— CHAPTER 5 —

Student teachers' evaluation of design components related to perceived learning outcomes

Chapter 5 Student teachers' evaluation of design components related to perceived learning outcomes [4]

The aim of the study in this chapter was to determine which components of GLAs students perceive as significant for their learning. Teacher education students ($N = 290$) from six Dutch universities completed a survey. Students' perceived task characteristics and group constellation are related to their perceived increase of domain knowledge, and task characteristics and teacher guidance to learning outcomes are associated with their development as primary school teachers. Both relationships were mediated by how students report they interact. Student engagement only mediated learning outcomes related to their development as primary school teachers.

[4] This chapter has been submitted in adapted form as: De Hei, M. S. A., Admiraal, W. F., Sjoer, E., & Strijbos, J. W. *Engagement and interaction as mediating variables of perceived learning outcomes of group learning activities in teacher education.*

5.1 Introduction

Collaborative learning can contribute to the acquisition of a variety of knowledge and skills, including higher order thinking skills and metacognitive skills (e.g., Johnson & Johnson, 2009a), and to the development of prosocial behaviour such as empathy and helping others (e.g., Gillies, Ashman, & Terwel, 2008). In teacher education, the use of collaborative learning has additional goals. For example, teacher educators use group learning activities (GLAs) to model how student teachers can facilitate collaborative learning in their classrooms as teachers in primary or secondary education. Furthermore, the future work setting of student teachers and the continuous professional development of teachers in schools require the skills of collaborative learning and work (Kwakman, 2003; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011; Zwart, Wubbels, Bergen, & Bolhuis, 2009). Therefore, it is important that GLAs in teacher education are designed properly and that student teachers consider participating in GLAs to be worthwhile.

However, GLAs are not always successful, and working in groups does not always lead to attainment of the learning goals (Brown & McIlroy 2011; Fransen, Kirschner, & Erkens, 2011; Gros, 2001; Hmelo-Silver, 2004; Janssen, 2014). A possible cause for not attaining the learning goals may lie in the students' resistance to participating in GLAs. To overcome students' resistance to group work, they need to be supported in their group work and they need appropriate scheduling, such as sufficient time to work on group assignments without the stress of other simultaneous courses (Payne, Monk-Turner, Smith, & Sumter, 2006). In addition, teachers in higher education experience difficulties with the design and implementation of GLAs. Teachers consider the design of GLAs a complicated task that often does not lead to the desired learning outcomes, and encounter problems such as free-riding of students, and issues with assessment and grading (Gillies & Boyle, 2010; Ross, Rolheiser, & Hogaboam-Gray, 1998).

Indeed, the design of a GLA is complex because of the pedagogical, interpersonal, environmental, and technological contexts simultaneously, in which various decisions need to be made regarding several GLA design components as well as their alignment (Dennen & Hoadley, 2013). On the basis of a literature review of 14 meta-studies on the design of GLAs, De Hei, Strijbos, Sjoer, and Admiraal (2016) developed a comprehensive framework: the Group Learning Activities Instructional Design (GLAID) framework. The GLAID framework distinguishes eight components for the design: (1) interaction, (2) learning objectives and outcomes, (3) assessment, (4) task characteristics, (5) structuring, (6) guidance, (7) group constellation, and (8) facilities. In addition, the alignment between the various components is stressed as crucial for the design of a GLA. The implementation of instructional designs, such as designs for GLAs, strongly influences students' perceptions of their learning outcomes (Shainkarakas, Inozu, & Yumru, 2010). Hence, the current study examines students' evaluation of GLA design components and their relationships with students' perceived learning outcomes.

5.1.1 Student evaluations and learning outcomes

How students perceive the learning environment is related to how they perceive the learning outcomes, and may be related to the learning outcomes attained. Lizzio, Wilson, and Simons (2002) found that student perceptions of the learning environment are related not only to student satisfaction, but also to academic achievement and the development of key (or transferable) skills. They explain that students' perceptions of the learning benefits of

courses are related to how they value different components of the design, such as task type or assessment. Salomon (1984) already found that students' perceptions of the learning materials affected their actual learning. Furthermore, Sahinkarakas, et al. (2010) found among 142 higher education students (English Language Teaching Department) that their perceptions of the learning outcomes were strongly related to their evaluations of aspects of the curriculum: the lecturer, the classroom, the interaction, and the task-related activities. In order to improve GLA designs so they can contribute to positive student evaluations and better learning outcomes, it is important to understand the relationship between the design components of a GLA and the learning outcomes from the students' perspective. Lizzio et al. (2002) distinguished two kinds of perceived learning outcomes in university students' perceptions of their academic environment: (1) academic achievement and (2) key or transferable skills. In the context of GLAs in teacher education, academic achievement may be described as the attainment of declarative and procedural knowledge about a specific domain or subject (Janssen, 2014; Johnson & Johnson, 2009a). Key or transferable skills could be regarded as learning outcomes related to the future profession that concern the development of social skills (Gillies, Ashman, & Terwel, 2008; Janssen, 2014; Johnson & Johnson, 2009a), the development of skills for implementing GLAs in their future classrooms (Ruys, Van Keer, & Aelterman, 2010), and the development of collaborative skills for professional development purposes (Kwakman, 2003; Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011; Zwart, Wubbels, Bergen, & Bolhuis, 2009).

