and evaluation of a method and support tool for integrating these manually sketched maps into an interactive synthesis map, designed to enable stakeholders to explore and discuss the insights that the design team has discerned from the consultation.

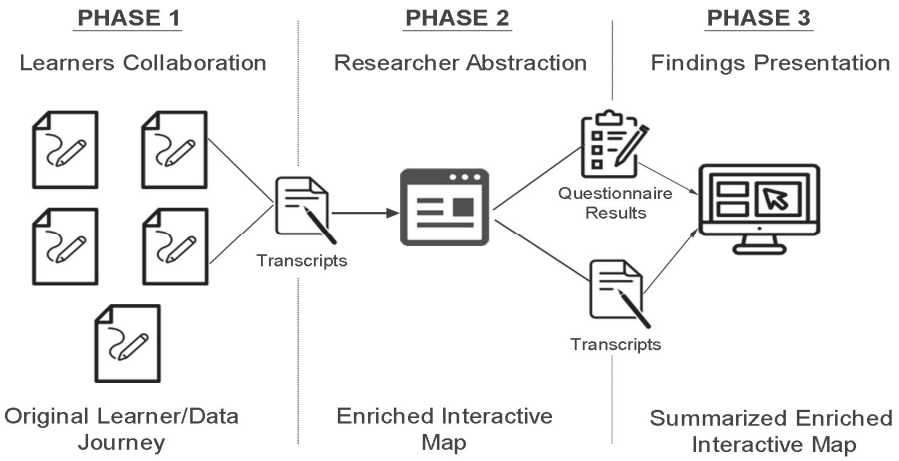

Figure 1: Generating a summarised enriched interactive map from single design journeys.

2.3 Co-designing for Participatory Surveillance

Quite apart from the well-established arguments for co-design, in the context of growing concerns around privacy and opaque analytics algorithms, there is a strong case that data-intensive educational technologies should be co-designed with learners and educators [14, 19]. Design research in learning analytics has identified that new tools need to be crafted and used to co-design or co-create innovations that consider both the pedagogical aspects of learning, and the particular implications of dealing with data about learners [19]

A concept that resonates with the idea of co-designing for data-intensive learning technologies is that of Participatory Surveillance [2, 21]. This concept proposes that data-intensive solutions, subject to surveillance methods, should be designed with the people who are going to be tracked, rather than solely by any third party. In other words, this concept aims to integrate people in the co-design of their own surveillance. Until now there is not much work done in co-designing for learning and for analytics (learner surveillance) with learners themselves or other stakeholders. Our work contributes to this line of research by positioning learners as active users in a horizontal relationship with designers/facilitators and the tracking and analytics technologies.

3 APPROACH

In this section we describe the process to collaboratively crafting Learner-Data Journeys with learners, distil insights from them and communicate these to other stakeholders. The aim of this process is to generate understanding about *places*, *timing* and *actions* associated with learners' experience in order to formulate potential data-intensive educational analytics solutions.

For a new field like learning analytics, the journey mapping technique may offer some flexibility to generate understanding about the pain points of learners. However, we propose that designers of these innovations require this technique to include specific dimensions associated not only with educational aspects (e.g. understanding how learning unfolds in the learning spaces, conditions under which learners may struggle, or situations in which learners' motivation may be undermined by certain pedagogical decisions), but also with data (e.g. detecting opportunities for learners to receive automated feedback, what kind of data they would like to see, or whether they would feel comfortable to share the data with others).

Figure 1 depicts our proposed three-phase process for crafting Learner-Data Journey maps and using them as communication tools to involve other stakeholders in the co-design of a data-intensive educational tool. The three phases in this process are the following:

i) **Co-designing Learner-Data Journeys with learners**. This phase involves scaffolding groups of learners to collaboratively co-create a Learner-Data Journey based on their own experience using a template and other associated tools

ii) **Synthesising Learner-Data Journey insights**. This phase consists in distilling key insights from these journey maps

iii) **Communicating insights and converging to make design decisions.** This involves providing the means for multiple stakeholders (educators, researchers, and learners themselves) to integrate and synthesise insights to suggest design requirements.

