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Cultivating the next generation designers: group work in urban and regional design education

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Abstract

This article contributes to the discussion about learning from group methods in design education. Based on action research results, it presents and reflects on teaching activities related to urban and regional design in TU Delft, Faculty of Architecture and the Built Environment, conducted and coordinated by the authors. Constructive alignment of the teaching triangle and feedbacks from students and teachers are used to assess the effectiveness of learning from group methods in these courses from the perspective of teaching quality. The evaluation does not aim for revealing missing components or links in theory on design education. Instead, it is using existing theories to analyse education practices, for a better understanding and performance of group work in a specific field of design education. The conclusions of the article focus on pros and cons of group work in urban and regional design education, with highlighted common challenges for teaching, such as assessment on individual performance, as well as specific ones, such as stimulating ‘out of the box thinking’ and supervising interdisciplinary groups.

Keywords Group work · Collaborative learning · Design studio · Constructive alignment

Introduction: collaborative learning in urban and regional design education

In the light of sustainable urban development, urban and regional design education is playing a crucial role in cultivating the next generation spatial designers who are expected to contribute proactively to the transformation of the society and the built environment towards more sustainable future cities and city-regions. The nature of sustainability implies certain sets of exit qualifications of students in spatial design education: they should be able to understand the interrelations among science, technology, society and design, with communication skills that are required in the collaborative design and decision-making

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processes (Schweitzer et al. 2008). In practice, achieving sustainability requires co-operation and co-creation between societal actors: practitioners from a variety of disciplinary fields, civil servants, civil society and individual citizens (McLaren and Agyeman 2015). Besides, the cities of today and tomorrow are in need of trained professionals (such as urban planners/designers, landscape architects, real estate developers, engineers, etc.), who can work in multi-actor environments (Rooij and Frank 2016). Therefore, programmes and curricula need to incorporate learning and teaching approaches that prepare students in higher education for working in co-creation settings by purposefully exposing them to learning environments that involve the community, science and practice (ibid.).

Group work¹ is used in design education to facilitate understanding and experiencing collaborative design processes. However, teachers need to understand its pros and cons, since group-working processes are complex and can have a profound influence on the learning experience of students (Reynolds 2013; Lawson and Dorst 2009). Among the literatures on group work in design education, few are focusing on urban and regional design education. Besides, it is unclear to what extent existing theories on group work in design education, in general, can contribute to a better understanding and teaching quality in the specific field of education practice on urban and regional design. This article intends to fill such knowledge gap, with action research results based on four courses that embrace intensive group work in TU Delft at the Faculty of Architecture & the Built Environment (A&BE), conducted and coordinated by the authors. They all use group work as the main teaching method, covering various stages of study in Bachelor and Master education, and multiple tracks, from Architecture to Urbanism and Management in the Built Environment. Such variety in teaching programmes may help to understand the role of group work in urban and regional design education more thoroughly than only focusing on one particular course. Two types of theories are used to analyse these courses: the ones for understanding the nature of urban and regional design education, such as multi-actor ways of working, situated learning, etc.; and others on teaching quality, such as group dynamics, the constructive alignment in teaching triangle, etc.

Based on the theoretical and empirical studies, the following research questions will be answered:

1. What are the main pros and cons of group work in urban and regional design education in general?
2. How is group work incorporated in urban and regional design courses to help train next generation designers, from the perspective of constructive alignment of the teaching triangle?
3. What are the challenges for teachers supervising group work in urban and regional design studios?

The article starts with a literature review on group work in design education in general and its implication in the specific context of urban and regional design education. Aspects involved include the changing nature of urban and regional design education on multi-, inter-, and transdisciplinary education, group work as a situated learning method, and the importance of group dynamics. The review highlights the knowledge gap on collaborative learning in urban and regional design education, from the perspective of teaching quality.

¹ Group work applied for efficiency is another perspective, but not in this article.

The article will then introduce and compare the collaborative learning approaches of the four TU Delft courses, focusing on the constructive alignment in the teaching triangle and feedbacks from students and teachers. To conduct this comparative study, teaching materials and a variety of evaluation documents are analysed (to ensure that the feedbacks are not biased). These case studies will lead to conclusions and discussion on pros and cons of group work in urban and regional design education and recommendations for a better performance. The results can be applied to other design faculties that provide similar education as TU Delft.

Literature review: the essence of group work in design education

Co-operation and multi-actor ways of working

Students of today need to possess professional skills of tomorrow, among which co-operation and intercultural communication skills are essential. The nature of the urban and regional challenges we are facing is complex while planning practitioners are encountering a changing urban environment full of uncertainty in the workplace. Multi-actor teams are becoming standard practice to search for solutions that can tackle the so-called wicked problem (Rittel 1972). Sometimes this more complex understanding also requires an interdisciplinary effort to facilitate the integration or synthesis of knowledge. According to Stember (1991, p. 5), the interdisciplinary effort seeks to “explicate relationships, processes, values, and context using the diversity and unity possible only through collaborative approaches”. Furthermore, our field is looking for (future) professionals who can work in transdisciplinary teams, cooperate and co-create with a variety of stakeholders seamlessly: from academics to policymakers and politicians, from business people to civil society representatives (Rooij and Frank 2016; Davoudi 2010).

