— CHAPTER 3 —

A comprehensive framework for the design of group learning activities in higher education

Chapter 3 A comprehensive framework for the design of group learning activities in higher education[2]

In this chapter a thematic review is performed to synthesise insights from various approaches for designing group learning activities (GLAs) into one comprehensive framework. This comprehensive framework, the Group Learning Activities Instructional Design (GLAID) framework, includes eight components: (1) interaction, (2) learning objectives, (3) assessment, (4) task characteristics, (5) structuring, (6) guidance, (7) group constellation, and (8) facilities. Each component, associated design decisions, and the corresponding design process are described. The GLAID framework aims to guide teachers in higher education in designing, implementing, and evaluating GLAs in their courses.

[2] This chapter has been published in adapted form as: De Hei, M. S. A., Strijbos, J. W., Sjoer, E., & Admiraal, W. F. (2016). Thematic review of approaches to design group learning activities in higher education: The development of a comprehensive framework. *Educational Research Review, 18*, 33-45. doi: 10.1016/j.edurev.2016.01.001

3.1 Introduction

Group learning activities are a key ingredient of course designs in higher education and refer to activities during the learning process in which students collaborate in small groups to contribute to the attainment of mutual goals (Janssen, 2014). GLAs can be found in face-to-face, online (often also referred to as Computer Supported Collaborative Learning (CSCL), e.g. Isotani, Mizoguchi, Inaba, & Ikeda, 2010; Villasclaras-Fernández, Hernández-Leo, Asensio-Pérez, & Dimitriadis, 2009) and blended learning environments (i.e. Dillenbourg, 2002; Yeh, 2010). Group learning activities are claimed to foster higher-order skills (Kollar, Fischer, & Hesse, 2006) and shared knowledge construction (Hämäläinen & Vähäsantanen, 2011; Hmelo-Silver, 2004). In this thematic review, the term "Group Learning Activities" (GLAs) (Brown & McIlroy, 2010; Tomcho & Foels, 2012) is adopted to include terms such as collaborative learning, cooperative learning, problem-based learning and team-based learning. These terms all emanate from the constructivist view of learning and instruction (Kirschner, Martens, & Strijbos, 2004). Although the principles of learning environments can be different regarding a number of aspects, such as the origin of the domain, the flexibility of the format and the underlying learning theories, they have in common that students need to work together to attain learning benefits that cannot be attained by working individually.

Even though GLAs can contribute to learning outcomes such as students' engagement in learning and improvement in their higher-order thinking skills (Järvelä, Volet, & Järvenoja, 2010; Johnson & Johnson, 2003), these learning objectives are not always attained (Fransen, Kirschner, & Erkens, 2011; Hmelo-Silver, 2004; Janssen, 2014). Four factors decrease the likelihood that GLAs will lead to the desired learning outcomes:

(1) Resistance of students and teachers. Payne, Monk-Turner, Smith, and Sumter (2006) found that appropriate scaffolding of group work is necessary to overcome teachers' and students' resistance to GLAs.

(2) Problems with the use of technology to support GLAs. Technology to support GLAs, although present, is hardly used, because it is not user friendly or teachers are not trained in the use of the specific technology. Dillenbourg (2013) advocates orchestration, which includes the integration of pedagogy and technology.

(3) Designs of GLAs are not grounded in theories on teaching and learning. Hämäläinen and Vähäsantanen (2011) conclude that the designs of GLAs should be better grounded in theoretical knowledge about orchestrating, scaffolding, facilitating, and supporting students in the process of shared knowledge construction.

(4) Design components are not aligned. Design components – such as learning goals, task characteristics, instructions on how to collaborate, and support of this collaboration – are worked out separately (Dennen & Hoadley, 2013; Hämäläinen & Vähäsantanen, 2011; McLoughlin, 2002; Strijbos, Martens, & Jochems, 2004). Alignment of the components means that, in every decision about a component, the designer takes into account every decision made regarding other components in former steps.

These factors stress that the design of GLAs is a crucial issue to be considered for successful implementation of GLAs in higher education settings.

The issue of GLA-design is not new and various approaches for the design of GLAs exist. However, they differ in their design components and how the design process is structured. Moreover, the metaphors and vocabulary differ as well: designing for interaction (Strijbos, Martens, & Jochems, 2004), scripting (Kollar, Fischer, & Hesse, 2006),

orchestrating (Dillenbourg, 2013; Hämäläinen & Vähäsantanen, 2011), and scaffolding (McLoughlin, 2002). This variety makes it difficult for teachers to determine how to design a GLA. The current review aims to generate a comprehensive generic framework (for face-to-face, online and blended contexts) for the design of a GLA from a constructivist view on learning and instruction. The majority of research on the design components and the design process focuses on specific components of (the design of) GLAs (e.g., the most appropriate instruction to increase the effectiveness of small group interaction, such as the studies of Webb, Franke, Tondra, Chan, Freund, Shein and Melkonian (2009) and Saab, Van Joolingen and Van Hout-Wolters (2007)).

This chapter aims to generate an overview of existing design approaches of GLAs as well as a synthesis of these approaches to determine the crucial components for the design of GLAs in order to support designers and teachers in this complex matter. Hence, a thematic review for design approaches of GLAs was conducted, guided by the following research questions:

(1) How can the components of designing GLAs be synthesised into one comprehensive framework?

(2) How can teachers in higher education use this comprehensive framework in the design of GLAs?