5.1.2 Mediators between design and outcomes

The strength of the relationship between an educational design and its (perceived) learning outcomes appears to be related to the extent to which students feel engaged (Martin, 2007). Furthermore, in assignments requiring student collaboration, the quality of the verbal interaction may also influence the strength of the relationship between the design of the assignment and the learning outcomes (Janssen, 2014). This means that both verbal interaction and engagement may mediate the relationship between students' evaluations of the design components of a GLA and their perceived learning outcomes. In the following two sections, each of these possible mediators will be discussed in more detail.

Verbal Interaction. Verbal interaction appears to be an important aspect of the collaborative process of needed to attain the learning goals (Dillenbourg, 2002; Janssen, 2014; Strijbos, Martens, & Jochems, 2004; Wilson, Ludwig-Hardman, Thornam, & Dunlap, 2004). Strijbos et al. (2004) describe interaction as "the heart of the matter": it is the process that influences how students collaborate and can, therefore, affect the learning outcomes of a group learning activity. Janssen (2014) also emphasizes that (a) interaction is the key component in instructional methods aimed at fostering student collaboration, and (b) interaction induces learning outcomes. Gomez, Wu and Passerini (2010) found that students who have positive perceptions of team interaction report greater enjoyment in learning and perceive higher learning outcomes than students with a less positive perception of team interaction.

Engagement. Engagement refers to the behaviour of students when they are motivated to learn, work effectively, and employ their potential (Martin, 2007) and is a second possible mediator between GLA design and learning outcomes. For example, Reyes, Bracket, Rivers, White, and Salovey (2012) found that student engagement was a mediator in the positive relationship between the emotional climate in classrooms and learning outcomes. Ferreira, Cardoso, and Abrantes (2011) found that intrinsic motivation served as a mediator

between students' sense of belonging at school and perceived learning after completing a course: when students evaluated their sense of belonging at the school negatively this had a negative impact on intrinsic motivation and, consequently, on perceived learning. Finally, Figueira and Duartes (2011) implemented an intervention to increase student motivation during a course. This intervention resulted not only in higher motivational outcomes, but also, via student motivation, in increased quality of the learning outcomes that were required in the course. Based on these findings using students' course evaluations, it was expected that student engagement and motivation could also mediate the relationship between the design of a GLA and the perceived learning outcomes of GLAs.

5.1.3 Hypotheses and research question

In the current study, it was investigated which components of implemented GLA designs students considered important for their perceived learning outcomes and to what extent student engagement and verbal interaction influenced this relationship. The focus was on two kinds of perceived learning outcomes: (1) outcomes regarding domain-specific knowledge and (2) outcomes regarding the future profession.

Our first two research questions were focused on the direct relationship between students' evaluations of GLA design and perceived learning outcomes:

(1) What is the relationship between students' evaluations of the design of GLAs and their perceived knowledge increase?

(2) What is the relationship between students' evaluations of the design of GLAs and their perceived learning outcomes for the future profession?

We also hypothesized that verbal interaction and engagement would mediate students' evaluations of the design aspects of GLAs and the two types of perceived learning outcomes. The third and fourth research questions were formulated as follows:

(3) To what extent do engagement and verbal interaction mediate the relationship between students' evaluations of the design of GLAs and their perceived knowledge increase?

(4) To what extent do engagement and verbal interaction mediate the relationship between students' evaluations of the design of GLAs and their perceived learning outcomes for the future profession?

5.2 Method

The implementation of GLAs in six teacher education programmes was examined. These GLAs differed in their learning objectives, tasks, and assessment. Retrospective analysis was applied (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003) to relate perceived learning outcomes to how students value design components and the implementation of those design components.

5.2.1 Participants and research context

The participants in the current study were 290 students from the teacher education programmes of six universities of applied sciences in the Netherlands.Their ages ranged from 16 to 26 years ($M = 20.3$, $SD = 2.0$); 76% were female. Seven GLAs were included in the study. In one teacher education programme, two different GLAs were used in two different academic years of the bachelor's programme. The teacher educators provided course documents related to the GLA and were interviewed about their implementation of the design. This information was used to investigate the implementation of each GLA (see Tables 1 and 2). Table 1 shows for each GLA the numbers of students and teacher educators, study level, duration of the GLA, and the size of subgroups for each GLA. Table 2 provides a brief description of the eight design components for each GLA (De Hei et al., 2016).