These multi-actor ways of working and approaches (Table 1) have become the standard for practice and thus should be the norms of higher education. This has substantial consequences didactically, in terms of defining learning objectives, learning activities and assessment strategies (De Greef et al. 2017). They directly influence not only the cognitive domain related to disciplines (knowledge and skills), but also the attitude domain: multi-actor ways of working need collaborative attitudes such as open-mindedness, cultural awareness, and awareness of own cognitive biases when dealing with data (ibid.).

Situated learning in design education

Group work, with its nature of collaboration among team members, has been used as a main method for teaching multi-actor ways of working in design education. Lawson and Dorst (2009) addressed group work in design education from the perspective of creating expertise collectively. They mentioned the value of ‘situated learning’ and ‘communities of practice’, the relationship between learning and the social situation in which it occurs. In this sense, design education should be understood in relation to practice, and in relation to developing design expertise.

In practice, people working together towards a common goal is the basis of a successful collaborative design project, which starts with and is conditioned by shared values and common ethics (Emmitt 2017). It is valuable to make a shared vision among the design team members before designing and make use of workshops for collective design activities

Table 1 Multi-actor approaches (based on: Rooij and Frank 2016; Davoudi 2010; Stember 1991)

A <i>cross-disciplinary</i> approach is a way of working, in which one discipline is looked at from the perspective of another	(RE)Framing	
A <i>multidisciplinary</i> approach is a way of working, in which the professionals from different disciplines contribute to the same design and/or planning task	Interaction	
An <i>interdisciplinary</i> approach is a way of working, in which the professionals from different disciplines together and integrally define the design and/or planning task. All involved disciplines are encouraged to cross their disciplinary boundaries, because all actors 'understand' that the problem at hand is too complex to tackle with the separate disciplinary concepts and/or methods	Integration	
A <i>transdisciplinary</i> approach relates to the co-operation between scientists and other actors from society, such as practitioners, policymakers, civil servants, companies et cetera in order to solve complex societal design and/or planning tasks	Co-creation	

(Rizal 2007). There are different types of meetings and workshops that could be used for collaborative design ways of working (such as design progress meetings, design team meetings, review meetings, knowledge exchange meetings, collaborative planning workshop, creative problem-solving workshop, value management and engineering workshop, team building workshop, etc.). Similarly, the design studio approach with group work is one of the main teaching activities in design education, where learning by doing (and implicit or explicit reflecting) happens. Design studios often use teamwork and the contribution of special competencies from several team members to problem analysis and solution development (Long 2012). It is where students most probably learn more from each other through the collaborative learning process than from their tutors.

In recent years, using urban living labs (Steen and Van Bueren 2017), is a new way in both research and education for developing knowledge on innovation and process—how to innovate in interactive, participatory co-creation processes. In most urban living labs, users, private sectors and public sectors work together with knowledge institutes to create and test solutions in real-life contexts. Due to the fact that design studios in universities usually involve little real interaction with stakeholders in the design process, such a setting is, only to a certain extent, mimicking the practice via role simulation. There are alternative solutions to cope with this problem though. Some role-playing and policy gaming literatures (De Caluwé and Stoppelenburg 2002; Geurts et al. 2007) describe interventions that could stir up the role simulation process. For example, invited external stakeholders with distinct input are ideal for disruption in the design studio, challenging students with responses from practice. Such an intervention may generate great impact in design education, provided that it fits the learning goals. Two of the courses to be introduced later in the article, Area (Re)Development in the Metropolitan Landscape and the Urban (Re)Development Game, both have experiences with organizing public debates. Critical responses of the local citizen of the redevelopment area towards the students' proposals proved vividly that, in practice, there is a huge number of stakeholders to be considered in the design and strategy making process.

Group dynamics

Group dynamics is a crucial component when students are brought together in order to design in groups, especially when the assignment involves higher levels of complexity, due to multi-actor ways of working and situated learning as mentioned above. Group work might be very synergetic when a group of students grows into a high-performance team, but group work can also be very frustrating when morale or productivity is under pressure. Barnett (2004) argues that development of skills and values involved in the learning for the uncertain future requires transformative and 'risky' pedagogies that expose students to dilemmas and uncertainties. Taking such risks is necessary while providing guidance on group dynamics could help students to deal with dilemmas and uncertainties more effectively.

The widely accepted FSNP model by Tuckman and Jensen (1977) illustrates the group development process convincingly. They state that teams progress through different stages: forming, storming, norming and performing (Table 2). Within those stages, many interdependent themes and issues play a role, which co-define success or failure. Literatures on group dynamics (Forsyth 2010; Levi 2015; Castka et al. 2001; Stember 1991) focus on themes and issues such as (1) group formation and development, (2) ambitions, goals, values and team ground rules, (3) measures of performance, (4) group culture,

Table 2 The FSNP model. *Source:* Made by authors based on the work of Tuckman and Jensen (1977)

Stage 1	Forming	Learning about each other	Group of people	Orientation
Stage 2	Storming	Challenging each other	Potential team	Dissatisfaction
Stage 3	Norming	Working with each other	Team	Integration
Stage 4	Performing	Working as one	High-performance team	Productivity

inclusion, identity and relationships, for the sake of psychological safety, (5) leadership, (em)power(ment) and influence, (6) the variety of needs, knowledge and skills of group members, as well as (7) communication, decision making, negotiation strategies, conflict management.