3.2 Method

3.2.1 Procedure

In February 2014, a literature search was carried out using a combination of databases that are commonly used in systematic literature reviews, such as ERIC (Educational Resources Information Center), PiCARTA, Web of Science, Science direct, Taylor and Francis online, Sage Publications, Springerlink, Directory of Open Access Journals (DOAJ), PsycINFO, and Wiley Online library. The following search terms were used: "educational design", "instructional design", instruction*, "problem based learning", "team based learning", "inquiry based learning", "assignment", "task", "teacher role", "assessment", and "orchestration". These terms were combined with collaborati* or cooperati* or team* or group*/ or collective* (with * as a joker). The search terms were used in combination with the following basic criteria:

(a) manuscripts in English;
(b) studies in peer-reviewed journals, book chapters, or conference proceedings;
(c) manuscripts published after 2001.

The year 2001 was chosen because in the narrative review of Strijbos et al. (2004) on the design of computer-supported group-based learning the latest references used are dated 2001. The intention for the current review was to follow-up as well as to broaden the review of Strijbos et al. (2014).

3.2.2 Data

The searches yielded 1573 hits from which manuscripts with a main research focus on group learning *activity of students* were selected. Manuscripts were excluded if they, for example, referred only to students' *perceptions* of GLAs, or concerned studies about *schools* collaborating. This first selection contained 230 relevant studies. The selection was subsequently narrowed to a set of studies that was explicitly focused on the design of group learning activities, leading to 110 studies (second selection, see appendix B). Next, these 110 studies were analysed using the following criteria:

(a) the design of GLAs covers a time period that is longer than one lesson,
(b) the design of GLAs includes at least two *components*, which are instructional design features that can be manipulated,
(c) the study describes an overview of how to design GLAs based on peer reviewed literature (meta-study: narrative review, meta-analysis or theoretical abstraction).

An overall design approach of GLAs was initially identified in 12 meta-studies out of the selection of 110. In order to assure the reliability of this selection, the co-authors analysed in total 20 manuscripts out of the set of 110 studies; 15 of these were randomly selected and 5 manuscripts were selected because the first author had doubts whether these manuscripts could be considered design approaches. The co-authors assessed whether the manuscripts met the criteria for an overall design of GLAs and, therefore, should be included. The result was that one more meta-study (Chiriac & Grangström, 2012) was added to the selection of articles on design approaches. Furthermore, references that were identified as design approaches were further checked (snowballing) for any design approaches that did not show up previously. This yielded one more article used in the final selection (Kutnick, Blatchford, & Baines, 2002). Therefore, the final selection that used for analysis consisted of 14 meta-studies.

3.2.3 Analysis

In order to answer the first research question 'How can the components of designing GLAs be synthesised into one comprehensive framework?' a matrix of the 14 meta-studies was composed to (a) generate an overview of the design components per study, and (b) identify design components used across meta-studies for the design of GLAs. As a starting point for the analyses, Strijbos et al.'s (2004) study was used, which defines and describes six components for the design of GLAs: (1) interaction, (2) learning objectives, (3) task type, (4) level of pre-structuring, (5) group size, and (6) computer support. If a component was confirmed in at least two of the other meta-studies, this component was kept in the final comprehensive framework. If a new component was mentioned in at least two of the other meta-studies, it was added to the framework. This procedure led to a framework with eight components, which will be described in the results section.

This framework differs from the approach of Strijbos et al. (2004) in three ways: (1) Strijbos et al. (2004) focus on critical elements that directly shape interactional processes in a small group, whereas the new framework also includes elements that more indirectly shape the interaction in groups (i.e., guidance and assessment), (2) the new framework adopts a whole class and course perspective instead of the rather narrow small group perspective, (3) the aim is for the new framework to be applicable to face-to-face, blended and online learning environments, whereas the approach of Strijbos et al. (2004) is solely about online learning. The analysis resulted in two additional components (Assessment and Guidance) and an extension of three of Strijbos et al.'s (2004) original components: "group size" was extended to "group constellation", "pre-structuring" was extended to "structuring" and "computer support" was extended to "facilities".

To answer the second research question, 'How can teachers in higher education use this comprehensive framework?' an adequate procedure to guide teachers through the design process was searched for. Therefore, it was necessary to determine whether the components should be designed in a specific order (and if so, which order) and how the alignment between the components could contribute to a comprehensive design. To this end the ADDIE model (Reigeluth, 1999; Ross et al., 2008) was opted for. This is a general instructional design model that summarises the design process in five steps: (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation.

3.3 Results: Design components of group learning activities

The 14 meta-studies considered to describe a design approach of group learning activities consisted of two book chapters (Dennen & Hoadley, 2013; Dillenbourg, 2002), two meta-analyses (Janssen, 2014; Tomcho & Foels, 2012), eight literature reviews (Gros, 2001; Hämäläinen & Vähäsantanen, 2011; Hmelo-Silver, 2004; Kobbe, Weinberger, Dillenbourg, Harrer, Hämäläinen, Häkkinen, & Fischer, 2007; Kollar, Fischer, & Hesse, 2006; McLoughlin, 2002; Strijbos, Martens, & Jochems, 2004; Wilson, Ludwig-Hardman, Thornam, & Dunlap, 2004), and two literature reviews that also use empirical research to underpin their literature review (Chiriac & Granström, 2012; Kutnick, Blatchford, & Baines, 2002). Before describing the eight components, first the label of each component is related to the terminology/labels used in the 14 meta-studies that were reviewed.