3.1 Phase 1: Co-designing Learner-Data Journeys with Learners

This first phase is divergent. The aim of this phase is for learners to engage in explaining their own learning experience in the form of a Learner-Data Journey. This can be a piece of paper where learners can draw. It can also involve a scaffolded process to ensure that relevant information is being captured for designers or other stakeholders can make sense of it. The scaffolded map construction should ideally be delivered in face to face co-design sessions. In these sessions, learners can start by responding to simple questions about their usual activities and actions performed during their classes. Being a collaborative task, participants can discuss the different ways in which students perform their activities and how data could help them reflect on such activities. Learners can be asked to represent their paths explicitly by using distinct colour markers, sometimes disagreeing with other

participants but always giving enough context for researchers to understand in post-hoc analysis sessions.

For a Learner-Data Journey to be useful, details of data interactions, learning scenarios and descriptions should be highlighted by learners, providing enough details on what each path represents. This should be scaffolded by using a template (see case study for an example in the next section) to delimit the area for marking and critical learning spaces that are meaningful according to the educational context.

The resulting Learner-Data Journey objects can be seen as descriptive snapshots of what happens during a class or learning session. This phase is divergent because the maps should portray how learning experiences vary across situations and for different learners. Each learner can bring a different perspective not only because each one is different, but also because each may face different teacher, tutors or learning situations. This is particularly the case of higher education. However, although it may be helpful to collect as many journeys as possible, researchers should consider adopting a careful recruitment strategy, prioritising diversification over quantity, to reach saturation and reach consensus of the most critical issues that may arise. At the very least, more than one collaborative session with three or more learners should be run to get different perspectives.

Since not everything can be mapped into the Learner-Data Journey, conversations during the activity can be recorded for further analysis. Recorded conversations between participants and the facilitator can be used to enrich the final journey map with valuable information to reconstruct what learners said while building the map.

3.2 Phase 2: Synthesising Learner-Data Journey Insights

Conducting multiple sessions with learners can produce different Learner-Data Journeys and a significant volume of information. Feeding findings back from these journeys to other stakeholders requires for facilitators (commonly designers or researchers) to summarise key information in such a way that the context remains presented. The role of the facilitator should thus be to develop one or more representations that summarise learners' input without decontextualising the information and communicate critical insights. We suggest that this phase is critical in any participatory endeavour.

A framework that can be used to craft effective representations of people knowledge is that of Knowledge Art [27]. This framework had been proposed to help facilitators to guide participants in creating representations of issues or ideas, such as collaborative diagrams, especially in the context of Participatory Design. In short, this paradigm highlights that facilitators also have a voice in the participatory process. Similar to participants themselves (e.g. learners in our case), the experiences of the facilitators and interactions between facilitators and participants, can strongly influence the creative ways in which the representations of participants' knowledge can be crafted.

The synthesis of the Learner-Data Journey may thus involve the generation of a coherent narrative, and consideration of other elements such as aesthetics, ethics, and sensemaking. In this paper, we focus on the narrative that is added to the different isolated Learner-Data Journey maps to provide them with coherence to be presented to other stakeholders and to distil critical insights from them. This process should not only consider the original maps crafted by learners but also the video recordings, and transcripts to understand how these were crafted (see Figure 1, transition between Phase 1 and 2).

3.3 Phase 3: Communicating and Converging to Make Design Decisions

This phase is focused on convergence. The synthesised journey maps can be further enriched by integrating other sources of stakeholder input that could assist interpretation (i.e. any contribution not recorded in the original journey maps). Using coding schemes and affinity diagrams may help the facilitator to link transcriptions with the main interest of stakeholders in Phase 2. For example, in the study presented in the next section of this paper, we used the KJ method to build affinity diagrams by: 1) identifying key individual challenges that students may face during their learning experiences, and 2) establishing possible relationships between them. Since participants come from diverse backgrounds, they may find interest in the different abstraction levels provided. We describe how this phase can be operationalised in the next section.