In group work, it is important for team members to commit to the collaboration, to understand, appreciate or embrace other perspectives—intellectual hospitality (Stember 1991, p. 8). There are literatures trying to offer solutions to this. For example, suggestions for interdisciplinary work are made including allocating appropriate group members and leaders, establishing ground rules, explicating and resolving epistemological and methodological differences, and gaining infrastructure support (Stember 1991). Nevertheless, the socio-personal and socio-cultural (international teams) challenges come with collaborative design (Rizal 2007), which also pose challenges to teaching and assessment.

Knowledge gap

The review above shows existing literatures on the emerging multi-actor ways of working that requires skills of co-operation and communication. Group work simulating these ways of working in practice could enhance these skills with ‘situated learning’, in which group dynamics are essential for success. The existing literature contributes to the understanding of group work in design education in general. However, there is a knowledge gap on learning from group methods, particularly from the perspective of teaching quality in the specific field of urban and regional design education: what are the pros and cons of group work; how effective it is in regard to achieving learning objectives; what are common challenges in implementing group work as a teaching method; and how to assess individual performance in group work? The following sections contribute to bridging this gap by comparing four urban and regional design courses of TU Delft, which have been running for several years until now.

TU Delft experiences in urban and regional design education

In this article, we investigate four cases of education programmes in the faculty of A&BE at TU Delft, which are characterized as urban and regional design courses to train next generation designers and have incorporated group work in teaching:

1. Neighbourhood of the Future—Green Blue Cities (BSc Minor; 9 ECTS—10 weeks, 30–50 students per year): interdisciplinary urban design and strategy making, group work with an ‘interdisciplinary consultancy team’ approach

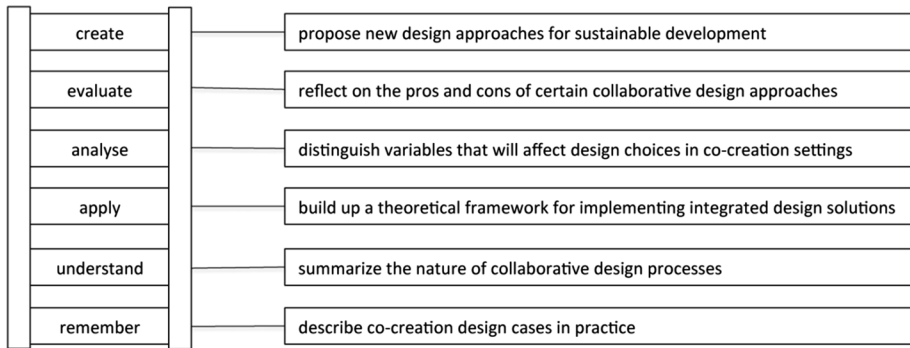


Fig. 1 Cognitive levels of urban and regional design education in line with the Bloom's (Revised) Taxonomy (based on Pohl 2000)

2. Spatial Strategies for the Global Metropolis (MSc Urbanism; 10 ECTS—10 weeks, 70+ students per year): regional design and methodology, group work with a 'designer consultancy team' approach
3. Area (Re)Development in the Metropolitan Landscape (BSc Architecture, Urbanism & Building Sciences; 10 ECTS—10 weeks, twice a year, 300+ students per year): the strategy-making process in urban (re)development project, group work through role-simulation
4. Urban (Re)Development Game (MSc Management in the Built Environment; 10 ECTS—10 weeks, 60+ students per year): strategy and plan making process in urban (re)development project, group work through role-simulation

The research methodology is mainly using the constructive alignment in teaching triangle as a framework to understand the embeddedness of group work in teaching, by comparing these four cases. What's more, the authors also considered the Bloom's (revised) taxonomy (Pohl 2000) in the comparison. From the perspective of a continuous and consistent curriculum design at the faculty level, urban and regional design education could be formulated into a progressive learning process indicated by cognitive levels (Fig. 1).

Neighbourhood of the Future: Green Blue Cities (NotF)

'Neighbourhood of the Future' is a minor course at Bachelor level that focuses on developing future-proof neighbourhoods in Rotterdam South, in response to climate change and socio-economic crisis. It has an interdisciplinary character and thus will assemble students into groups to create a balanced variety of backgrounds (Fig. 2a). Students come from Delft (60%) and other Dutch and international universities (40%), in the fields of architecture, urban planning, regional planning, civil engineering, landscape architecture, management, industrial design engineering, social science and others disciplines related to climate change. The course aims to have students from various backgrounds—future actors involved in transforming the built environment—to experience the collaborative process of developing integrated solutions for problematic neighbourhoods (Fig. 2b). To create effective groups, students are recruited based on relevant interest and academic curiosity.