Table 1 GLA assignments

	Students *(N)*	Teacher educators *(N)*	Year of bachelor program	Period in weeks the GLA could be worked on	Number of students per subgroup
Assignment 1	23	3	3	6	3 - 4
Assignment 2	69	7	1	8	12 - 13
Assignment 3	60	5	4	12	12 - 14
Assignment 4**	55	1	1	3	3
Assignment 5	16	2	1	10	3 - 4
Assignment 6 */**	41	3	3	1	3 - 6
Assignment 7	26	2	1	8	3 - 4

* Students were allowed to work full-time for an entire week on this assignment

** Assignments in the same teacher education program.

5.2.2 Measures

During the final meeting of the GLA, or in the week immediately after the GLA was completed, the students completed a survey with pre-structured answer options (5-point Likert-type scale with 1 = strongly disagree and 5 = strongly agree). This survey was used to examine their evaluations of the GLAs. This survey was constructed using eight design components of the GLAID framework (De Hei, Strijbos, Sjoer, & Admiraal, 2016). The component learning objectives and outcomes refers to two perceived learning outcomes: (1) perceived knowledge increase (declarative and procedural knowledge) and (2) learning outcomes for the future profession (social skills and preparation for professional development). The component interaction was understood as the verbal representations of students in the collaboration process (such as listening, explaining, and discussing). This component was hypothesized to act as a student variable that mediates the evaluation of GLAs. Engagement with GLAs was hypothesized as a further mediating variable (Martin, 2007).

Together with the two learning outcomes and the two mediators, the remaining six components to design GLAs formed the basis of the survey. The survey consisted of 58 items. A Principal Component Analysis (PCA) with Oblimin rotation (KMO = .858, R^2 = 57.93) was performed on the data from the 290 participants to examine the construct validity of the survey, using as inclusion criterion a factor loading of ≥ .4 on one factor only. This led to the addition of a scale (contribution: the extent to which each individual student of a group contributes to and is responsible for group performance and the group learning product). The facilities scale (students' evaluations of available time, available rooms, and digital support) was left out of the analyses because of low reliability. For each scale, Table 3 provides the number of items, an example item, reliability in terms of Cronbach's α, descriptive statistics, and the number of students for which a scale mean was computed. All of the items of the scales (in Dutch) can be found in Appendix C.

Table 2 GLA assignments as described in the course documents and elaborated by the teacher educators in the interviews

Learning objectives/ outcomes	Interaction	Assessment	Task characteristics
More than 30 learning objectives in the course description focused on three domains (geography, history and biology) and seven competencies	Exchange of ideas and giving peer feedback	Written product containing the lessons and evaluations, group-grade	Designing lesson cycle on the theme "evolution" integrating geography, history and biology
To be able to design lessons for a primary school group	Exchange of ideas and task division	Perform the lessons in groups: group grade, individual grade for individual report	Design an afternoon with lessons for a 3th and 4th grade class of a primary school focused on the theme of a picture book
Gain knowledge on school innovations, develop collaboration skills and present a project	Exchange of ideas and task division	Report about the design of the innovation and possibilities for implementation. Presentation of the report. Group grades.	Design an innovation for a primary school
Develop domain specific skills and collaboration skills	Exchanging ideas and explaining to others	Product: stop-motion movie, presentation of the collaboration process. Peer assessment of the presentation, teacher assessing the group product.	Make a stop-motion movie with the theme "travelling from one point to the other"
Develop communication and social skills, develop lesson plans	Exchange of ideas, task division and giving peer feedback	Perform the lessons in groups, group grade	Design a morning for a primary school class with lessons focused on one theme
Abstracting a theme from information of three domains, formulate learning questions, develop research skills	Brainstorming and task division	Presence during the meeting, presentation of the product, formative peer feedback	Perform practitioner research on a theme and develop lessons that relates to the researched theme
Develop social skills and practitioner research skills	Exchange of ideas, task division, discussing and reaching consensus	Practitioner research report and presentation of the report, group grades	Perform practitioner research within the theme: "the teacher as jack of all trades"

Structuring	Guidance	Group constellation	Facilities
Jointly performing the designed lessons	One time obligatory halfway the GLA and on request, focus on the final product	Self-chosen groups of 3 or 4 students	Format for the design of lessons
Students individually reflect on their role in the collaboration after the GLA is finished	Weekly focus varying per teacher educator (on the process of collaboration and/or the final product)	Students randomly assigned to groups of 12 to 13 students	Electronic learning environment only used to host the course documents: course description, assessment form with criteria
Group evaluation during the GLA of the collaboration process.	Weekly focus on the process of collaboration	Students chose an innovation focus and were assigned to students with the same focus, 12 to 14 students per group	Format for the steps to take in a school innovation
None	Weekly, focus on the final product	Self-chosen groups of 3 students	Electronic learning environment only used to host the course documents Software to produce a 'stopmotion' movie
Students individually reflect on their role in the collaboration after the GLA is finished	Weekly, on request or when the teacher educator found it was necessary	Self-chosen groups of 3 or 4 students	Electronic learning environment only used to host the course documents
None	One time at the start, after that on request	Self-chosen groups of 3 to 6 students	Electronic learning environment only used to host the course documents, supporting lectures regarding domain knowledge
Specific group and individual feedback on the collaboration	Weekly	Students were randomly assigned to groups of 3 or 4 students	Electronic learning environment only used to host the course documents