4 STUDY

4.1 Learning Context

An authentic study was conducted to instantiate our proposed process to co-design Learner-Data Journeys and use them to distil insights and make design decisions with educators and learning designers. This study was conducted at the Faculty of Health in the University of Technology Sydney. The study was part of a project aimed at building an automated learning analytics tool that can provide immediate feedback to nurses in the classroom while they engage in healthcare simulations. During these simulations, learners need to enact practical skills through simulation-based sessions interacting with training equipment such as manikins and hospital-grade equipment. Some of these scenarios are quite immersive, involving reacting in a life-threatening situation to save a simulated patient. The regular classes are conducted in classrooms that are equipped with several hospital beds where patient manikins are placed. One section of the classroom looks like a regular classroom, but the other half simulates a hospital room (see Figure 2 for an iconic representation).

Following a co-design approach, participants were invited to multiple sessions with the intention of understanding the current challenges faced during the sessions. Participants in this project required to be part of the nurse program or familiarised with the current learning design behind simulations. Participants included:

- **Learners (L)** currently enrolled in the bachelor's in nursing program including new and senior learners.
- **Teachers (T)** who have been mentors/tutors in any simulation classes.

- **Learning designers (LD)** responsible of giving structure to the pedagogic content and strategies followed during classes.
- **Designers (D)** responsible of developing the automated feedback tool and relevant prototypes.

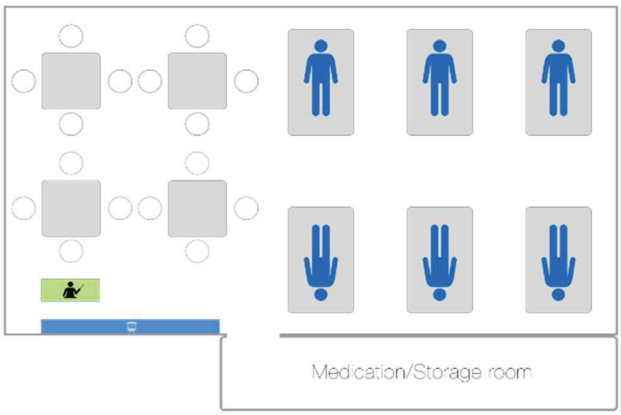

Figure 2: Template used for learners to describe their journey during a learning activity.

The common learning design across simulation-based classes is structured within 3 main parts:

1) introduction/demonstration, in which tutors provide theory behind the practice and instructions they should follow;
2) practice/simulation, which requires learners to distribute the relevant roles to play and practice using the equipment available including mannequins; and
3) debrief/reflection, in which learner commonly receive some feedback on their performance and reflect on how their team did.

The next sub-sections provide details about each of the phases of the study where Learner-Data journeys have been used to generate understanding on the current challenges faced by learners.

4.2 Phase 1: Crafting Learner-Data Journeys

The first implementation of Learner-Data Journeys as a co-design tool was deployed in a study involving 15 learners, as participants. Learners were aged between 18 and 26 years. Eight learners were enrolled in the second year and seven learners were enrolled in third year of their 3-years Bachelor of Nursing degree. Learners participating in the co-design sessions were distributed into 5 groups of three nurses each. In this first phase, learners were asked to form groups and participate in a structured focus group session, a collaborative Learner-Data Journey design session and they were asked to fill a questionnaire to collect further information.

Figure 2 shows a journey template that was provided to learners, representing the learning space (in this case, a simulated ward with manikin patients in beds). Each group used the template provided and drew the trajectories they commonly follow during the class. Thus, this represents the sequence of the tasks or idle time, in the physical space. They were asked to use stickers to represent feelings, locations where they want to receive feedback, critical actions they perform in the spaces, and what data they would like to have captured. Table 1 summarises what kind of iconic representations they were asked to use to represent their learning experience.

