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Identifying Associations between Expansive Framing and Transfer through Learning Analytics in an Online Context

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Abstract: This study presents preliminary work in social learning analytics by identifying instances of expansive framing and their relationship with transfer in an online course iteratively designed using the situative principles of productive disciplinary engagement and expansive framing. This analysis occurred in two stages. First, through a discourse analysis of fifteen students who completed the course in summer 2020, a mixed-effects logistic model was constructed to understand the relationship between students' use of expansively framed speech and transfer strategies. Second, a mixed-effect linear model of students' transfer strategy use and student performance on three summative exams was constructed. While a clear link between students' expansively framed discourse and transfer strategy use was detected, no significant relationship between students' transfer strategy use and exam performance was detected. We interpret these findings in relation to the role of expansive framing, transfer in of knowledge, and the transfer out of knowledge.

This research was conducted in an online, graduate level course on educational assessment that has been iteratively refined (see Hickey et al., 2020) from the starting point of the design principles for *productive disciplinary engagement* (PDE; Engle & Conant, 2002) and *expansive framing* (Engle, Lam, Nix, & Meyer, 2012). These principles were adopted to provide multiple beneficial processes for learners to engage with the disciplinary content of the course. PDE describes a set of principles for learners to engage in authentic disciplinary problems by "problematizing" instructional content from their own perspective and publicly being held accountable for developing disciplinary norms and practices. Expansive framing is intended to increase the likelihood of transfer to subsequent contexts by extending learners' use of linguistic frames beyond the course context (i.e., outside *people*, *places, topics, and times*) to be positioned and position themselves as authors who are accountable to disciplinary norms and practices.

The principle aim of this study is understanding the relation between expansive framing and transfer as proposed by Engle et al., (2012) within an online teaching and learning context intended to promote such practices. A recent review of published research on PDE and expansive framing (Hickey et al., 2021) revealed little evidence documenting the relative impact of expansive framing on transfer in authentic teaching and learning contexts other than Engle et al. (2011). As such, this study fits within both an existing design-based research project of online teaching and learning and a larger framework for understanding the relationship between expansive framing, productive disciplinary engagement, and transfer.

An agenda for researching expansive framing within an online context

Engle et al., (2012) advanced five specific explanations of why expansive framing should lead to more generative learning and increased transfer, compared to more "bounded" curricular routines. These explanations are (a) connecting settings promotes an expectation of transfer; (b) connecting settings means prior contexts continue to be relevant in potential transfer contexts; (c) authorship and connecting to prior settings during learning leads to transfer-in of ways that support later transfer out; (d) authorship promotes accountability in particular contexts; (e) authorship as a practice generalizes practices of accountability and adaptation in transfer contexts. Engle et al. indicate that an explanation of transfer could incorporate one, a combination, or all of these hypothesized mechanisms. The current course design seeks to enable learners to expansively frame their interaction with curricular routines in terms of an actual or aspirational aim and evaluate educational assessment practices through repeated connections and revisions of these aims. This feature is intended to promote greater intercontextualities and authoritative positioning in the course context. Thus, our primary focus in the current study is to understand the relationships more fully between transfer in of knowledge introduced through expansive framing and the taking up of authoritative positions on disciplinary knowledge as introduced by the course design. This focus is chosen in part to explore whether the course mechanisms to support transfer-in actually do so, which is presumed to help explain whether transferring out knowledge also obtains. This focus further reveals if and how the establishment of intercontextuality in the form of numerous connections to outside contexts that are further expected to support transfer actually does so.

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Research question and methods

This analysis focused on the following research question: Does encouraging students to expansively frame their engagement lead to greater transfer in of prior knowledge through the use of transfer strategies of generating examples, making comparisons, and generalizations that more frequently connect to frames beyond the current course context. If so, do these transfer strategies support transfer out as estimated by exam performance?