Table 3 Variables of the study

	N items	Example item	α	*M*	SD	*N* students
Perceived knowledge increase	6	I gained new insights about knowledge I already had by listening to other students during this GLA.	.79	3.59	0.64	288
Learning outcomes for future profession	6	I consider this GLA an adequate activity to prepare for my future profession.	.81	3.56	0.64	290
Verbal interaction	3	Working on this GLA I improved my skills in articulating my ideas towards my fellow students.	.75	3.21	0.80	288
Engagement*	5	During the GLA I am driven to complete the assignment in a good way.	.62	3.91	0.57	288
Contribution	3	In the group I participated in, every group member contributed equally to the final product.	.78	3.40	1.01	289
Assessment Quality	4	It was clear beforehand how the GLA would be assessed.	.72	3.41	0.74	281
Task characteristics	4	The task was suitable to work on in collaboration.	.69	3.72	0.68	289
Structuring*	4	It was clear how we were supposed to collaborate as a group in this GLA.	.61	3.47	0.74	288
Guidance	5	Our teacher was available for us in case we needed him/her.	.85	3.77	0.81	280
Group constellation	5	Knowledge and prior experience of the group members were complementary.	.75	3.83	0.70	288

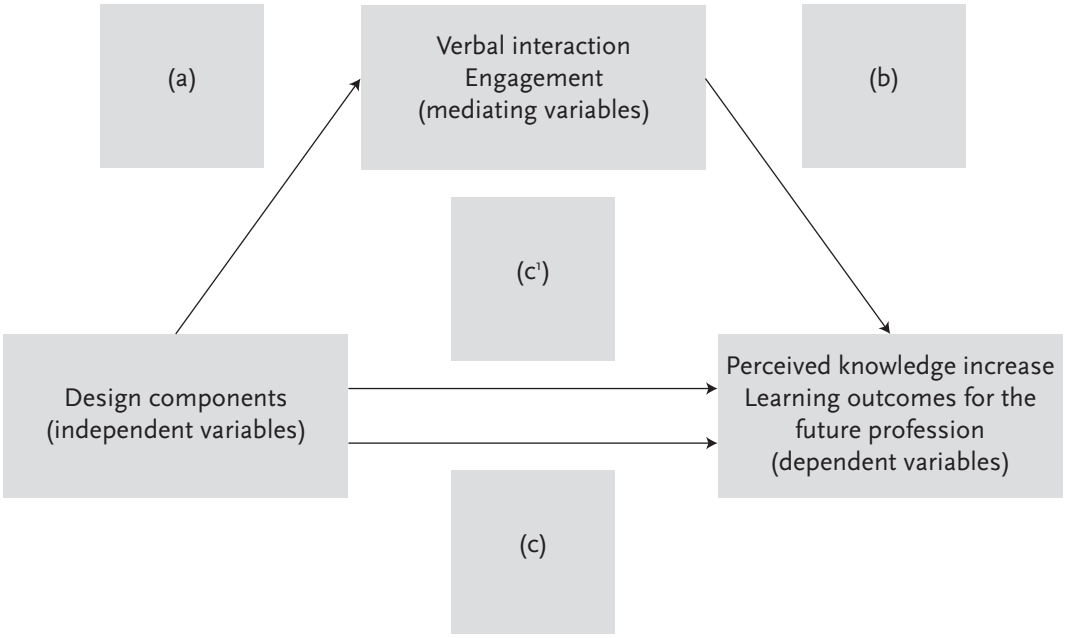
*Reliability after using the Spearman-Brown formula to lengthen the scale to 6 items (Engagement, $\alpha = .66$ and Structuring, $\alpha = .70$).

5.2.3 Analysis

As the student data are nested within seven different GLAs, multilevel analyses were used to test whether the variance at the level of the seven GLAs in both dependent variables differed significantly from zero. This was not the case and consequently the analyses were performed at the student level only.

Two multiple mediation regression analyses, one for each of the dependent variables, were performed using an SPSS macro developed by Hayes and Preacher (2014). The macro uses 5,000 bootstrap resamples to generate 95% confidence intervals for the indirect effect of the mediators on the dependent variables. The two regression analyses are visualised in Figure 1: the c-path represents the relation between the independent variables and the dependent variable in the absence of the mediators (total effect, unmediated model), the c^{1} path represents the same relation taking into account the effect of the mediators in this relation (direct effect, mediated model). In both analyses, verbal interaction and engagement were included as mediators and either perceived knowledge increase or learning outcomes for the future profession as dependent variable. Separate regression analyses were performed for each dependent variable, because this study specifically focused on the relationship between the design components and each of the dependent variables. The following independent variables were included: contribution, assessment quality, task characteristics, structuring, guidance, and group constellation. Students' prior educational level, year of bachelor's programme, and gender were included as covariates (not visualised in Figure 1).