The purpose of giving pre-defined stickers in this case was to help learners with the complicated task of drawing actions or defining specific medical equipment. It also provided a standard method for further analysis since the same emoticon has the same (or similar) meaning across sessions. Learners were free to use their own annotations for actions, feelings or aspects not represented in the set of predefined stickers.

Table 1: Stickers to annotate the journey that were used in the study presented in this paper.

Meaning	Stickers
Emoticons Feelings at particular points of the learning process, e.g. happy, neutral, frustrated, doubtful.	**Sad** **Happy** **Doubtful** **Frustrated**
Data Collection Interest in data being logged, including audio/video recording, location, movement and interaction with learning content	**Audio** **Video** **Positioning** **Proximity/movement** **Manikin vital signs**
Critical Event Major events that should be noticed by everyone including learning activities, actions performed, and equipment being used.	**Cardiovascular resuscitation** **Defibrillate** **Administer drug** **Check vital signs** **Administer injection**
Analytics Interest in an analytics tool providing automated feedback during the process.	**Look at a dashboard**

Stickers can be placed at the end of specific paths to identify important events. Figure 3 presents an example of a journey map filled by a group of learners. As seen in the figure, multiple roads can be traced over the same map and have different experiences. Some of the learners, in this case, identified the action of sitting on the table at the beginning of the class as a positive experience while others struggled to fit into one group. Notations are placed on the map, but the particular details are being explained in the conversation with the facilitator.

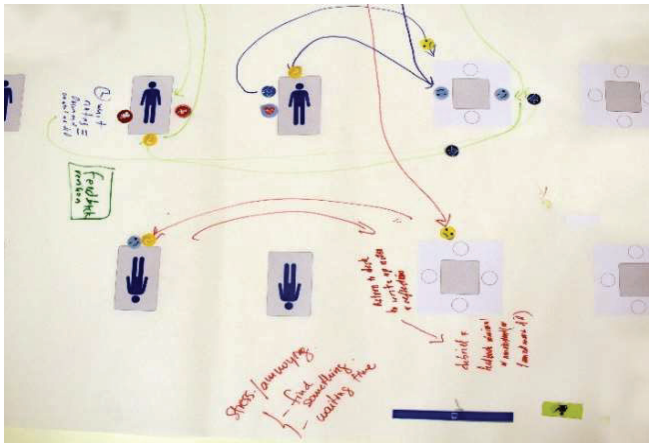

Figure 3: Example of paper-based Learner-Data journey

4.3 Phase 2: Synthesis

Analysing and abstracting data produced from the first Learner-Data journeys require a set of specific themes to look at. These themes include: practice, feedback, analytics and challenges. In this phase, the facilitator can map important statements in the transcriptions with the drawing representations. By following this process, each comment can be linked to specific stages. This allows to add context to the comments mentioned by learners on what commonly happens during a simulation.

The facilitator can look for recurrent themes and comments mentioned repeatedly. From these, some quotes can be extracted and included into the summarised log to be used for the interactive map construction (see next phase). Comments that are not associated with any of the main themes area left in the general transcription log. Since not all learners express the same feeling about the learning stages, the facilitator can provide an "Experience Spectrum" measure line. This object is used to define the overall experience after looking at the emotion icons on the map. Mapping learners' experiences in a linear scale allows the facilitator to track mood changes between stages and link those to the possible reasons following the transcripts.

4.4 Phase 3: interactive map exploration

Our next study required for the facilitator to produce an interactive tool using the summarised information from the previous stage and for participants to evaluate it.

The main objective of this second study is to produce and evaluate the interactive journey tool. This part needed a different set of participants in addition to learners who participated in the first study. The recruitment included two teachers (aged 40 and 50 years) with experience in simulation-based classes and in organising the course structure; two designers (aged 28 and 34 years) who have been involved in designing the process of the automated feedback tool, one learning designer (aged 39 years) in charge of updating and structuring the current course content and two learners (aged 18 and 26 years) who participated in the first study.