We frame this analysis as social learning analytics (Buckingham-Shum & Ferguson, 2012) in that rather than focusing on automated, computational processes from data generated from networked systems we are attending to the social processes that are stored and represented within these systems. Specifically, we attend to the discourse stored within the course management system. As such, we approached this analysis as an initial exercise in labeling said discourse and identifying associations through a mixed method design.

Methods, participants, and data sources

A total of 15 students who took the course in Summer 2020 were eligible as participants. Only students who completed the course and did not opt out of the study were included in the analysis. These criteria did not exclude any student. Observations from these participants included student responses to wikiflolio and reflection prompts in relation to students' self-selected educational assessment problems. Wikifolio prompts asked students to evaluate their interaction with a particular element of educational assessment with their problem; whereas reflections encompassed five prompts that asked students to consider how their prior engagement in the wikifolio and their peer and instructor interactions influenced their understanding of educational assessment. Excluding missing responses, this resulted in a total of 1,597 observations. Each student's three modular exams were also used to assess the extent students' transferred out knowledge.

Our analysis incorporated quantitative methods of qualitative codes (see Chi, 1997). The analysis occurred in two stages. First, a coding of these wikifolio and reflection responses was conducted. Second, two statistical analyses were conducted. This analysis involved a mixed-effect logistic regression model constructed from coded observations to identify the relationship between expansive framing, authorship, and each transfer strategy and a linear mixed-effect model of student transfer strategy use within each module and their modular exam performance was constructed. All analysis codes, coding discussions transcripts, and R cleaning and analysis scripts are available in an Open Science Framework (OSF) repository (https://osf.io/dqfap/).

Coding procedures

Expansive framing and authorship & accountability codes were adopted from Andrews et al. (2019) and transfer strategy codes were adapted from general strategies that have been identified as effective in promoting learner transference of knowledge (see Bransford et al., 2000). All codes were binary and coding was conducted openly and transparently by the first author. Three audit sessions (see Cresswell & Miller, 2000) between the second author and two peers were held to discuss their findings and elaborate further directions in coding analysis.

Mixed-effect models

Mixed-effect models describe a family of statistical approaches that used both random and fixed parameters to deal with clustered and repeated measure data (see Raudenbush & Byrk, 2002). For the first, model each observation was used as "trial" for whether expansive framing occurred and whether corresponding use of a transfer strategy was also observed. The second model was constructed from student's modular exam scores and the frequency of transfer strategy use within the wikifolios and reflections within that module for each student.

Results

Table 1 confirms that multiple instances of expansively framed elements increased the odds that students engaged in transfer strategy use. For example, students' who framed their engagement using *time past* increased the odds that they generated examples by a factor of 5.61. However, different transfer strategies coincided with different components of expansive framing and productive disciplinary engagement. For instance, framing engagement using *time future* led to a statistically unlikely increase in the odds of making generalizations but was not significant for students' generation of examples. For comparisons, demonstrating *authorship* (making authoritative claims) and framing with *topics* (beyond educational assessment) increased the odds of making comparisons by a factor of 2.09 and 3.32, respectively (both significant). Notably whether expansive framing was specifically encouraged by the prompt did not significantly relate to the odds of using transfer strategies. Also, the type of prompt appeared to have varying influence on the extent to which a particular transfer strategy was employed. For instance, engagement in reflections indicated a reduction in the odds of students generating examples and generalizing but increased the odds of students making comparisons. This is possibly due to students

making more comparative actions on their work at different times and in relation to other participants. Taken as a whole, then, these results suggest that students were likely to use these strategies to transfer in previous knowledge as Engle et al., (2012) suggested. As such, the course appears to be functioning as intended. Of course, this raises the question on whether there was a substantive relationship of students' transfer-in and transfer out as measured by course exams.