Figure 1 Testing mediation of verbal interaction and engagement



5.3 Results

Before discussing the results of the multiple regression analyses, the correlations are reported between the independent variables, the mediators, and the dependent variables in table 4.

Table 4 Correlations of the independent, dependent and mediator variables

	1	2	3	4	5	6	7	8	9	10
Perceived knowledge increase (1)	-	.65**	.33**	.44**	.22**	.31**	.57**	.34**	.35**	.56**
Learning outcomes for the future profession (2)		-	.45**	.54**	.10	.37**	.65**	.37**	.44**	.34**
Verbal interaction (3)			-	.30**	.03	.19**	.37**	.28**	.21**	.19**
Engagement (4)				-	.14*	.40**	.62**	.54**	.43**	.48**
Contribution (5)					-	.09	.16**	.26**	.05	.49**
Assessment quality (6)						-	.42**	.40**	.42**	.26**
Task characteristics (7)							-	.46**	.43**	.45**
Structuring (8)								-	.39**	.36**
Guidance (9)									-	.21**
Group constellation (10)										-

** p<.01

* p<.05

5.3.1 Perceived knowledge increase

5.3.1.1 Direct relationship with students' evaluation of the design

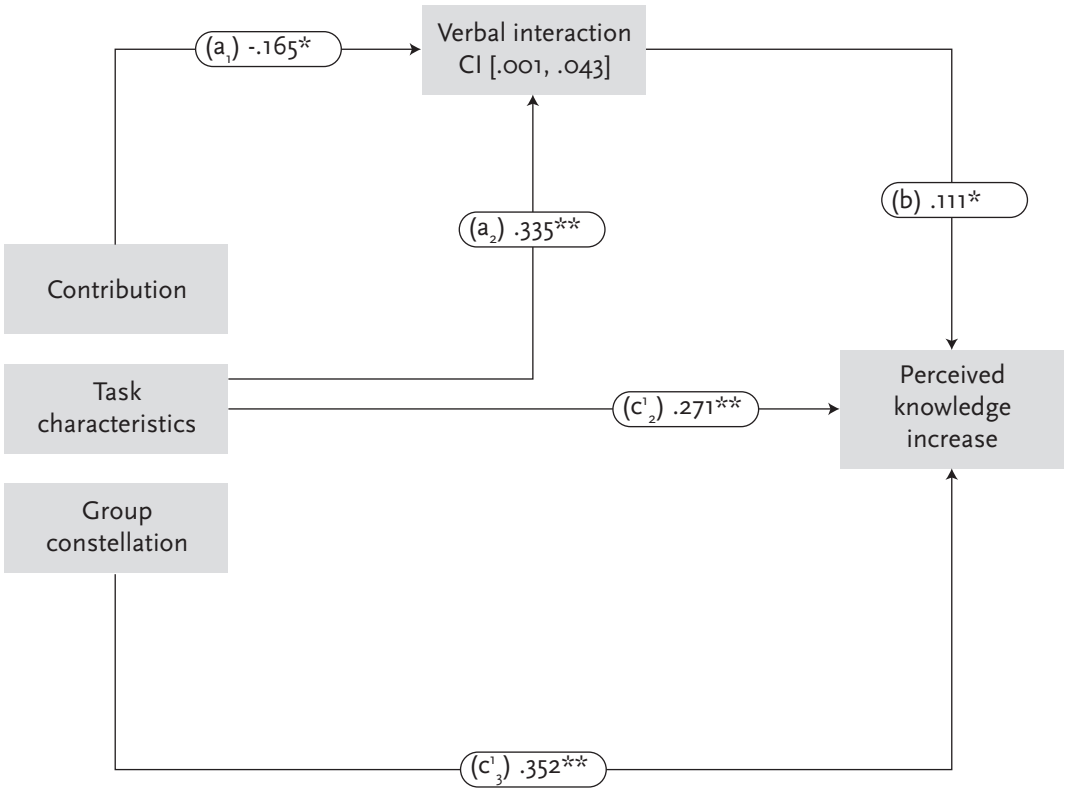
The design components that significantly relate to perceived knowledge increase are task characteristics (B = 0.313; SE = .055) and group constellation (B = 0.367; SE = .055), as shown in Table 1a of the Appendix D (total effects unmediated model: R2 = .457). The findings confirm that there is a positive relationship between students' evaluations of some of the design components and perceived increase in knowledge.