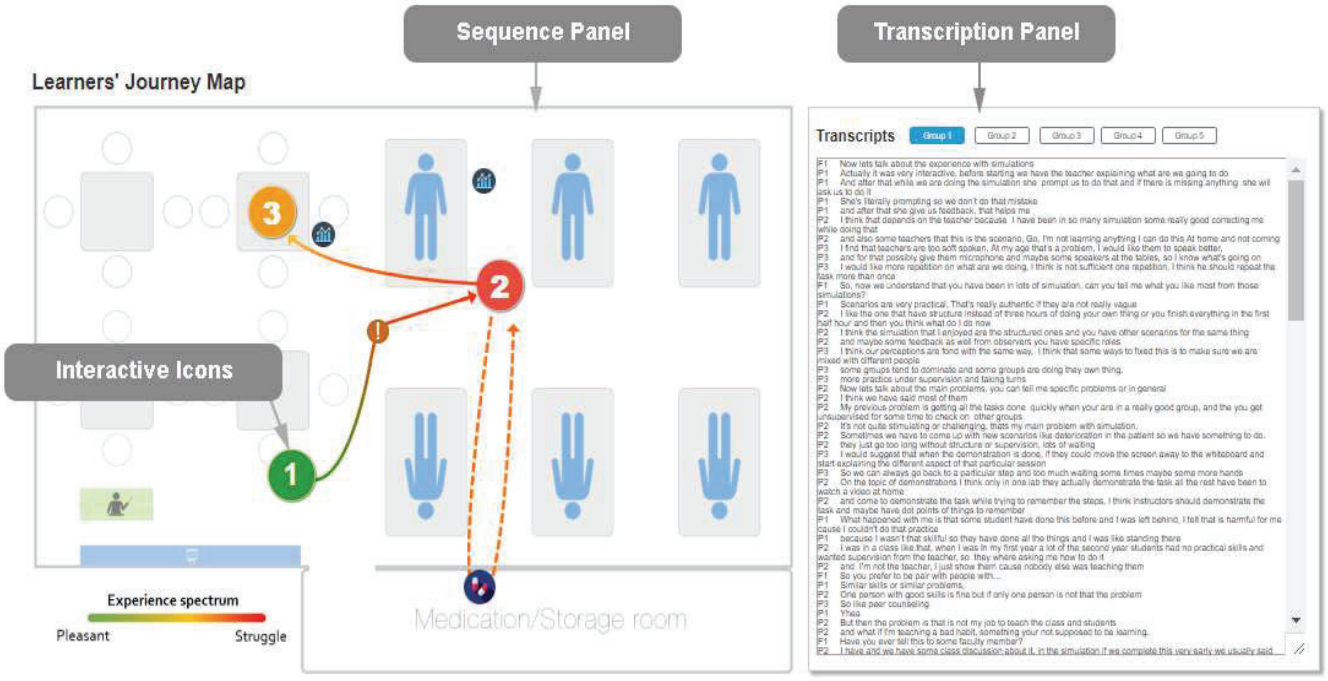

Figure 4: Enriched interactive map integrates learners' annotations with transcript extracts.

Journey maps may seem limited if information is not captured and linked with the source material. To address this, we designed a summarised, enriched version that merges what the facilitator collected from the sessions including video, audio, questionnaires and other media where learners provided some input. Mapping these resources with the Learner-Data Journeys was aimed at providing tutors, designers and other stakeholders a channel for exploration. In this case, the facilitator used a prototyping tool to produce a web-based application ready for distribution among participants (see Figure 4).

The interactive tool links transcriptions to stages described by learners, tutors, researchers and designers. Participants can explore in detail actions described by clicking on each icon. The novelty of using this format is that exploration is being guided by what are designers interested on instead of what the facilitator wants participants to see.

The interactive version provides two panels; the first panel show the sequence of actions summarising learner's paths. The second panel shows the transcriptions related to those particular sections, if required, participants can explore the content per group or per line using the top menu.