The component "interaction" was found in six studies (Dillenbourg, 2002; Gros, 2001; Hämäläinen & Vähäsantanen, 2011; Janssen, 2014; Kutnick, Blatchford, & Baines, 2002; Strijbos et al., 2004). Two other studies also refer to interaction, but use a different terminology: (1) Wilson et al. (2004) use "Progressive Discourse" to describe the process of sharing, questioning and revising opinions within a learning community, and (2) Dennen & Hoadley (2013) use "discourse norms and values" to refer to participation expectations and process contributions of the learners.

The component "learning objectives and outcomes" was found in nine of the fourteen studies although the terminology differed: learning goals (Dennen & Hoadley, 2013; Hämäläinen & Vähäsantanen, 2011; Hmelo-Silver, 2004; Janssen, 2014), learning objectives (Kollar, et al., 2006; Strijbos et al., 2004), shared goals (Wilson et al., 2004), learning orientation (Dillenbourg, 2002) and goal orientation (Mc-Loughlin,2002).

Assessment is explicitly mentioned as a component by Chiriac and Granström (2012). Tomcho and Foels (2012) included the component "peer-assessment". In other studies, assessment is not explicitly mentioned as a separate component, but four studies referred to an assessment of the GLA that is to be designed: Dillenbourg (2002) speaks of "task completion criteria", Janssen (2014) refers to assessment when he describes rewards based on group or individual performance related to interdependence of the participants, and Strijbos et al. (2004) suggest to consider in the design of a GLA the grading of students.

Only Janssen (2014) used the term "task characteristics", although in seven of the studies similar terminology is used: tasks (Chiriac, & Granström, 2012; Gros, 2001; Kutnik, Blatchford, & Baines, 2002), task definition (Dillenbourg, 2002;), task types (Strijbos et al., 2014), task complexity (Tomcho & Foels, 2012), or task structures (Hämäläinen, &Vähäsantanen, 2011). In the other studies, authors refer to the task characteristics implicitly, such as using the "activities" (Kobbe et al, 2007; Kollar et al., 2006), "events and activities in collaboration scripts" (Dennen, & Hoadley 2013), and "role of the problem" (Hmelo-Silver, 2004). The term "task characteristics" was chosen, because this word seems to cover all terms related to the task in the other studies.

The component structuring refers to "roles" in four of the studies: Dennen and Hoadley (2013), Gros (2001), Kobbe et al. (2006) and Kollar et al. (2007). The term "distribution" is used by Dillenbourg (2002) when he refers to structuring. Finally, Chirac and Granström (2012) refer to structuring as "participation" ("all members take part in the work", p. 353), Strijbos et al. (2004) refer to "level of pre-structuring", Janssen (2014) refers to " pre-activity preparation" and Wilson et al. (2004) to "mutual appropriation". The term

Structuring, because this can take place before, during and after the collaboration.

The guidance component is referred to as the "role of the teacher" in four studies (Chiriac, & Granström, 2012; Hämäläinen, & Vähäsantanen, 2011; McLoughlin, 2002; Wilson, et al., 2004), and by Dennen and Hoadley (2013) as "Types of facilitation", by Gros (2001) as "tutoring", by Hmelo-Silver (2004) as "role of the facilitator", and by Kutnik et al. (2002) as "adult presence and support of groups".

The group constellation component is not used as a label in any of the studies, however, Strijbos et al. (2004) and Tomcho and Foels (2012 both refer to "group size", and other studies refer to "group composition" (Chiriac, & Granström, 2012; Dennen, & Hoadley, 2013; Dillenbourg, 2002; Hämäläinen, & Vähäsantanen., 2011; Janssen, 2014; Kobbe et al., 2007; Kutnik et al., 2002). The term "group constellation" was chosen, because "constellation" does not only refer to group size or how groups are composed but also to why groups are composed in a specific way.

The final component "facilities" is referred to by Dillenbourg (2002) as "mode of interaction", by Gros (2001) as "telematic support", by Hämäläinen and Vähäsantanen (2011) as "External resources", by Janssen (2014) as "Tools, support and scaffolds", and by Kobbe et al. (2007) as "Resources". However, these authors do not only refer to computer support, as Strijbos et al. (2004) do, but also to other means to support learners in GLAs, such as books, cases to work with, etc. Therefore the term "facilities" was opted for.

In the following section the eight design components will be described in more detail and they will be related to the original design approaches for GLAs. Furthermore, possible design decisions are distinguished that are discussed in the 14 meta-studies. These design decisions refer to considerations and choices teachers can make when designing a particular component.

3.3.1 Interaction

In the context of GLAs, "interaction" refers to the process of collaboration needed to attain the learning goals (Dillenbourg, 2002; Janssen, 2014; Strijbos et al., 2004; Wilson et al., 2004). There are two design decisions that can be addressed according to the studies considered in this review: (a) interaction about *declarative and procedural (domain) knowledge*, and (b) interaction as *social and metacognitive activities*.

In his literature review, Janssen (2014) distinguishes interaction aimed at gaining deeper understanding of the knowledge domain (for example, verbalizing ideas, asking questions to elicit important content information) and interaction aimed at attaining and maintaining a shared understanding of the task, well-being of group members, and group cohesion. The latter kind of interaction includes meta-cognitive activities that consist of regulative activities such as planning, monitoring, and evaluating the collaboration. Other authors also address the collaborative interaction process, including (meta-) cognitive and social activities of students by which they learn to understand each other and to regulate their way of working in GLAs (Dennen & Hoadley, 2013; Dillenbourg, 2002; Gros, 2001; Hämäläinen & Vähäsantanen, 2011; Hmelo-Silver, 2004).