5.3.1.2 Mediation by verbal interaction and engagement

The results of the mediator regression analyses are summarised in Tables 1b and 1c of the Appendix D. Of the two mediators, only verbal interaction was significantly related to perceived knowledge increase (B = .111; SE = .040). Furthermore, it was found that verbal interaction mediated the relationship between students' evaluations of task characteristics and perceived knowledge increase (CI [0.006, 0.089], leading to a smaller but still significant

direct relationship between task characteristics and perceived knowledge increase (B = .271; SE = .060). This means that a complementary mediation was found (Zhao, Lynch, & Chen, 2010) of verbal interaction in the relationship between students' evaluations of the task characteristics of GLAs and their perceived knowledge increase. Furthermore, verbal interaction mediated the relationship between students' evaluations of the contributions of the group members and perceived knowledge increase in the absence of a significant direct relation between evaluation of the design and perceived knowledge increase. This indicates a full mediation (Zhao, Lynch, & Chen, 2010) of verbal interaction in this relationship. The relationship between contribution and verbal interaction was negative, which means that the higher the evaluation of contributions, the lower the evaluation of verbal interaction. Figure 2 visualises the findings on the mediation of verbal interaction.

Figure 2 Verbal interaction partially mediating between students' evaluations of design components and perceived knowledge increase.



* Significant at the .01 level
** Significant at the .001 level

5.3.2 Perceived learning outcomes for the future profession

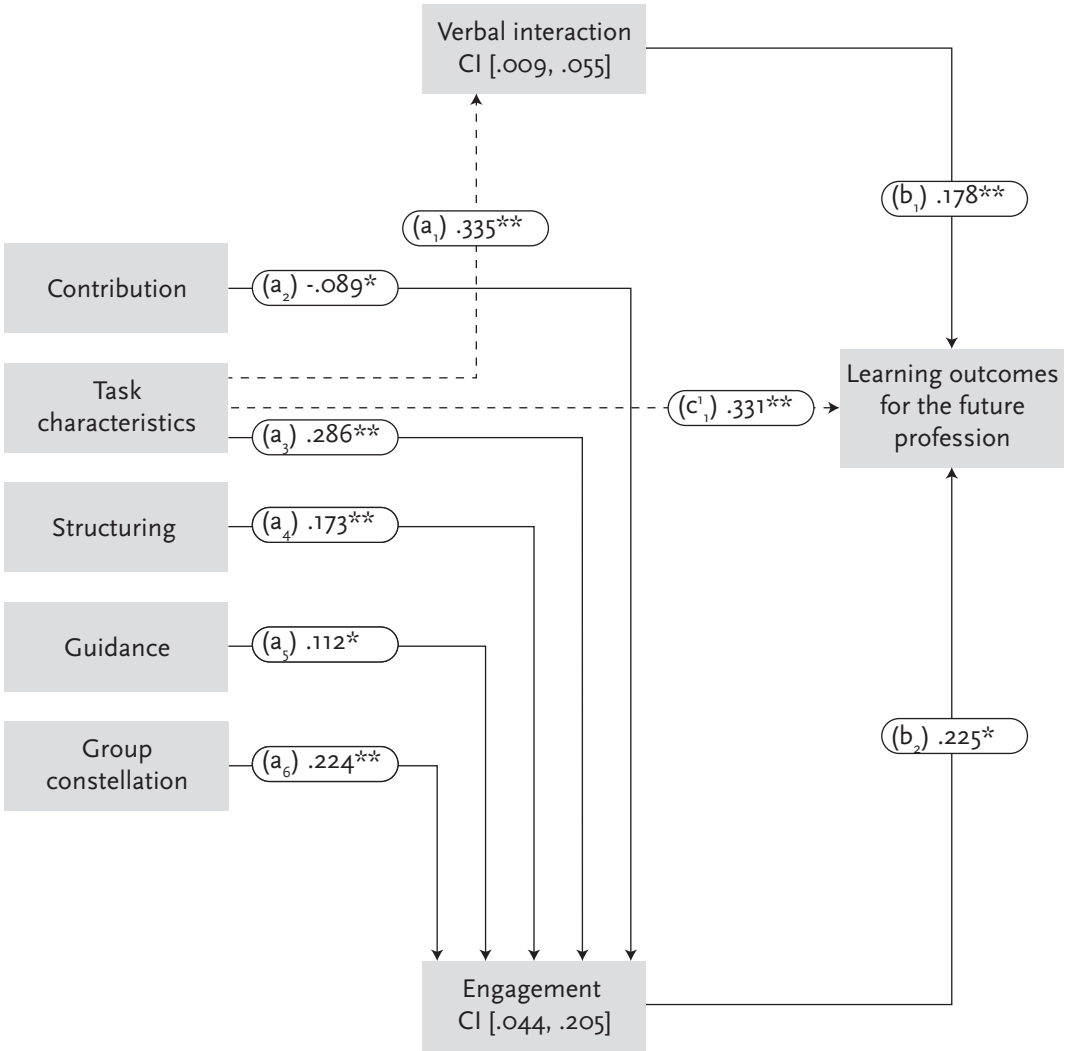
5.3.2.1 Direct relationships with students' evaluations of the design components

The design components that relate to perceived learning outcomes for the future profession are task characteristics (B = 0.455; SE = .054) and guidance (B = 0.119; SE = .044), as can be seen in Table 1d of the Appendix D (total effects unmediated model: R2 = .463). The findings confirm that there is a positive relationship between students' evaluations of the design components and perceived learning outcomes for the future profession.