Transcriptions are shown in a side panel and react to users pointing at interesting events (Figure 5). Participants do not require to read the full text since the tool takes them to where the quote is being taken for further context. Stickers become icons and are placed in the positions of the journey map in which learners positioned them during the Learner-Data Journey design. The detailed cards show the most relevant quotes and the overall feeling about that stage using the "Experience spectrum" line.

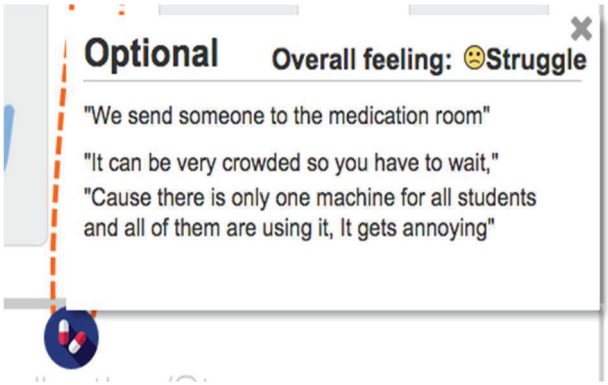

Figure 5: Interactive icons for transcriptions' context.

The protocol followed for the evaluation of this second study consisted in a think-aloud approach through 4 activities for all participants with the following steps:

1) The facilitator explains how the first Learner-Data journeys were built,

2) Participants explore the Learner-Data journeys produced while trying to re-construct the actions,

3) Participants explore the interactive journey map and compare with the initial Learner-Data Journeys and

4) Participants answer a questionnaire evaluation the clarity and usefulness of the Interactive map.

4.5 Analysis Methodology

All the sessions were video and transcribed for analysis using a coding scheme and the KJ (bottom-up) method to generate affinity diagrams on emergent topics. The primary topics used to categorise information were data collection, learning activities, perceptions on getting feedback, and the perceived usefulness of the Learner-Data Journey map. This information was used to generate the summarised interactive map for tutors, learners, researchers and designers to explore the findings and move onto generating a first design.

Next, evaluation sessions were held, exploring stakeholders' ability to understand, explore and reflect on the data collected using the original 1) Learner-Data Journeys (paper) and 2) the interactive Learner-Data Journey. For this test, we invited two learners, two teachers, one learning designer and one designer. The following section shows a comparison and insights on the perception of usefulness of these objects.

5 EVALUATION RESULTS

Results are separated in 3 main categories starting with the insights from generating the original Learner-Data Journeys in the first study, then the contrast between the original Learner-Data Journeys produced and the interactive journey map, and finally a series of observations based on the application of this three-phase approach.

5.1 Evaluating the Co-design Process

Feedback collected from the first phase suggests that the of Learner-Data Journeys were used by the learners without further changes during the co-design sessions. Introducing this new tool into the co-design session did not require additional effort in terms of extensive learning curve or a considerable training time. In terms of perceived usefulness, we spotted 3 benefits in using Learner-Data Journeys: it facilitated open communication, it provoked instant self-reflection and it helped learners to generate understanding of the possibilities of using analytics to support their own learning.

In terms of the role that the Learner-Data Journeys played to facilitate open communication, some learners expressed a positive feeling in being able to communicate their problems to a faculty member. One of the learners stated this as following: *"We never have a chance to talk about these issues besides the short questionnaire at the end of the semester".* This illustrates the potential value of providing a mechanism for learners to have an active voice and a representational language to communicate their learning experiences.

In terms of instant self-reflection, some learners were able to reflect on their current experiences, including common mistakes and pain points that they may share with other learners. One learner expressed this as follows: *"Now I know I'm not the only one having problems with that class, maybe is the teacher".*

Lastly, in terms of the possible role for the Learner-Data Journeys to help learners gain some understanding of the analytics that can be used to support their learning, some learners expressed

being able to better understand how data can be collected and used to create a data-intensive educational tool. One of the learners started to think about the 'correct' uses of data as follows: *"I guess is fine if you only use information from the session"*. A second learner suggested a way in which the surveillance mechanism could be fine if used for the right purposes and under certain limitations as follows: *"I don't mind if you use my information as long as you don't share my name"*.