3.3.2 Learning Objectives and Outcomes

The second design component extracted from the selection of studies refers to learning objectives or learning goals. Learning objectives are defined as the intended learner outcomes regarding declarative and procedural (domain-specific) knowledge or (social) skills. Strijbos et al. (2004), and Dillenbourg (2002) emphasize that learning objectives should be designed

simultaneously with the desired interaction. In the studies the following design decisions for the learning objectives component were found: (a) *the goal setting*, and (b) t*he content of learning*.

Goal setting. The design can focus on individual learning goals (e.g., learning to give feedback to a peer or to acquire knowledge about a particular topic) as well as group learning goals (such as achieving shared understanding) (Janssen, 2014). Wilson et al. (2004) emphasize that "(...) by establishing goals and rules that mandate interaction and co-dependence, students can develop a shared goal that gives real purpose in collaboration" (p. 5). Thus, learning objectives do not always have to be set in advance by the teacher, but can also be formulated collaboratively by the students during the process of a GLA. Moreover, Kollar, Fischer, and Hesse (2006) state that the "goal-setting control", i.e., who has control over determining what the learning goals are, is also part of the design of GLAs. Learning goals may be set by the educational designer or the teacher, but also by the students themselves, possibly together with the teacher.

Content of learning. In his literature review, Janssen (2014) describes two types of learning objectives: 1) declarative and procedural knowledge about a specific domain or subject and 2) social skills, such as how to give each other compliments, provide positive feedback, and contribute to group cohesion. Gros (2001) also distinguishes two kinds of learning objectives, which she labels "specific content" and "procedural learning". Hmelo-Silver (2004) labels learning goals related to these social skills as the learning objective of knowing how to function well as part of a team. Both Hämäläinen and Vähäsantanen (2011) and Kobbe et al. (2007) emphasize an "open" design of the learning goals. The former authors state that "the learning goal and its contextual needs set the limits for how much learning should be designed and instructed" (p. 179), and the latter authors claim that the type and the degree of learning depends on the kinds of activities that are described in the collaborative task. This perspective relates to the studies by Dennen and Hoadley (2013) and Strijbos et al. (2004), who emphasize that in collaborative learning the learning outcomes are probabilistic. This means that it depends on the context which particular learning goals can be achieved by the learners through the GLA, and to what extent.

3.3.3 Assessment

The assessment component refers to measuring the extent to which students attain the learning goals of a GLA design. The description of assessment in the 14 studies leads to the conclusion that teachers should decide on (a) what means they will use for the assessment (Janssen, 2014; Strijbos et al., 2004; Tomcho & Foels, 2012) and (b) what criteria they will use (Dillenbourg, 2002; Chiriac & Gronström, 2012). These 'big' decisions about assessment are based on other 'smaller' decisions such as:

1) *Individual or group assessment*: whether an individual or a group assessment is conducted, or a combination of both. Chiriac and Granström (2012), for example, emphasize that the reward system should match the task, and that assessment procedures should stress group as well as individual accountability.
2) *Assessor*: this refers to the use of co-assessment, peer assessment, and self-assessment. Tomcho and Foels (2012) discuss the contribution of peer assessment in relation to the effectiveness of group learning activities. They suggest, in line with Chiriac and Granström (2012), that if peer assessment is used the criteria should be clear and developed together with the students.
3) *Formative or summative*: this concerns the decision to use assessment for learning or

assessment of learning. The probabilistic outcome and the decision whether goals should be fixed or focused (Dennen & Hoadley, 2013; Strijbos et al., 2004) require consideration of whether the assessment should be formative or summative.

4) *Number, timing, and integration* of assessment measures. One of the task characteristics of a GLA (described in 3.4) implies that it can be divided into several phases (Dennen & Hoadley, 2013; Dillenbourg, 2002; Kobbe et al., 2007; Kollar et al., 2006) that contain different activities in which students work on the attainment of (a variety of) learning objectives. This variety of learning activities can be assessed separately or as a whole.

3.3.4 Task Characteristics

The task characteristics are the activities that students have to perform to attain the learning objectives. From the studies the following design decisions that teachers at least should make in designing a task for GLAs were derived: (a) *kind of activities* (task type), (b) *phases in or sequencing of activities,* (c) *duration and frequency of group meetings,* and (d) *performance control.*

Kind of activities. Requirements for tasks that result in "real group work" imply that a task demands common effort, employing the group's competence and joint problem solving (Chiriac & Granström, 2012). As task types for GLAs, complex authentic tasks, i.e., tasks that require open skills (i.e., Gros, 2001; Hämäläinen & Vähäsantanen, 2011; McLoughlin, 2002), and activities that concern problem solving (i.e., Hmelo-Silver, 2004) are often recommended for GLAs.

Phases in or sequencing of activities. In a GLA, the task can consist of several activities in a particular sequence (Dennen & Hoadley, 2013; Dillenbourg, 2002; Kobbe et al., 2007; Kollar et al., 2006). The sequencing of activities can also be referred to as dividing GLAs into different phases. The activities can be collaborative, but it is also possible that one or several phases include individual activities. It should be specified for each phase how the students should collaborate (component Structuring, see 3.5) and how they are to work on the task.

Duration and frequency. According to Dillenbourg (2002), the duration of the activities of students in a task should be designed as well. Therefore, it may be beneficial to determine whether a certain frequency of collaboration is necessary and how many group meetings are required.

Performance control. In line with the learning objectives and the assessment, the design of the task implies considerations about who decides how the task will be performed, that is, the performance control (Kollar et al., 2006): the teacher, the students, or the teacher together with the students.