5.3.2.2 Mediation by verbal interaction and engagement

The results of the mediator regression analyses are summarised in Tables 1e and 1f of the Appendix D. Both verbal interaction (B = 0.178; SE = .038) and engagement (B = 0.225; SE = .073) were significantly related to perceived learning outcomes for the future profession. Students' evaluations of task characteristics had complementary mediation via verbal interaction (CI [0.021, 0.120]) and engagement (CI [.025, .116]), leading to smaller though significant direct relationships (Verbal interaction, B = 0.335; SE = .084 and Engagement, (B = 0.286; SE = .043). Moreover, the results indicate that engagement fully mediated the relationship between the learning outcomes for the future profession and the evaluation of four design variables: contribution (CI [-0.045, -0.052]), structuring (CI [0.015, 0.080]), guidance (CI [0.006, 0.057]), and group constellation (CI [0.016, 0.106]). This means that the evaluation of these design components was only related to the learning outcomes for the future profession through student engagement: the more positive the evaluation, the higher students' engagement and the higher the perceived learning outcomes. Figure 3 visualises the findings for the mediation of verbal interaction and engagement in relation to the learning outcomes for the future profession.

Figure 3 Verbal interaction and engagement partially mediating between students' evaluations of design components and learning outcomes for the future profession.



* Significant at the .01 level
** Significant at the .001 level

5.4 Discussion and conclusion

The relationship between students' evaluations of the design of GLAs and the learning outcomes of those GLAs in teacher education was explored. It was found that students' evaluations of task characteristics and group constellation were positively related to a perceived knowledge increase. Students' evaluations of task characteristics and guidance were positively related to their perceptions of their learning outcomes for their future profession. In addition to these direct relationships, several mediated relationships were found . First, complementary mediation of verbal interaction was found in the relations between students' evaluations of task characteristics and both perceived knowledge increase and learning outcomes regarding the future profession. Complementary mediation indicates the likely presence of another mediator that was not included in the analyses. Second, full mediation of verbal interaction was found in the (negative) relation between students' evaluations of contributions of the group members and the perceived knowledge increase.

Third, full mediation of engagement was found for the relation between students' evaluations of contributions of the group members (the relation between engagement and students' perceptions of contributions of the group members was negative), structuring, guidance, and group constellation, on the one hand, and the perceived learning outcomes for the future profession, on the other hand. Full mediation indicates that a positive evaluation of the design components is not directly related to higher perceived learning outcomes for the future profession, but is only related through students' engagement with GLAs. This means that a positive evaluation was only related to positive learning outcomes because a positive evaluation led to high engagement of students with the GLAs. The main findings will be discussed below.

5.4.1 Importance of evaluation of task characteristics

Students' evaluations of task characteristics were related to both kinds of learning outcomes, directly and indirectly via the mediators verbal interaction and engagement. Evaluation of the design component task characteristics explained the largest proportion of variance in both outcome variables. Therefore, the quality of the task seems to be a dominant variable for explaining the perceived learning outcomes of GLAs. This conclusion is related to the findings of Wieland (2011), who found that students learn more when task characteristics are described in detail. Her findings revealed that students who worked collaboratively on an assignment with precise instructions outperformed students who worked on an assignment with general instructions.

Sockalingam, Rotgans, and Schmidt (2012) describe a validated and reliable quality-rating scale to rate the quality of problems in problem-based learning, which might be useful for the evaluation of task design in group learning activities. They found five aspects that indicate the task quality: the extent to which a task (1) leads to learning objectives, (2) is familiar, (3) triggers students' interest, (4) stimulates students' critical reasoning, and (5) promotes collaborative learning.

5.4.2 Mediating role of engagement and verbal interaction

The findings showed that student engagement played a crucial role in mediating the relationships between evaluations of design components of GLAs and perceived learning outcomes. The results showed that engagement fully mediated the evaluation of the design components structuring, guidance, and group constellation, on the one hand, and the

perceived learning outcomes for the future profession, on the other hand. This means that the design of GLAs should be aimed first at triggering student engagement and then at other student learning outcomes.