5.2 Evaluating the (Paper) Learner-Data Journeys

Feedback gathered from the third and second phases of the evaluation study of the original Learner-Data Journeys resulted in contrasting views about how useful it is to revisit these representations. Table 2 shows insights after each code analysis from stakeholders' comments:

As pointed out by researchers and designers, the Learner-Data Journeys helped to better understand what happens in simulations, it also allowed learners to have a voice as a form of contextual enquiry. However, showing journeys to other stakeholders outside the nursing program would require further explanations. Participants described the journey maps as "incomplete" since learners used markers to draw their paths and oral explanations for the details. For example, a learner said *"I know this is the direction because I was there"*. This means that contextual information represented in the maps needs to be decoded in order for people who are not familiar with the context to gain understanding of the activity. This was described by a second learner as follows: *"Other learners may have a problem understanding the icons"*. Even the designer of the learning analytics tool reiteratively asked for the description of the icons. For example, she asked the following question during one of the sessions after being explained the characteristics of the map representations: *"Do you have some description on these icons?"*.

Table 2: Perceived advantages/disadvantages of paper-based Learner-Data Journeys.

Strengths	Weaknesses
Opportunity to have a voice (Learner 1)	Detailed descriptions are missing (Learner 2, Teacher 1)
Identify pain points (Teacher 2)	Hard to identify sequence (Learner 2, Teacher 2)
Visualise opportunities to deliver a first design (Learning designer, Designer)	Requires prior knowledge about simulations (Learning designer, Designer)

We also found out that Learner-Data journeys may be attached to prior knowledge related to the subject or first-hand experiences. Learners found other journey maps difficult to understand besides their own, in most cases using their own experiences to make sense of the actions represented in others' maps. Requiring prior knowledge to understand the current maps may have an impact on how new participants are invited to collaborate. This is illustrated by the confusion of one of the learners in the following statement: *"I remember doing this, but I don't remember what this means (points at emoticons)"*. One of the learning designers that have been in some classroom sessions also stated the following: *"Because I was there I can remember things but for someone else they won't understand."*.

5.3 Evaluating the Summarised Interactive Learner-Data Journey

Table 3 presents some of the feedback gathered from the interactive Learner-Data journey evaluation using two categories: strengths and weakness, based on participants comments.

By exploring the interactive map, tutors and teachers expressed interest in how learners rated the overall experience per stage. While we used a representation based on the most used icons in each event, the fact that participants could corroborate that not all learners struggled in the same place made them reconsider if they are having the same issues. For example, one of the learners explained this as follows: *"I would think that stage 3 was somehow pleasant, I feel kind of relief after the simulation part" (Learner 2)*. One of the learners also expressed the following: *"It's interesting how other learners feel the same" (Learner 1)*.

Table 3: Perceived strengths/weaknesses of the interactive Learner-Data Journey

Strengths	Weaknesses
Able to find similarities between comments (Learner 1, Learner 2)	Difficult to visualise contrast between personal views and other learners comments (Learner 1, Teacher 1)
Able to track the context of the quote being used (Teacher 1)	Unable to explore contrast between overall feeling ratings (Teacher 2, Learner 1, Learner 2)
Able to revisit the conversation where data is being collected (Learning designer, Designer)	

Figure 6 shows the clickstream heatmap of how teachers (in green) and learners (in red) interacted with the tool. Teachers were more interested in seeing the summarised findings through the icons and stages. Learners found interesting the ability to navigate through the transcriptions. In some cases, learners started to look for their own quotes to corroborate if there were not being misinterpreted.