3.3.5 Structuring

Collaborative interaction between students does not automatically develop and continue during GLAs. Therefore, some kind of structuring is needed to support the process, ensuring positive interdependence and individual accountability (Johnson & Johnson, 2009). From the 14 studies can be concluded that teachers can decide during different phases of GLAs how to structure the GLAs, distinguishing between (a) structuring *a priori,* (b) structuring *during GLAs,* and (c) *reflection on and evaluation of* the collaboration.

Structuring a priori. In the14 studies the framework is based upon, the use of roles is considered an important approach to structure student interaction (Dennen & Hoadley, 2013; Dillenbourg, 2002; Gros, 2001; Janssen, 2014; Kollar et al., 2006; Kobbe et al., 2007; Strijbos et al., 2004). Strijbos et al. (2004) describe structuring of GLAs along the

continuum highly structured (strong task division) to poorly structured (no task division). Janssen (2014) describes two ways to structure the interaction: reward-interdependence (e.g., giving a group grade) and task-interdependence (e.g., dividing the resources amongst group members or by assigning roles). Supporting materials (also described in the facilities component: 3.8) can be distributed amongst students to induce social interdependence – students need other students to access the resources (Kobbe et al., 2007; McLoughlin, 2002) – or to induce controversy by providing students with materials containing conflicting evidence (Hämäläinen, & Vähäsantanen, 2011). Wilson et al. (2004) state that a designer needs to establish clear rules and support for including all group members in the activities and decision-making processes. In other words, teachers should include students in the collaboration process by structuring it. Another way to structure how students should collaborate before they start working on a GLA is to provide them with training in collaborative skills. Such training can contribute to on-task behaviour, higher levels of task-related discussions, high-level elaborations, and social skills (Janssen, 2014).
Structuring during GLAs. Structuring during GLAs gives the teacher the possibility to adapt the way students collaborate. Structuring the collaboration during the activities is described, for example, by Chiriac and Granström (2012), who state that the teacher needs to support student collaboration during the group work. McLoughlin (2002) states that teachers should monitor the collaboration of their students and intervene during the process. She describes that in online settings it is possible to provide students with scaffolds for collaboration using tutorial supports, for example, by using a FAQ (frequently asked questions)-tool with input from a moderator if needed.

Reflection and evaluation. Related to structuring is reflection on and evaluation of the collaboration and interaction by students. Hmelo-Silver (2004) states that after completion of the task students should reflect on whether they attained the learning goals, how they collaborated, and how they managed to direct their own learning. Gros (2001) and McLoughlin (2002) also stress the importance of evaluating the collaboration process to help students determine how well their group is functioning.

3.3.6 Guidance

"Guidance" is defined in the framework as the coaching of students during GLAs, supporting their learning process during collaboration. In the studies the following decisions need to be made for the design of the guidance were found: (a) *executor*: who guides the students (i.e., teacher, peers, software), (b) the *teacher's role* (i.e., facilitator, expert, coach, or observant), (c) the *communication mode* (e.g., oral, written, or electronically such as email, texting, or discussion fora), and (d) the *duration and the timing* of the guidance (i.e., in what phase do the learners need which form of support).

Executor. The guidance can be performed by persons or technology. The teacher may guide the GLA, but the collaborating students also may guide their peers during a GLA. Kutnick et al. (2002) describe that it should also be considered whether groups can work on a GLA autonomously, guiding themselves during the assigned task. Furthermore, technology can support students in the GLA, for example, Kollar et. al. (2006) examined prompts or guiding questions for learners to discuss a particular topic.

Teachers' role. The teachers' role can consist of monitoring interaction and learning (Dennen & Hoadley, 2013; Dillenbourg, 2002; Gros, 2001; Hmelo-Silver, 2004; Wilson et al., 2004), guiding and supporting student activities (Chiriac and Granstrom, 2012; Dennen & Hoadley, 2013; Gros, 2001; Hämäläinen and Vähäsantanen., 2011; Kutnick

et al., 2002; Wilson et al, 2004), providing feedback on the collaboration and the outcomes of student activities (Dennen & Hoadley, 2013; Dillenbourg, 2002), and evaluating the process of collaboration and learning (Gros, 2001; McLoughlin, 2002).

Communication mode. The guidance of a GLA can be performed orally by the teachers or the peers in a face-to-face or electronic group meeting (e.g., video-conference), but also written (electronically). McLoughlin (2002) for example describes threaded computer conferencing when a problem should be solved collaboratively.

Duration and timing. As GLAs can consist of different phases, the extent of the guidance and the kind of guiding activities can differ per phase. Guiding the process of a GLA is a subtle skill (Dillenbourg, 2002; Hmelo-Silver, 2004). It requires the teacher to be proficient in metacognitive questioning. Furthermore, the teacher should be skilled at posing questions that focus students' attention on the learning goals and the task. The guidance should also aim at eliciting causal explanations. Timing the different phases of a group learning activity and thereby also the timing of the guidance is important. Teachers should determine whether the guidance is obligatory (at fixed moments or a specific number of times) or on demand (Dillenbourg, 2002; Strijbos et al., 2004). Hämäläinen et al. (2011) stress that teachers need to consider how to give guidance *at the right moment* (when and for as long as it is needed).

3.3.7 Group Constellation

Group constellation refers to how groups of students are composed. Based on the 14 studies, at least the following design decisions should be taken into account: (a) *number of groups* and *group size*, (b) *heterogeneous or homogeneous groups*, and (c) *group duration*.