Given the Bachelor level, we defined learning objectives according to the lower cognitive levels of the Bloom's taxonomy, mainly applying existing knowledge. Nevertheless, in



Fig. 2 Group work in the Minor course NotF. **a** One group of 2016 with multi nationalities and disciplines discussing their project. **b** An integrated strategy for Rotterdam South, developed by one group of 2016 focusing on Green Blue Structures. (Sources of the photos: **a** photo taken by Mariette Overschie; **b** drawing from the final report of the group called ‘Harbouring Green’)

some domains, we also challenged students with higher cognitive levels, such as reflecting on their design choices. By the end of the course, students should be able to work in interdisciplinary teams: giving relevant feedback to peers and reacting on feedback from others; collaborating with students from other disciplines to improve own research, design and writing skills and help others. Besides, students should demonstrate understanding on integrated planning and design: selecting and arguing development goals for a future-proof neighbourhood; formulating a neighbourhood transformation strategy and integrated spatial intervention plan based on criteria of sustainability; presenting a spatial strategy convincingly in writing, visuals and verbally. The students, with varied knowledge and culture background, work in groups of 4–6 people in the research and design studio, supervised by two tutors with backgrounds in urban planning and urban design. They get additional input from visualization, GIS and writing workshops. Two other course elements on urban design and sustainable development support students with theories and practices on sustainability and urban redevelopment. The assessment is based on a report on a development strategy for neighbourhoods in Rotterdam South, and oral presentations, which are all group work. Peer review on each individual’s contribution to group work is incorporated in assessment.

According to students’ feedback of 2016, students were mostly interested in the interdisciplinary setting of the group work. Architecture students from abroad, who never worked in interdisciplinary groups, were especially excited about working with peers from different disciplines, universities and countries. Peer feedback implemented in mid-term was well received. Students found it helpful to improve their studio work. There were also critics in relation to group work. Some students experienced the group work as not ‘real’ interdisciplinary. Some of the architects in the group were very dominant, and eventually, the spatial interventions were architectural instead of integrated. This was partly due to the fact that students without design background find it difficult to visualize their design concepts. They felt in a weak position when working with ‘designers’. Besides, there was a lack of knowledge support for students from other disciplines than urban/landscape design, especially the technical fields, which also led to more ‘design’ oriented results.

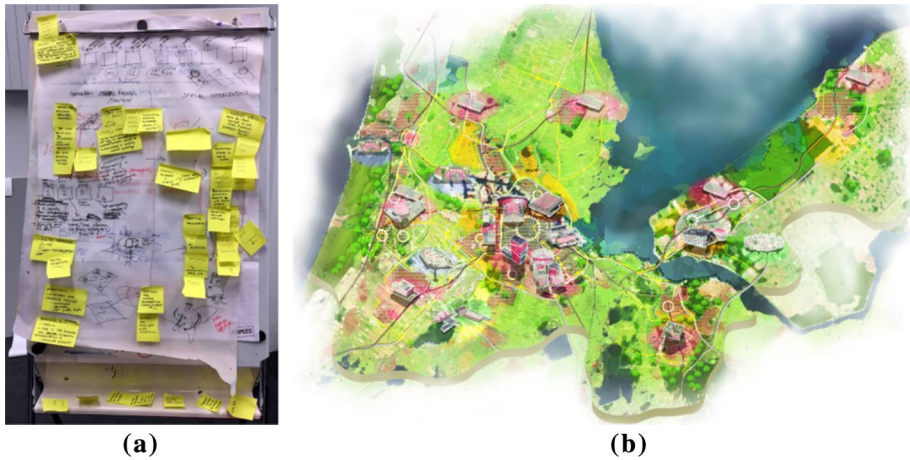


Fig. 3 Group work in regional design. **a** Brainstorm session of one group of the year 2017 on guiding principles for their regional vision. **b** The regional vision developed from the brainstorm session of the same group. (Source of the photos: final report of the group called ‘Mind the Gap’)

Spatial Strategies for the Global Metropolis

This is a compulsory course for the first year Urbanism Master students, focusing on regional design, steering regional development in the direction of more sustainable future. “It is a reflection on prevailing spatial conditions, political agendas and planning regimes, meant to improve good (democratic) decision-making and to inform long-term strategic planning approaches to desirable spatial change” (Quarter guide Q3 2016–2017) (Fig. 3a, b). Prior education of students includes mainly Architecture, Urbanism and Landscape design. Generally speaking, these education backgrounds are not as diverse as students of the Minor course NotF. Nevertheless, due to the composition of the group—50% to 70% international MSC students—starting skills of students vary largely. Based on the nature of regional design, which involves processes of collaboration and negotiation among various stakeholders and professionals, as well as thorough understanding on global trends that are influencing urban regions, the course deliberately focuses on group work, so that students could learn to cooperate, debate and compare.

Students at Master level of Urbanism should be able to obtain knowledge by themselves and reach higher cognitive levels after the course, suggested by Bloom’s taxonomy. By the end of the course, students should be able to understand roles/instruments of strategic spatial planning; understand the nature of regional spatial development; critically reflect on roles/impacts of regional design; formulate a comprehensive regional vision and development strategy; use communication media in collaborative decision-making; and explain the ethical issues involved. Students work in mixed groups (nationalities, disciplines, genders) of 4–5 people in the research and design studio, supervised by 2–3 tutors with backgrounds of urban planning, urban design and governance. They get input from supporting course elements on spatial development strategies and methodology. The assessment is based on group work products of a report on visions and strategies for a chosen region in the Netherlands (e.g. Amsterdam metropolitan region for the class of 2016–2017), oral presentations, and individual reflection on own group strategy. The assessment is graded on the quality of

group work (80%), with individual variations based on the individual reflection and performance in the group.

