

Effects of Multi-Attributional Student Diversity in CSCL

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Abstract: Many online learning contexts are characterized by high student diversity in terms of both socio-demographic and task-related attributes. In 381 groups, we found that when multi-attributional task-related diversity was high, multi-attributional socio-demographic diversity was negatively associated with structural integration of the groups (i.e., communication patterns between group members). In turn, structural integration was positively related to subsequent information elaboration and shared mental models (i.e., a shared understanding of task-relevant aspects) of the groups, indicating targeted intervention opportunities.

Introduction

A growing number of distance education opportunities (Casey, 2008) in combination with trends towards lifelong learning and globalization are leading to an increase in non-traditional (e.g., older, international) students (Sursock & Smidt, 2010). As a result, group assignments in computer-supported collaborative learning (CSCL) contexts are characterized by an increased multi-attributional student diversity. A better understanding of how this diversity shapes CSCL groups' collaboration processes is therefore needed. Social psychological research suggests that the relative lack of individualizing cues in CSCL may amplify the influence of readily available categorical information (such as gender) on impression formation and group functioning (e.g., Flanagin et al., 2002; Postmes & Spears, 2002). Consistent with this, a recent study found multi-attributional socio-demographic diversity to be negatively related to CSCL groups' structural integration in CSCL, indicating that high diversity leads to lower collaboration intensity. This effect was even stronger in groups with high task-related diversity (Voltmer et al., 2022). The present study seeks to answer the following research questions: (1) Can the interactive effect of diversity on structural integration be replicated? (2) Do information elaboration and shared mental models mediate the relation between structural integration and group performance?

Method

The study was conducted in the context of a mandatory course on scientific reading and writing, in which psychology freshmen of the FernUniversität in Hagen were assigned a nine-week CSCL task within which they had to collaboratively summarize a psychological research paper. With currently more than 70,000 students enrolled, the FernUniversität in Hagen is Germany's largest public university, and one of the largest distance education institutions worldwide. The data used for the present analyses were obtained from those 1995 students, who participated in a pre- and post-quiz. The average number of students in the 381 CSCL groups was 5.2 ($SD = 1.4$). 73% ($n = 1,382$) of the students were female, 43% ($n = 860$) were 30 years or older, 17% ($n = 330$) reported to be non-native German speakers, and 23% ($n = 313$) indicated a higher self-perceived socio-economic status.

Multi-attributional socio-demographic diversity at T1 was operationalized as the variety of gender, age, (non)native speaker status, and perceived socio-economic status in the groups using Blau's index (Blau, 1977). An average of these four diversity indexes was calculated for each group. Higher scores reflect higher diversity. Multi-attributional task-related diversity at T1 was operationalized accordingly regarding prior university education, experience reading scientific papers, experience working in virtual learning environments, and prior attendance of the present course. Structural integration was calculated as the density of social networks (number of students interacting bi-directionally divided by the number of all possible bi-directional interaction pathways; Scott, 2017) based on intra-group forum interactions between T1 and T2 (first collaboration phase). Information elaboration (Cronbach's $\alpha = .91$) was assessed at T2 using seven items (e.g., "My group members exchange a lot of information about the task"; van Dick et al., 2008), calculating group-level averages of the individual item averages. Shared mental models ($\alpha = .91$) were assessed using three items developed by Santos et al. (2015, e.g., "In my group, group members had a similar understanding of each other's roles and responsibilities."). Group performance was operationalized in a peer review procedure, where students blindly rated their peers' assessments along 20 criteria (e.g., "Is the submitted text structured and does it build on each other logically?").

Results

First, we conducted a moderation analysis on group-level. Importantly, multi-attribitional socio-demographic diversity and multi-attribitional task-related diversity had a negative interactive effect on structural integration, $b = -0.02$, $p = .048$, $\beta = -.11$. An analysis of simple slopes revealed that socio-demographic diversity had a negative effect on structural integration of the groups when task-related diversity was high (Figure 1). When task-related diversity was low, this effect was nonsignificant. Second, to examine potential mediators of structural integration on subsequent group performances, we conducted a series of mediation analyses. In the most plausible model (Figure 2), direct positive relationships existed between structural integration and subsequent information elaboration, information elaboration and subsequent shared mental models, and shared mental models and subsequent group performance. These direct paths resulted in significant positive indirect effects of structural integration on shared mental models via information elaboration, $IE = 0.44$, $p = .001$, $\beta = .09$, and of information elaboration on group performance ratings via shared mental models, $IE = 0.10$, $p = .04$, $\beta = .06$.

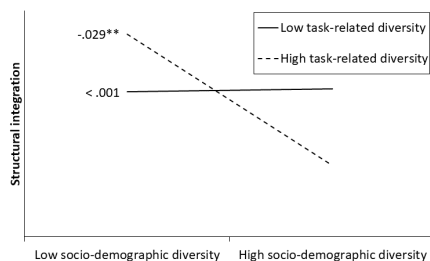


Figure 1. Simple slopes of the interactive effect of multi-attribitional socio-demographic \times task-related diversity.
** $p < .01$ (two-tailed).

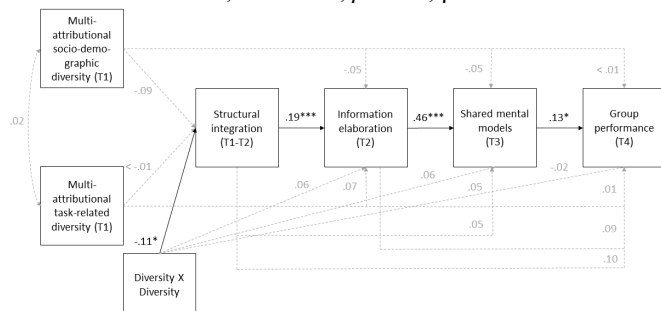


Figure 2. Path model with standardized path coefficients, dashed lines for nonsignificant relationships, and double-headed arrows for standardized covariances.
* $p < .05$. ** $p < .01$. *** $p < .001$ (two-tailed).

Discussion

The results of this longitudinal study provide further evidence for the notion that CSCL groups' multi-attribitional diversity, if not explicitly managed, can have negative effects on collaboration processes among students. Using path analyses, we found that socio-demographic diversity was negatively related to groups' structural integration only when task-related diversity was high. The relation between structural integration, that is, communication patterns between group members, and group performance was mediated in part by information processing and a shared understanding of the task. One main practical implication of the present study is that CSCL groups may benefit from active diversity management in the early phases of collaboration. This could be aimed at either increasing the intensity of collaboration or facilitating more intensive elaboration of information within groups (both through scaffolded communication, thus fostering information elaboration beyond mere exchange).

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