Number of groups and group size. Depending on the learning goals and task characteristics, and the number of students taking part in a course, the number of groups and the group size can vary (Kobbe et al., 2007; Kutnick, et al., 2002). For example, Kutnick et al. (2002) found that teachers mostly teach dyads and triads in tasks that involve application of knowledge to new areas, and that teachers teach with large groups (7-10) for tasks that involve introduction of new information. Both the quantity and the quality of the interaction between participants are likely to differ with different group sizes (Chiriac & Granström, 2012; Janssen, 2014; Strijbos et al., 2004). Chiriac and Granström (2012) found that students consider a group with about three members the optimal size, and students feel that larger groups (more than six members) are a hindrance to good group work. However, both Janssen (2014) and Strijbos et al. (2004) state that the effects of group size are inconclusive and further research is needed

Heterogeneous or homogeneous. The composition of the groups can be either homogeneous or heterogeneous (Dennen & Hoadley, 2013; Janssen, 2014), which influences the productivity of the student interaction (Hämäläinen & Vähäsantanen, 2011). The criteria used for the composition can be either set externally, for example, by age, gender, friendship, level of ability or expertise, domain of expertise, or geographical, social, or cultural background, or set internally by, for example, student behaviour or the products of previous phases of the GLA (Dillenbourg, 2002).

Group duration. In their meta-analysis, Tomcho and Foels (2012) found a negative relationship between group duration and learning outcomes: the learning outcomes diminish as the time the same students work together increases. They suggest varying the group constellation during a GLA. In contrast, Wilson et al. (2004) stress the importance of continuing in identical groups in subsequent courses as this stimulates a collective identity

within bounded learning communities in formal courses. Therefore, it is suggested that group duration should be aligned with the task characteristics as well as with duration of the activities. As activities can differ per phase of the GLA, the teacher also has to decide whether each phase should have different groups or not (Tomcho & Foels, 2012).

3.3.8 Facilities

The component Facilities embraces all supporting materials, virtual and physical, to facilitate GLAs. The authors of the studies mention the following design decisions of the facilities component: (a) *learning resources,* (b) *technology resources,* and (c) *space and time* for the GLA.

Learning resources. Learning resources can consist of (a) information resources, e.g., books, articles, websites, case descriptions, concept maps, or graphical diagrams, (b) functionality resources, e.g., software, tools such as calculators, libraries or dictionaries, and (c) modifiable resources, e.g., argument sheets or tables to complete (Kobbe et al., 2007). Those resources can be made available physically or on computers.

Technology resources. In this design decision is referred to the use of computers, mobile phones, and any other possible technology students can use to communicate, interact, and collaborate. For example, teachers can decide whether students collaborate with technology or through technology, whether technology is used to support synchronous or asynchronous collaboration, and whether technology is used as a resource to facilitate and structure GLAs (Dillenbourg, 2013; Strijbos et al., 2004), to online assess GLAs (Strijbos, 2011), or to implement learning analytics (Suthers & Verbert, 2013).

Space and time. In terms of contextual settings, two more aspects could be considered: the time students have available to work on the GLA (Chiriac & Granström, 2012; Dillenbourg, 2002) and the available physical and/or electronic space for the groups to work together (Chiriac and Granström, 2012; Gros, 2001).

3.4 Results: Alignment of the components

To design GLAs it is necessary to determine how the eight components should be used in the design process. This means that a decision has to be made in which order the components should be designed as well as how they can be aligned. Alignment between the components is described by several studies as very important for a successful design (Dennen & Hoadley, 2013; Hämäläinen & Vähäsantanen, 2011; McLoughlin, 2002; Strijbos et al., 2004), but specific recommendations on how to achieve such alignment are missing. In order to shape the alignment in the design of GLAs the ADDIE model is used (a general model commonly used for instructional design). The Group Learning Activities Instructional Design (GLAID) framework thus mirrors the five general steps of instructional design (see Table 1). Only steps 2 and 3 refer to the design of GLAs; the other steps are not specific to the design of GLAs and include preparing the design (step 1) or refer to activities that occur after the design: the implementation and the evaluation (steps 4 and 5).

Step 1: Analysis. The process of designing a group learning activity starts with determining the *fixed characteristics* of the learning environment. The teacher ascertains what characteristics are already fixed in the curriculum, (e.g., the number of students), and what characteristics should be fixed: (e.g., whether there should be criteria for the students to be allowed to participate). The teacher inquires what is already known about student characteristics, for example their prior knowledge about collaboration and the learning content (Brown & McIlroy, 2011; Kobbe et al., 2007, Kollar et al., 2006). If the teacher who designs the GLA does not conduct the GLA, she/he also needs to determine (a) characteristics of the teacher(s) assigned to conduct the GLA, such as experience in and knowledge about the domain and guiding group learning activities (Hämäläinen, & Vähäsantanen, 2011; Ozdilek, & Robeck, 2009; Siegel, 2012; Van den Akker, McKenney, Nieveen, & Gravemeijer, 2006), and (b) curriculum characteristics, such as the social and physical characteristics of the learning environment and the cohesion of the different curriculum parts (Van den Akker et al., 2006). The designer also needs to decide on the collaborative premise (Dennen & Hoadley, 2013; Van den Akker et al., 2006): why students need to work together. Three of the 14 studies stress the importance of determining the fixed characteristics beforehand (see Hämäläinen & Vähäsantanen, 2011; Kobbe et al., 2007, Kollar et al., 2006).

Step 2: Design. The design of three components is included in step 2: interaction, learning objectives and outcomes, and assessment. These components are designed simultaneously because they need to be aligned with one another, and with the fixed characteristics of step 1.