In the evaluation of the MSc Urbanism regional design studio (POLIS 2017) students were asked to reflect on their group dynamic experiences. Comments on workload topped out and communication within the team was mentioned second most. For some, the English language was seen as a barrier. Other topics concerned the team working approach, team productivity and the ambiance among team members. Students were asked if they found ‘working in a group beneficial for your own skills and progress as a student’. The overall response was positive (8.0), with a few negative experiences in their groups. Generally speaking, the results suggested that working in teams was appreciated but group working can also be very difficult and frustrating for students. Many students found that group work was tough but necessary, especially in a complex project. Group members could help and learn from each other. However, the discussion and communication are time-consuming. There are highly productive moments, but also confusing, counterproductive and frustrating times. Managing the level differences in skills (writing, visualization, oral presentation) among group members is an issue and strength at the same time. It causes uneven distribution of workload, in case necessary skills are not evenly spread among group members. On the other hand, in case there are balanced skills, group work can be done with effective collaboration—sharing tasks of writing, drawing and oral presentations. Last but not least, free riders do exist. Students suggested that tutors should have more focus on group dynamics—a call for additional teaching professionalization.

Area (Re)Development in the Metropolitan Landscape

In the sequence of the six large (10 ECTS) design courses in the Bachelor of Architecture, this course is the 5th one, introducing the complexity of governance with many stakeholders involved and the more abstract level of designing a strategy instead of a tacit building or plan. Being a compulsory course in the third year of a Dutch BSc, both cultural and educational backgrounds of students are rather homogeneous: students are mostly Dutch; the diversification of the compulsory curriculum among students is mainly reflected in the chosen minor courses, in which the above-mentioned first course has been one of many options.

The course pays a lot of attention to developing expertise in group work and to the design process. It covers a full range of cognitive levels, but focuses more on the remembering, understanding and applying knowledge. The learning objectives include: to develop integrated strategies for area development; understand the link between the project and regional scale; work in the iterative design process and collaborative research; reflect on the practice of urban planning and development based on research outcomes; document the design process and report the expert input. Based upon interests, students are given a role as project leader, economic affairs, urbanist, landscape architect, developer, real estate user, transportation planner, environmental consultant or regional planner. In the first part (4 weeks) of the course (10 weeks in total), students will familiarise themselves with the study case, from the perspective of their role. Different study cases of area redevelopment are provided each year: e.g. a deteriorated area in Schiedam in 2016/17; the redevelopment of a harbour area in Rotterdam and Schiedam in 2017/18. The purpose of the first 4 weeks is to develop a strategy, which is individual and role specific. Only starting in week 5, after completion of a supporting course that provides knowledge on urban management and (re) development, groups composed of different roles are formulated, to design the integrated



Fig. 4 Group work in the course of Area (Re)Development in the Metropolitan Landscape. **a** Sketchy pitch during the final presentation to the whole class, the jury and the aldermen of Schiedam. **b** A complete strategy captured in one poster, one of the presentation methods, next to a slide presentation with discussion and a 3-minute pitch. (Source of the photos: **a** photo taken by Arjan Boonstra, **b** poster of the group called 'De Blauwe Loper').

strategy. The second part of the course consists of different phases—exchange, negotiation and elaboration—to reach an integral strategy of the group in the end. Next to didactics on course structure and phasing, elements of explicit design education (Cross 2006; Van Dooren et al. 2014) and policy gaming (Geurts et al. 2007; Bruil and Van der Toorn Vrijthoff 2011) are used to set up this course (De Jong et al. 2015).

Working in two different groups at the same time (role group and design group) makes group work rather complex. To deal with this challenge, the course emphasizes communication skills. Besides, a specific workshop focusing on group dynamics is provided. Consideration is given to the composition of the groups using different tests on management profiles, styles of influencing and the Myers–Briggs Type Indicator (MBTI) (Myers 1962), as well as ways of dealing with conflicts. Furthermore, the role of project leader, a specific element of project management, is guided by the group instructor. (S)He is not a design tutor as in previous studios, but one monitoring the group. Lastly, students give peer reviews to each other: the first round during the process enabling adjustment of attitude and the second round in the end.

Evaluation of the course is done in multiple ways. Firstly, the statistical quality control is done by regular enquiries of the dedicated department of the faculty, with increasing positive results over the years. Improvements are not only reflected in the detailed questions in this enquiry but even more in the evaluation done by student panels immediately after the course. The course is given twice a year, therefore quick adjustments based on feedback from student panels are possible and necessary, especially for case adjustment. Above all, students have to complete the course with a role report including reflection on their own performance and comments on the course, including suggestions for the team. Usually, students ask for more steering on production in the first phase, which is always pushed by the tutors. However, it seems that only the peer pressure in the second half really enables top performance on production, especially in the last week before the final presentations (Fig. 4a, b).