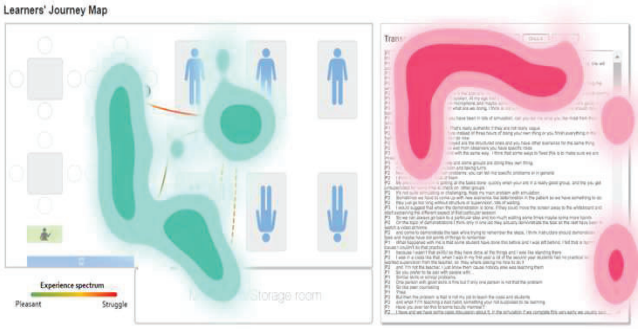

Figure 6: (Green) teachers (red) learners click stream heat map.

Learners also stated that they were are aware that simulations are practical scenarios in a controlled environment. Even when the instructions are the same as the ones used by professional nurses, stress and situational pressure when dealing with a real patient is hard to be re-enacted. This was described by one of the learners as follows: *"It's hard to feel stressed since the mannequin is not that real" (Learner 1).* Teachers also realised that learners commonly do not see the simulation scenarios as real enough, making them reflect in future efforts to improve the current practices. This was expressed by one of the teachers as follows: *"This is rather interesting because the level of stress impacts their ability to do all the other stuff" (Teacher 1)*

In terms of surveillance and data sharing, most learners would not openly share information through social media but are keen to give personal data in favour of getting help. This was expressed by one learner as follows: *"I won't mind sharing my data if that means we are having some feedback" (Learner 1).* Additionally, another learner specified what kind of data they would not like to share, such as those representing errors or potentially embarrassing situations. This was stated as follows: *"I don't want other people to see my mistakes" (Learner 2).* Finally, this learner also mentioned her trust on university's data policies but also hinted that she does not have a good understanding of the data that is being captured about her learning experience, as follows: *"I guess I trust the University, and not sure what information they have about me" (Learner 2).*

Another item to add on this topic is the fact that participants never thought about data privacy and surveillance before being asked through these co-design sessions. Building the maps helped learners to reflect what other sources of data can be used by researchers to build a first design.

Inviting learners to participate in the design of their own surveillance tools not only prompted learners to think about possible design features for a feedback tool, but also to ask question about how algorithms behind the analytics are using their data. Coordinating some strategy to enhance learners' data literacy to a certain level may help the design team to make the process more transparent for everyone. In sum, the Learner-Data Journeys provided an alternative to the usual document "Terms and conditions" that most participants admitted is too hard to understand or too long for them to read.

6 DISCUSSION AND CONCLUSION

Implementing Learner-Data Journeys as collaborative objects still requires adjustments to fulfil practitioners' expectations. Further exploration in different scenarios is required to provide corroboration in other aspects including participants data literacy, knowledge background and experience with technology design. A scaffolded process based on three phases makes the implementation of Learner-Data Journeys understandable for facilitators and new designers without having to generate additional objects. The level of analysis and abstraction conducted in the second phase is linked to how familiarized is the facilitator with the research subject. However, in some cases this will result in biased assumptions on what themes are important and what information should be shown in the interactive journey map.

Learner-Data Journeys have the potential to become into boundary objects for bigger design teams. This characteristic should be tested in future research studies including people from other fields outside the health faculty. Sharing this design object in other settings may enhanced the Learner-Data Journeys presented in this paper following our comments on how design objects should evolve beyond the original stated purpose.

While Learner-Data Journeys are well received by participants, there are some additional constraints in relation to the effort and time for facilitators to build and connect all the information through the different phases. These constraints may impact the adoption of this tool by other designers. A potential way to enrich the Learner-Data Journey of a specific educational context can be to integrate a journey map crafted from observations that could be used to scaffold communication with learners.

At a bigger glance, Learner-Data Journeys can be seen as a first step into a whole design process, For example, information presented by this tool may be useful when identifying the main requirements during the exploration phase of a iteration. Insights from the journeys can potentially be used by designers to identify low level specifications, such as hardware requirements and infrastructure, and also higher order learning aspects that can lead to the re-design of pedagogical materials such as the curriculum, learning task instructions and expected learning outcomes.

Further research will help us to bring other tools and open the whole design process for collaboration, starting with learning scenarios as presented in this paper, and expanding to other areas such as service design, innovation and healthcare.

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