Step 3: Develop. In step 3, the design activities are divided in two sub-steps: the instructional strategies (step 3a), and the logistics, which are the organizational decisions needed to facilitate the instructional strategies (step 3b).

Step 3a: Instructional strategies. The components from the 14 studies that relate to instructional strategies are as follows: the tasks students have to complete (component task characteristics), structuring student collaboration and interaction (component structuring), and how students can be guided through the group learning process (component guidance). The instructional strategies described in those three components need to be aligned, taking into account the fixed aspects of step 1 and the design decisions in step 2.

Step 3b: Logistics. In this step, the design decisions refer to two components: the composition of groups (component group constellation) and the facilities that students need to carry out the tasks (component facilities). As in the former steps, the decisions regarding these two

components should be aligned. The design of these two components should also be aligned with the results of all earlier decisions of step 1, step 2, and step 3a.
Step 4: Implementation. In the framework, step 4 concerns the implementation of an instructional design. In this step, the process of the GLA should be monitored. Each design component should be monitored separately and in alignment with (all) other components and, if necessary, components and their alignment should be adjusted.
Step 5: Evaluation. The final step consists of the evaluation of both the design and the implementation of GLAs. The evaluation of the components and their alignment can help in effectively evaluating the processes and outcomes of the designed GLAs and inform redesigns of GLAs. The design components inserted in the GLAID framework can be found in Table 1.

Table 1 summarises the comprehensive framework for the design of group learning activities. It is called the GLAID (Group Learning Activity Instructional Design) framework; it is a synthesis of 14 studies of GLAs. In order to ensure adequate alignment it is recommend that teachers design the components in a *linear* as well as in a *cyclical* manner. Figure 1 illustrates how the alignment of the eight components could be established by using the GLAID framework for the design of a GLA. Such alignment will also depend on the institutional environment, for example whether the designer can decide on criteria for student admission, which teacher(s) will be guiding the GLA, or what facilities are available.

Figure 1 Illustration of the application of the GLAID framework.

The *learning objective* of a GLA in this example is described as the ability of students *to help each other* to develop oral presentation skills. This means that the teacher needs to decide how the *interaction* regarding this learning objective should take place. Perhaps students have to give each other feedback on an oral presentation. As *helping* is the learning objective, and not the oral presentation itself, the assessment should focus on grading the quality of students' helping behaviour. This also means that giving each other feedback in order to help in the development of presentation skills should be one of the activities described in the *task characteristics*. The task, therefore, should be to give an oral presentation (which is conditional for providing feedback on presentation skills) as well as provide feedback on the presentations of peers. *Structuring* the collaboration and interaction between students to attain this learning objective can be performed by the teacher by determining in what manner (for instance, by using a given format) and how often students should provide feedback. Another consideration as part of structuring could be whether the teacher prescribes the manner of providing feedback or whether the students are allowed to determine themselves how they organise the feedback sessions. The extent and the manner of *guidance* the teacher foresees as necessary is what should be decided next. This guidance should be focused on coaching students in how to provide feedback. The next step in the design is to determine the *group constellation*: what group size and composition is the most suitable for this task. The teacher could decide, for instance, that groups of four students are suitable, consisting of two more and two less skilled students. The *facilities* for helping each other may be instructions for and formats of providing feedback, and a digital environment that enables students to watch the presentations of their peers multiple times, and to download all information and upload their feedback.

Table 1 Design components and possible design decisions of the GLAID framework.

Step 1: Analyse	Determine Student characteristics		
	Determine Teacher characteristics		
	Determine Curriculum characteristics		
	Determine Collaborative premise		
	Determine Global goals		
Step 2: Design	**Interaction**	**Learning objectives and outcomes**	**Assessment**
	Declarative and procedural (domain) knowledge	*Goal setting*	*Means*
		Content of learning	*Criteria*
	Social and meta-cognitive activities		
Step 3: Develop			
Step 3a: *Develop Instructional Strategies*	**Task characteristics**	**Structuring**	**Guidance**
	Kind of activities	*A priori*	*Executor*
	Phases/sequencing	*During GLA*	*Teachers' role*
	Duration and frequency of group meetings	*Reflection and evaluation*	*Communication mode*
			Duration and timing
	Performance control		
Step 3b: *Develop Logistic*	**Group constellation**	**Facilities**	
	Number of groups and group size	*Learning resources*	
		Technology resources	
	Heterogeneous or homogeneous	*Space and time*	
	Group duration		
Step 4: Implement	Monitor the instructional process		
Step 5: Evaluate	Evaluate the processes and outcomes		

3.5 Discussion and conclusion

The current study aimed to develop a comprehensive framework that teachers in higher education can use to design GLAs. The first research question concerned how various components for the design of GLAs can be synthesised into one theoretically informed comprehensive framework. To develop this comprehensive framework 14 meta-studies that describe design components of group learning activities were analysed. Eight components for the design of GLAs were extracted: (1) interaction, (2) learning objectives and outcomes, (3) assessment, (4) task characteristics, (5) structuring, (6) guidance, (7) group constellation, and (8) facilities. In addition, multiple design decisions within each component were distinguished.

The second research question focused on how teachers in higher education can use this comprehensive framework for their teaching. Therefore, these eight components were inserted in steps 2, 3a, and 3b of the ADDIE model, resulting in a comprehensive framework for the design of Group Learning Activities: the GLAID framework. Prior to step 2, characteristics of the students, the teachers, and the curriculum should be determined, as well as the collaborative premise. In step 2 of the GLAID framework, the design process of a GLA starts with designing the interaction, the learning objectives, and the assessment simultaneously. This is followed by step 3a, in which the instructional methods, task characteristics, structuring of the collaboration, and guidance, are designed. Finally, in step 3b, the logistics are designed: the group constellation and the facilities. In each step and between steps, the components should be aligned with each other in order to ensure an effective design (linear and cyclical alignment).