Fig. 5 Group work in the URG course. **a** Group discussion in urban development charrette, interpreting from different roles. **b** Integration of the group vision (one group of the year 2015) on the redevelopment of brownfield Overhoeks in Amsterdam. (Source of the photos: **a** photo taken by Yawei Chen; **b** drawing from the group work ‘Overhoeks-the missing link’ in 2015)

Urban (Re)Development Game (URG)

URG is a compulsory course in Management in the Built Environment at the end of the first-year master programme, with an inflow of students from other tracks in the faculty and other (international) universities. The number of international students is increasing, with an expected number of 30% in 2018. Such changes in the diversity of cultural and professional training background have increased the challenge of communication or mutual understanding in group work. The course is built up around a Dutch urban development project—an area that needs regeneration, like docklands or a train station area. Through role-simulation, students are asked to play different stakeholders within a large group. Different from the above-mentioned role simulation course in the Bachelor programme, URG emphasizes the interaction between public parties and market players and simulates the negotiation process in project initiation, land transfer, property development and phasing.

Given the problem-solving nature of the course, objectives are defined covering all cognitive levels suggested by Bloom’s taxonomy, with the special focus towards the higher levels of applying, analysing, evaluating and creating. With regard to group work, learning objectives include: (1) to understand group dynamics by identifying the problem perceptions and positions of actors and their relations and interaction rules through actor, game, and network analysis; (2) to develop negotiation, decision making and conflict management skills through role-simulation; (3) to develop urban development strategy, including functional programs, budget, institutional and financial plans for different phases in multi-disciplinary setting. In this course, students work in simulated transdisciplinary teams of around 10–14 members, with 9–11 different roles related to urban development projects in practice, based on their preference and previous knowledge. To direct students smoothly into their role, a series of mentorship have been organised so that students gradually establish ground rules for procedures and for approaches towards each other within the group. During the game, students receive regular role supervision to intensify the special knowledge; at the same time, students work in the same group inform and educate other colleagues by presenting both theoretical and methodological views under the supervision of group supervisors. To prepare students for the co-creation process, we organize a highly intensive workshop—urban development charrette—just before students enter the negotiation phase for land and property transaction and development. Students first experiment

with innovative development concepts and then work in their own groups to integrate the different perspectives into one vision (Fig. 5a).

URG is considered by students as very thought-provoking, reflective of complex urban reality and possible confrontations that may happen between actors. Students show their gradual understanding in the transdisciplinary features of urban development and the appreciation of multi-discipline solutions. In role-simulation, specialized knowledge development and understanding of simulated transdisciplinary problem-solving by individuals are both valued. Students are guided to critically reflect, assess and suggest improvement in their collaborative design process collectively and individually in group reflection and peer review. Besides, the close link between the design of roles and assignment and the real case used in the course created situated learning experience, which is cherished by students. Most challenges recognised in the reflection of students are related to understanding and appreciation of the different disciplines, task sharing when the rule is not clearly written in group work and workload distribution among different roles during the process. Different cultural backgrounds and personalities add to the challenge of communication and conflict management between roles.

Findings from comparison

Comparing the above mentioned four TU Delft courses (Table 3), some shared features on urban and regional design education incorporating group work are summarized in this section:

- From the perspective of constructive alignment in teaching triangle, group work is a relevant and necessary teaching method in achieving learning objectives related to urban and regional design. Students could understand better the complexity and uncertainty of urban development, especially multi-disciplines behind urban development process and the co-creation features of urban development projects. Assessment of individual performance is a common challenge for teaching, where individual products and peer review are often used as tools. Fairness in assessment is a common concern from students, mainly related to the sharing of workload among group members, which is differentiated by roles allocated and skills possessed within the group.
- Feedback from students showed that they appreciate group work and found it challenging at the same time. It is considered as a kind of real-life experience, in which working with peers from different disciplines or cultural backgrounds is interesting. Group members can help and learn from each other. However, there are also issues related to communication and productivity. Group work can be very productive, for example, when close to deadlines. It can also be very time consuming, and even sometimes frustrating, especially when under pressure. In this regard, the size of the group matters: more people in a group leads to more communication, which is time-consuming and challenging when dividing tasks.
- Group dynamics is important to success. Tutors should monitor it and provide guidance, especially when problems are perceived. For example, leadership may contribute to the productivity of a group. However, too strong leadership from one role/discipline may become dominant and damage the co-creation process in the setting of multi/inter