Table 1:
Mixed-Effect Logistic Regressions of Expansive Framing and Transfer Strategies

	generates_example			generalizations			comparisons		
Predictors	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*
(Intercept)	0.14	0.09 – 0.21	**<0.001**	0.02	0.01 – 0.05	**<0.001**	0.00	0.00 – 0.01	**<0.001**
prompt type [Reflection]	0.25	0.17 – 0.37	**<0.001**	0.50	0.30 – 0.84	**0.008**	5.78	2.75 – 12.14	**<0.001**
encourages ef [1]	0.88	0.62 – 1.23	0.451	0.77	0.48 – 1.23	0.269	0.90	0.50 – 1.60	0.709
time past [1]	5.61	3.70 – 8.50	**<0.001**	1.66	0.97 – 2.86	0.066	0.97	0.47 – 2.03	0.943
time future [1]	1.47	0.90 – 2.39	0.122	2.34	1.35 – 4.06	**0.002**	1.41	0.71 – 2.81	0.326
participants [1]	3.44	2.11 – 5.61	**<0.001**	2.40	1.35 – 4.27	**0.003**	0.96	0.37 – 2.46	0.925
topics [1]	2.47	1.67 – 3.65	**<0.001**	1.26	0.74 – 2.16	0.390	3.32	1.61 – 6.87	**0.001**
authorship [1]	1.42	1.01 – 1.99	**0.043**	4.55	2.81 – 7.39	**<0.001**	2.09	1.17 – 3.77	**0.013**
accountability [1]	0.84	0.51 – 1.40	0.506	1.39	0.80 – 2.41	0.246	1.60	0.86 – 2.99	0.141
Random Effects									
σ^2	3.29			3.29			3.29		
τ_{00}	0.09_{student}			0.22_{student}			0.16_{student}		
	$0.15_{\text{assignment}}$			$0.56_{\text{assignment}}$			$0.78_{\text{assignment}}$		
ICC	0.07			0.19			0.22		
N	$11_{\text{assignment}}$			$11_{\text{assignment}}$			$11_{\text{assignment}}$		
	15_{student}			15_{student}			15_{student}		
Observations	1595			1596			1597		
Marginal R^2 / Conditional R^2	0.281 / 0.328			0.213 / 0.365			0.161 / 0.347		

Relation between transfer strategy and course exams

Table 2 shows that, there were no significant effects of any of the transfer strategies and exam performance. In other words, the transference out was too subtle for detection within these selected response measures and that the variation between transfer strategy did not discriminate enough to detect differences in the relatively high exam performances (the respective exam medians were 9.5, 9, and 8 out of a maximum of 10) and was not able to identify the subtle variations of transference of knowledge entailed by these strategies. Taking stock, then, we have observed that the course design facilitates and supports the transfer in of knowledge through repeated engagement routines, but we have not found a corresponding effect of students' capacity to transfer out due, in part, to the limitations of these exam measures. Namely, the exams were entirely selected response and displayed little variation.

Table 2:
Relation Between Transfer Strategy Use and Exam Scores

	exam_score		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	8.20	7.51 – 8.90	**<0.001**
generates example tot	0.04	-0.07 – 0.15	0.498
generalization tot	0.06	-0.07 – 0.18	0.390
comparison tot	0.14	-0.10 – 0.39	0.244
Random Effects			
σ^2	0.80		
$\tau_{00\ \text{student}}$	0.16		
ICC	0.16		
N_{student}	15		
Observations	44		
Marginal R^2 / Conditional R^2	0.120 / 0.263		

Discussion & conclusion

These preliminary results suggest that the course design effectively encouraged the development of students' transfer strategies through expansively framing engagement and increasing students' transfer in of previous knowledge and experience. As such, the evidence that intercontextuality was established supports Engle et al's (2012) explanation that expansive framing is likely to encourage students to transfer in prior knowledge. Similar links were observed between students taking up of authoritative positions and the transfer in of their prior knowledge. We did not observe, however, a clear indication of learners' ability to transfer out this knowledge. This may have been due to a ceiling effect in the exams as little variation in student performance scores was observed. This suggests a need for refining the exams to enable students' to more readily display their knowledge within these assessments through constructed response items. Such a revision could also assess whether there is a cost to the contextualizations produced in these courses since ongoing discussions indicate a trade-off between contextualization and likelihood of transfer (see Day et al., 2015; Goldstone & Son, 2005).

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