5.4.3 Limitations

Several researchers argue that student self-report data should be interpreted cautiously and that the validity can be debated (e.g., Porter, 2011; Schwarz, 1999). However, Bowman (2010) argues that, although students' self-reported learning gains may not adequately reflect longitudinal gains, they do provide useful information because perceived learning gains are positively associated with student satisfaction. For example, in an online survey study of 110 students participating in an undergraduate online course, Lee, Srinivasan, Trail, Lewis, and Lopez (2011) found that students' perceptions of support (in their study operationalized as instructional support, peer support, and technical support) were significantly related to course satisfaction. Moreover, Lizzio, et al. (2002) found that students' perceptions of the learning environment were related not only to their satisfaction, but also to their academic achievements and the development of key (or transferable) skills. Therefore the use of self-reports for this study was considered to be adequate for answering the research questions.

5.4.4 Implications for GLAs in teacher education

5.4.4.1 Task characteristics and the relationship with engagement.

The evaluation of task characteristics is a dominant variable in explaining differences between students in perceived learning outcomes. This implies that teacher educators need to explicitly select tasks that are aligned with the desired learning outcomes. For example, if the main learning goal of the GLA is to acquire knowledge about a particular topic, the task characteristics should lead to activities that induce collaboration and prevent the students from dividing the work: if each student works on a different aspect of the task, they might not acquire sufficient knowledge about the topic as a whole.

Furthermore, to induce student engagement, authentic tasks are recommended for group learning activities (e.g., Gros, 2001; Hämäläinen & Vähäsantanen, 2011; McLoughlin, 2002). Another important characteristic of the task that is assumed to lead to better achievement is its complexity. In their review of research comparing the effectiveness of individual learning environments and collaborative learning environments, Kirschner, Paas, and Kirschner (2009) argue that the more complex tasks are, the higher the learning outcomes of group learning. Yet, Boekaerts and Minnaert (2006) found that learning tasks that matched the competence level of the students generated topic interest. They argue that a task needs to elicit students' perceived autonomy and feelings of competence to complete the task. It can be concluded that a positive evaluation of task characteristics might be influenced by the alignment of task difficulty and student competence.

Another implication for teacher education is the use of resources that induce intellectual conflict: resources that provide students with information that seems inconsistent with what they already know. Johnson and Johnson (2009b) describe this procedure as constructive controversy. They state that constructive controversy stimulates students' effort to seek further information and to study more and longer. In other words: it fuels their engagement.

5.4.4.2 Engagement related to other design components

The findings stress the important mediating role of student engagement in the design of group learning activities. Therefore, the design of GLAs should first be focused on the extent to which structuring, guidance, and group constellation induce the engagement of students with GLAs.

The component of structuring concerns instructing students in how to collaborate during the task: for example, by appointing roles or distributing the resources among students in order to make them interdependent to complete the task. Roles contribute to student awareness of what they need to do in the collaboration (Strijbos, Martens, Jochems, & Broers, 2004, 2007). It may also lead to more self-efficacy, which in turn may lead to engaged and motivated students (Pintrich, 2003).

How guidance was designed was also related to the engagement of students: the higher they evaluated the guidance of the GLAs, the more they felt engaged. In the design of a GLAs the guidance should describe how the teacher guides the focus of the attention of the students (McGregor, 2008) and as part of the design the guiding teacher should model the behaviour she/he wants the students to learn (Webb, 2010). The latter includes posing questions to elaborate on argumentations or summarizing the contributions of others to check whether the content of the interaction has been understood correctly.

Engagement was also induced by how students valued the group constellation. It was found that the more satisfied students were with the group size and composition, the more engaged they felt. Consequently, teacher educators are advised to deliberately decide on group composition, while keeping in mind what this means for the engagement of the students. For example teacher educators should decide whether the groups will be homogeneous or heterogeneous, and which criteria can be used for group composition, such as age, gender, achievement level, motivation, or personal interests (Dennen & Hoadley (2013). One important consideration in group constellation is how the team characteristics (group size and composition) match the task demands (Fransen, Kirschner, & Erkens, 2011).

For example, in some tasks it is important to reflect on a particular problem from different perspectives in order to stimulate students' broader awareness and understanding of the problem. The teacher educator might compose collaborative groups of students from different educational programmes or with different motivations to work on these particular problems. The different perspectives of these students will stimulate group discussion and reflection, which may contribute to student engagement with the task.

5.4.5 Future research

The mediation analyses showed complementary mediation of verbal interaction and engagement, indicating the existence of another mediator not included. To gain a comprehensive insight into the relationship between the evaluated design components and the perceived learning outcomes, future researchers might explore other mediators. An example of a possible mediator is described by Franssen, et al. (2011): interpersonal trust contributes to the building of shared mental models, which in their turn contribute to effective group work.

To yield more insights into the effectiveness of particular design components, future researchers might examine the relationships of those design components with learning outcome measures using a quasi-experimental design. In such studies, design components could be manipulated and objective learning outcomes could be used as outcome measures (such as test scores and observations).

5.4.6 Concluding remark

The relationship between students' evaluations of the implemented design components and the perceived learning outcomes was explored. The findings show that the extent to which GLAs contribute to positive student perceptions of the learning outcomes largely depends on how students evaluate the implemented design components and whether these evaluations are related to student engagement and student interaction.