Table 3 Comparison of the four TU Delft courses of urban and regional design

Comparison	Course names			
	Minor Neighbourhood of the Future	Spatial Strategies for the Global Metropolis	Area (Re)Development in the Metropolitan Landscape	Urban (Re)Development Game
Group typologies	Interdisciplinary	Design team	Simulated transdisciplinary	
Knowledge input	Urban design, with limited input on other disciplinary knowledge	Regional planning and design	Knowledge of assigned roles and correlated work methods	
Learning objectives related to group work				
Gaining skills of team working	Collaborate with peers; Give peer review/feedbacks		Give peer review; Evaluate criticism and give feedback	Understand group dynamics; Develop negotiation, decision making and conflict management skills
Working in groups	Work in an interdisciplinary team; Present a spatial strategy (in groups)	Use communication media in collaborative decision-making	Take part in the interactive design process; Report (group) design process and expert input; Research and develop an integrated strategy in groups	Understand the context, content, players and means of implementation during the cyclic phases of the urban development process
Working on assignments that call for collaboration	Formulate transformation strategies; Design for integrated spatial interventions; Manage complexity in planning and design; Argue for sustainable development goals	Justify a vision and development strategy conceptually; Formulate a comprehensive regional vision and strategy; Explain the ethical issues involved	Justify process and design choices; Use research results to discuss 'the practical context' and to propose grounded alternatives	Develop urban development strategy & plan, including functional programs, budget, institutional and financial plans for different phases in a multidisciplinary setting

Table 3 (continued)

Comparison	Course names			
	Minor Neighbourhood of the Future	Spatial Strategies for the Global Metropolis	Area (Re)Development in the Metropolitan Landscape	Urban (Re)Development Game
Teaching methods: Students...	...work and receive tutoring (2/week) in interdisciplinary teams of 4–6 people	...work and receive tutoring (2/week) in teams of 4–5 people	...work and receive tutoring (6 times) in monodisciplinary role teams of 10–24 people ...work and receive assistance (6 times) in transdisciplinary design teams of 9 people; ...take part in workshops, including one on group dynamics	...work and receive tutoring (1/week) in transdisciplinary teams of 10–13 people ...work and receive tutoring (1/week) in groups of 4–6 for same discipline; ...participate in workshop development charrette on transdisciplinary solutions ...organize negotiation sessions (related to e.g. decision-making process)
The weight of group work in final grade	2/3	80%	0% (give prizes to the best performing groups)	10% (give prizes to the best performing groups)
Assessment of individual performance	Daily performance; Peer review	Daily performance; Individual reflection	Individual role report (50%); Individual contribution to group work (50%, peer review is incorporated)	Individual final report; Daily performance; Peer review

disciplinary groups. In this case, providing disciplinary knowledge may enable other group members to contribute and play their roles more effectively.

There are also findings based on differences among the four courses incorporating group work, mainly with regard to the various teaching objectives, methods and assessment:

- There are two types of learning objectives that are directly related to group work: (1) Gaining skills of team working, such as: to give peer review or feedbacks; to understand group dynamics; to develop negotiation, decision making and conflict management skills through role-simulation; (2) working in groups, such as: to take part in research elaborated by the group; to take part in an interactive design process; to document the design process in a group. There are also learning objectives with indirect links to group work, especially those about working on design assignments that call for collaboration, such as: to develop urban development strategy in a multidisciplinary setting; to design for integrated spatial interventions; to formulate a comprehensive regional vision, etc.
- Teaching methods and assessment strategies for group work are determined by learning goals, which can be identified as ‘process-oriented’ or ‘product-oriented’. For example, the two courses of management games put more effort in monitoring and guidance on group work, both content-wise and in regard to group dynamics, compared to the other two courses (Minor NotF and the regional design course). This is because that the two management games focus more on the urban and regional development processes, involving more learning objectives directly related to group work; while the other two courses focus mainly on developing urban and regional design proposals, for which group work is more of a learning method but not an objective in itself. This also leads to two models of assessment: the two management games assess mainly individual performance in the process of group work; while the Minor NotF and regional design courses put more weight on the quality of group work products.
- Group work with the interdisciplinary approach (e.g. the Minor course) and co-creation approach (e.g. the two courses of management games) require knowledge input for each discipline and actor. This is different from group work with ‘designer consultancy’ approach (e.g. the regional design studio), for which tutors are mainly providing knowledge on urban planning and design. Sharing of workload is more of an issue for the former, since contribution from different disciplines and actors may vary. While for the latter, the workload can be more evenly shared among group members, however individual contributions cannot be fully identified without peer review.
- Cognitive levels matter in the design of group work assignments. The four courses introduced in this paper include two from BSc and two from MSc level. The cognitive levels of each course measured with the Bloom’s taxonomy show a continuous training, such as the differentiated focuses of the two management games in BSc and MSc as explained in the case descriptions.

Conclusions

The paper tried to fill the knowledge gap on collaborative learning in urban and regional design education from both theoretical and empirical study on TU Delft experience. The gap perceived by authors does not refer to missing components or links in theory, but to

a better understanding and performance of group work in the specific field of education practice on urban and regional design. The comparison of four TU Delft courses demonstrates the application of theories in systematic analysis of the design-driven education in the Faculty of Architecture and the Built Environment, which is taking a lead in cultivating the next generation urban and regional designers. The authors drew following conclusions according to the studied TU Delft experiences:

1. Group work plays an effective role in cultivating skills of collaboration and communication for students. It formulates a collaborative learning process that partially mimicking the multi-actor ways of working in practice, and helps students to understand the multi-, inter-, and transdisciplinary approaches in urban and regional design. However, it also brings risks in teaching by exposing students to uncertainty related to group dynamics and uneven levels of (design) skills in the team, which may bring small chances of failure. In the context of internationalization in higher education, differences in culture and design education backgrounds among students have posed additional challenges on group work in urban and regional design education.
2. The extent to which learning objectives determine group work as a necessary teaching method in urban and regional design education may vary. In courses whose learning objectives are more directly related to group work, 'collaborative design process' is more at the core and group work itself becomes an essential part of the learning goals. In these cases, there are more teaching methods related to group work, for example, providing knowledge input on group dynamics or role simulation. 'Design product' of the group work is less concerned in the assessment comparing to the performance of individuals in group work. While in courses whose main learning objectives are indirectly related to group work, innovative 'design product' gets more attention and group work is seen as an optimal setting for achieving content-related learning goals on urban and regional design. In these cases, less input on group work and group dynamics is expected and the teachers are mainly functioning as 'knowledge hubs' of urban planning and design. The collaborated design process is concerned more as part of the knowledge framework and a real-life experience for students. The quality of the group product on urban and regional design has a higher weight in assessment. In these courses, assessment on individual performance is tricky, since the role of each individual is less recognizable compared to the type of 'process-oriented' group work that is based on role-simulation.
3. A major concern from students on group work in inter- and trans- disciplinary setting of urban and regional design is related to fairness in individual assessment. Differences in cognitive levels, skills, personalities, education and culture backgrounds of group members may lead to an unbalanced distribution of workload among students. This might be a common issue in group work in general. What is essential in this specific type of design education is the presence of adequate design skills in each team, especially in cases that not all students have design backgrounds. Besides, when role simulation is involved, different timing and tasks of individual contribution to the design process might also lead to uneven distribution of workload. Individual assessment in these cases becomes tricky for teachers. Assessment strategies are needed to evaluate both the quality of group work and individual performance, in which peer review and individual assignments related to either design product or design process are helpful tools. Providing guidance both content-wise and on group dynamics is necessary, depending on the setting of the design studio.

4. Teachers supervising group work in urban and regional design education are facing multiple challenges: they should be able to cope with the complexity of teaching collaborative design, considering both the non-linear process of design (Van Dooren et al. 2014) and progress of the work influenced by group dynamics at the same time. Furthermore, in the light of facilitating innovation in design education, it is necessary for teachers to keep an open and reflective approach. The application of disruptive elements of Policy Gaming in the BSc management game, for instance, requires continuous monitoring and reflection, and if necessary, adaptation.

Discussion

The authors of this article are involved in teaching and coordinating the design courses under discussion. Case studies and comparison were conducted collectively. According to De Hei (2016), compared to others, teachers who apply collaborative learning are more positive about students' effort in working collaboratively and the results. The conclusions of this paper support this statement of de Hei in design education.

From the viewpoint of teaching quality in a design faculty like A&BE in TU Delft, a continuous but not repetitive education curriculum on urban and regional design involving group work in both Bachelor and Master education is essential. It facilitates students to meet exit qualities in relation to skills that are required in collaborative planning and design process. Nevertheless, one should be aware that within the set-up of such courses, group work could have pros and cons. Therefore, it is essential that the alignment of learning objectives, teaching methods and assessment strategies is carefully tailored to group work for the specific design assignment of a course. Besides, depending on the nature of design products, teachers could use some special tools to strengthen the commitment of students to group work in design studios. For example, creating competition among groups by setting a prize for the best final design product (without too much influence on the assessment results), or presenting design products to the public (in conferences or seminars) so that students get the chance to defend and feel proud of their group work.

In design courses that are based on group work, there is a variety of knowledge, skills, and (academic/collaborative) attitudes involved, from which students could learn and improve. However, the actual learning of each individual varies greatly, depending not only on the set up of the course, but also cognitive levels, the commitment of students themselves, and in the case of role simulation specific role-related knowledge shared at the group level. Assessment based on the final group design products or individual performance might indicate the quality of students' work, but does not always tell what students have actually learnt during the course. Feedbacks on individual and group performance from team members, teachers, and invited guest reviewers may help to enhance the self-evaluation of each student, so as to position oneself well in the 'situated learning' of group work in design education.

Last but not least, when group work is seen as a compulsory element in design education, most of the students would get the chance to experience such learning process a few times during their study. However, not all teachers are familiar or have the knowledge of dealing with the complexity involved in such design courses. It is necessary to raise the awareness among teaching staffs in design schools on the pros and cons of group work, and tactics of coping with the complexity of design education involving non-linear design process and group dynamics at the same time. This paper didn't address design process in

this regard, particularly the question of how group work can contribute to creativity in the design process, for example, when formulating guiding themes and domains, experimenting and exploring design solutions, etc. (Van Dooren et al. 2014). These design specific elements and process in collaborative design education are also essential from the perspective of teaching quality. However, it is another interesting topic other than the focus of this paper on the constructive alignment of teaching triangle in group learning and deserves attention for future research.

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- Module guidebook *Area (Re)Development in the Metropolitan Landscape 2016–2017 Q3*, Version February 12th 2017, Faculty Architecture and the Built Environment, Delft University of Technology.
- Polis MSc Education Evaluations Q3 Synopsis, Version May 8th 2017, Department of Urbanism, Faculty of Architecture and the Built Environment, Delft University of Technology.
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