Examining Students' Online Learning and Collaboration Using Analytics-Supported Assessment Tools and Dashboards

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Introduction

Learning analytics (LA) allows student data to be analysed automatically to unravel students' patterns of ongoing performance in the online environment (Ferguson, 2012), thus enabling **personalised and individualised feedback** supported by teacher- and student-facing dashboards.

Although LA tools are available in most learning management systems (LMS), which were previously reviewed (Susnjak *et al*., 2022), the data provided often **diverges from the expectations of university students** (Silvola *et al.*, 2021).

As such, a new LA tool needs to be developed to enhance university students' conceptual understanding and communicative practice. This project thus aims to develop an analytic dashboard that identifies and encourages instances of **disciplinary, interdisciplinary, and collaborative** competence development. Specifically, there are two inter-related research goals:

1. To **design a suite of innovative LA tools** to provide personalised feedback for assessing and promoting engagement, (inter)disciplinary knowledge building and dialogic communicative competence
2. To examine **pre-service/beginning teachers' (PSTs') patterns of behaviours** using LA in the three areas: participation, keyword use and communication acts, which are essential indicators of their conceptual mastery and communicative competence.

Technological innovation

The LA tool provides an interface for five different functions: two interfaces are input interfaces, and the others are visualisation interfaces. The two interfaces allow **keyword** lists and **discourse markers** to be input. The three interfaces are "Participation", "Lexical network", and "Communication acts". For all three above interfaces, instructors and PSTs can use a menu and simple clicks to select for viewing different groups in different cycles (topics) to compare PSTs' online performance.

- "**Participation**" interfaces provide information on students' post-writing behaviours, including the number of posts per PST, the number of replies per PST, and the number of words per post or reply.
- The "**Lexical network**" visualised how the PSTs use the target terms (i.e., keywords) in a **two-mode network form** (Borgatti and Everett, 1997), where one type of node is about the target terms that have been used. Another type is about the PSTs who make use of the targeted terms. Figure 1 shows a sample network produced by the plugin. The simultaneous showing of the user identifiers and conceptual terms in the non-directional network allows the visualisation of PSTs' **connected use of concepts** and the identification of **commonly used terms that bring coherence** to the discussion.
- Figure 2 shows a sample display of the students' use of "**Communicative Acts**" - Seven categories were identified based on a relevant framework previously established by the first and second authors (Chan *et al*., 2023). In designing LA, examples are provided for each category (e.g., "I agree", "I'd like to build on") and using **pattern matching** to identify the instances of use of these markers

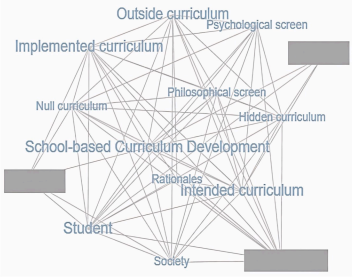

Figure 1. Sample lexical network of a group of three students

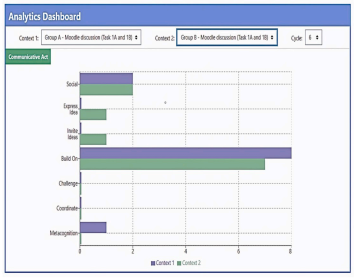

Figure 2. Sample analytics of the use of communicative acts

Results

- The number of replies indicates STs build on peers' ideas. They have written more words than the course requirements (250 words), suggesting good engagement. As expected, the full-time sub-class shows more reply notes and word lengths than the part-time class since part-time PSTs are busier.
- Table 1 shows that PSTs become **more able to include targeted concepts** (number of nodes) in their writing, and the concepts are more interconnected into **high-density lexical networks** (density > 0.5). The network density suggests the **maturity of PSTs' understanding** and hints at the need to encourage complexification and cross-topic/interdisciplinary knowledge transfer. The networks tended to be random with **no clear community structure** (modularity near zero), which indicates the need for the instructors to work on students' organisation of their conceptual framework.
- To provide some initial validation of tools and LA, we examined relations of communicative markers offered by LA and course performance for FT classes who have submitted one assessment task. Comparison of high and low-performing groups and statistical analyses (Table 2) showed that the PST groups obtaining **higher grades also "replied" more, used more communicative dialogic acts, and specifically, used more "build on" and "social" communicative acts**; these differences are significant.

Sub-class	Theme	Means (Standard deviations)			
		Nodes	Edges	Density#	Modularity#
Full-time	1	4.8 (2.9)	7.5 (5.9)	0.65 (0.26)	0.15 (0.12)
	2	11.8 (7.3)	58.0 (85.5)	0.60 (0.16)	0.12 (0.05)
Part-time	1	3.8 (2.1)	5.8 (4.5)	0.81 (0.18)	0.02 (0.04)
	2	7.0 (1.7)	16.7 (8.1)	0.77 (0.11)	0.08 (0.13)

Density & modularity are normalised

Table 1. Characteristics of the lexical frameworks for two sub-classes

Category	Measures	Performance levels (Mean / Standard deviations)	
		Low	High
Participation	Posts per cycle	1.5 (0.7)	1.5 (0.8)
	Replies per cycle**	2.4 (3.1)	5.4 (5.2)
	Words per posts	346.3 (120.8)	311.1 (109.4)
Communicative act instances	Social*	2.0 (2.5)	3.4 (2.9)
	Express ideas	1.6 (3.8)	0.9 (1.4)
	Invite ideas	0.9 (2.8)	0.8 (1.3)
	Build on**	2.2 (2.7)	5.5 (5.2)
	Challenge	0.0 (0.0)	0.0 (0.0)
	Coordinate	0.0 (0.0)	0.0 (0.0)
	Metacognition	0.0 (0.2)	0.1 (0.3)

Note: Mann-Whitney U-test: * $p < .05$, ** $p < .01$

Table 2. Comparison of the dialogic behaviours between students at different performance levels

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