3.5.1 Limitations

For the sake of clarity, the design of group learning activities was separated into components and clustered in three steps (2, 3a, and 3b). However, these steps relate to one another and have a certain amount of overlap. An example is peer feedback: it can be used for assessment purposes and, therefore, may be regarded as part of the Assessment component, but it can also be considered as part of the Interaction component, the Task component, or the Guidance component, depending on the purpose of peer feedback.

Furthermore, the design decisions deduced from the fourteen meta-studies are not exhaustive. Design decisions to illustrate the choices explicated in the fourteen meta-studies per design component were described. Many more examples can be found elsewhere for each component and component related issues, such as sequencing activities or assessment for/of learning. The advice for educational designers is to consult additional literature for each of the GLA components whenever there are issues raised as to how it can be shaped best.

Although many studies on GLAs originate from studies on collaboration with and through technology, technology in the GLAID framework is addressed within the component facilities. As with other types of facilities, the use of technology can strongly influence how the other components are designed so as to trigger effective and efficient GLAs (e.g. Zahn, Pea, Hesse, & Rosen, 2010). However, attention for the quality of course design should precede attention for the technological facilities (Bernard et al., 2004).

3.5.2 Practical implications

This section will elaborate on how the newly developed GLAID framework can support teachers in higher education with their design, implementation and evaluation of GLAs. It is not the intention to suggest that the design of GLAs always starts from scratch, although teachers should make decisions for all components.

First, in university teaching parts of the curriculum are sometimes fixed and the design has to be aligned with these fixed parts. Examples of fixed curriculum parts are: a task that is an obligatory part of the curriculum (such as students performing market research for a client), learning objectives students need to attain in a specific academic year (such as students showing they are able to perform a math lesson for a third grade primary school class using specific didactics) and student characteristics (such as whether they are freshmen or sophomores; prior knowledge or experience of the students). Using the GLAID framework to design a new GLA in this case means that the components or steps that are fixed in the curriculum serve as the starting point. The design of all other components is aligned with what is already fixed.

Secondly, parts of a course can already exist for some years, and teachers may want to adjust an existing GLA design for the new academic year. In this case the components of the GLAID framework can be used to evaluate the design per component, taking into account former experiences of the teacher(s) with this GLA and student evaluations of the GLA. For example, students can provide feedback about (the lack of) clarity in the description of the task or learning objectives, the teacher may have experienced shallow student conversations that did not contribute to them attaining the desired learning outcomes. Part of this evaluation could also be whether the components were aligned properly (e.g., whether the assessment was suited given the learning objectives).

One major aspect to take into account in the design of GLAs is the collaborative premise: the reason why students need to work on a particular assignment collaboratively. If the assignment can be performed equally successful by individual students, this may lead to a resistance to the group work. Teachers should justify why student interdependence is an important part of the learning process and how the collaboration is related to the attainment of the learning goals (Dennen and Hoadley, 2013). Teachers are advised to start every GLA design or redesign with the consideration of the collaborative premise and be explicit to students about why it is necessary for them to collaborate.

The GLAID framework should not be used as a one-size-fits-all solution. Dillenbourg (2002) already pointed out the risk of over-scripting collaborative learning, and asks whether "the fun and the richness of group interactions will survive the quest for effectiveness" (p. 61). He stated that the answer lies in the design rationale: the designer should keep in mind how the expected interactions can lead to the desired learning effects. Dennen and Hoadley (2013) and Strijbos et al. (2004) both noted that collaborative learning has a probabilistic outcome: there is no certainty what the outcomes will be, because of the uncertainty of human interactions. Hence, learning goals can be designed for, but their attainment by all students is not guaranteed by the design. For example, formulating the learning objectives together with students can be part of the design of a GLA (i.e., Wilson et al., 2004; Dobber, Akkerman, Verloop, Admiraal, & Vermunt, 2012). This flexible way of designing GLAs is possible using the GLAID framework too, as the framework is not about fixing the components, but about making decisions on how to design these components. Teachers should adapt components of the design during the implementation whenever this seems to be necessary for students to attain the learning goals.

Another possible danger of fixing the script may be a discrepancy between the design of the GLA (the external script) and the students' internal script of collaborative learning (Kollar et al., 2006). If the design of the GLA is not adaptive to students' prior knowledge of collaboration, their collaboration skills, and how they evaluate collaboration, this will have a negative impact on the attainment of the learning goals. In GLAs, students need to come to a mutual understanding, have to learn to collaborate, and need to have a common understanding of the task (Beers et al, 2005). Therefore, students need to attune their internal collaboration scripts and come to a mutual understanding of the external collaboration script (Kollar et al., 2006). Teachers could check whether the external collaboration script (what students should do) is congruent with students' internal collaboration script (what students are inclined to do).
In sum, although the structuring approach to the design of GLAs is considered important for its effectiveness and efficiency, educational designers should consider how much of the design needs to be fixed and which parts of the design can be kept more flexible and adaptable to its users.

3.5.3 Concluding remarks

The GLAID framework is developed for the design of GLAs to guide educational designers and teachers in higher education in the complex process of designing group learning activities. Additionally, the framework can be used for the monitoring and evaluation of GLAs. Finally, the framework can also be used to interpret the outcomes of research on GLAs in higher education in terms of all design components that can be used in designing group learning activities in higher education.