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Integrated studio approach to motivate collaboration in design projects

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Abstract

In an attempt to resolve some of the gaps associated with the pedagogical integration of teamwork in design curricula, this article seeks to share a model for learning teamwork skills. This model is the result of a multiple case study methodology based on the learning experiences of 22 design students. Data was collected during various team projects through questionnaires and interviews. In relation to the concept of the zone of proximal development, the coded data was organised by thematic categories and training levels to provide a practical tool to support teaching and assessment practices to encourage the learning of teamwork skills. The proposed model allows for a systemic understanding of teamwork skills that should be acquired during design training to navigate with efficiency and confidence in the collective projects of design's community of practice. The use of the model promotes the adoption of more complex teamwork dynamics, such as collaboration, enhanced with an integrated pedagogical approach. It also motivates individual action towards collaborative initiatives in the hopes of more coherent teamwork processes.

Keywords:

Design, teamwork, collaboration, process, project-based learning, zone of proximal development

Introduction

Since the 1980s to the mid-1990s, the design community has recognised and valued the social dimension of its processes. For example, Bucciarelli (1988) positioned design as a social practice, Cross and Cross (1995) studied the distinctions between different team processes, and Goldschmidt (1995) compared individual and collective practices. Since then, design has been more and more leaning towards shared and collective processes. As Goldschmidt (1995) stated, the complexity of design projects led designers to be confronted with 'the need for multiple expertise and division of labour' (p. 189). Nevertheless, an integrated vision of the project is crucial to support complexity and encourage its deep understanding by project experts (Stompff & Smulders, 2013). Accordingly, the application of pre-existing solutions is neither possible nor desirable.

The last decade and the most recent international crises have confirmed the need for practitioners to develop new skills to conduct their tasks and projects in complex circumstances. Above all, understanding and optimising the work that is carried out in partnership with others is fundamental to propose innovative solutions created from new knowledge (Minder & Lassen, 2018). In that context, professional designers have been invited to join projects initiated by many disciplines, ranging from medical products, ergonomic solutions, technological innovations, marketing initiatives, etc. In that sense, the designer has become a generalist that masters a creative process and analytical skills to converge to meaningful and innovative propositions.

Building on these insights from practice, teamwork is now an accepted way of working in design. The industry and design agencies are explicitly asking for teamwork skills from novices as they integrate their work environments (Sands & Worthington, 2007; Council for Interior Design, 2020). Unfortunately, knowledge on that matter can be difficult to gain because of the multiplicity of factors that differentiate these experiences. Most of our past research initiatives have been directed towards gaining a better understanding of these collective dynamics of design activities (Zahedi et al., 2017, 2018; Tessier & Zahedi, 2019). However, the integration of teamwork within design curricula around the world does not seem to have been the subject of consistent inquiry to ensure the coherence of its teaching, learning methods, and assessment practices. Despite the repeated efforts of teachers and institutions to offer learning situations that are based on authentic practices, most tend to assume that teamwork skills are "learned 'on the job'" (Kleinsmann et al., 2012, p. 502), resulting in limited training for this set of skills.

From our experience in design education and research, we notice that teachers are proposing team projects as part of their classes or workshops, but most often without reflecting on the necessary skill set to gain performance for team projects or the optimal learning progression to achieve such performance. Among others, Tucker et al. (2014) and Kleinsmann et al. (2012) did start to draft typologies distributing teamwork experiences across typical design curricula. Still, the lack of attention offered to learning methods and assessment practices to judge the performance of students or teams does not encourage the optimal integration of these frameworks within the pedagogical environment (Davies, 2016).

This paper will explore the actual situation of teamwork skills development in design programs. To better understand how students learn teamwork, we will trace how they experience these learning situations to propose a potential framework and orient its pedagogical alignment. In hopes of proposing paths for meaningful solutions to the identified gaps, we will first introduce teamwork by defining some of its main concepts, presenting a selection of benefits for design practice, and exposing the recurring educational challenges that structure our inquiry. Next, we will present our multiple case study methodology based on the team projects of 22 undergraduate students. These case studies will allow us to gain an in-depth understanding of how students live their workshop experiences when projects are conducted in teams. The following part of the article will share the qualitative data analysis process and create links with the theoretical concept of the zone of proximal development, which understands learning as continuously ongoing and collectively influenced. Such an interpretation will allow us to propose a model to facilitate complex teamwork skills integration during design training. To conclude, we will discuss the proposed model, its implications for design education and elaborate on the preparation of novices to navigate with confidence in the collective projects of design's community of practice.

Defining team dynamics

Based on a recently published scoping review on the subject (Tessier, 2020, 2021), we identify three main team dynamics that are solicited in design practice: coordination, cooperation, and collaboration. These dynamics all ask for the contribution of multiple individuals but are also differentiated based on distinctive characteristics.

First, coordination is noted when parts of a project are segmented and organised sequentially. Bedwell et al. (2012), Burkhardt et al. (2009), and Kvan (2000) explain coordination in relation

to strategic planning, division, and sequential organisation of tasks. Project assignments are divided between team members, who work in isolation, according to their skills or interests.

Secondly, cooperation builds on shared objectives combined with simultaneous task distribution. “Reciprocal interaction” defines this dynamic (Bedwell et al., 2012, p. 136), as the contributions of team members enrich and contribute to one another. According to Achten (2002), “in cooperative design, participants get such parts to solve and later integrate in partial solution that are integrated in a whole design” (p. 4). In that context, good communication is necessary to ensure cohesion of efforts.

Thirdly, collaboration translates into a complex team dynamic, asking for high interdependence, shared comprehension, and the definition of common objectives (Chiocchio et al., 2011; Kleinsmann, 2006; Kvan, 2000). Kleinsmann (2006) defined collaboration as a process built from a series of stages based on knowledge sharing. During collaboration, most tasks are accomplished as a team, resulting in an integrated and shared result.

These short descriptions indicate various levels of team cohesion. Accordingly, coordination asks for limited cohesion, cooperation demands moderate cohesion, while collaboration needs optimal cohesion. Team dynamics contribute to structuring teamwork in different ways and for different purposes. Some team dynamics are more complex than others, which makes it important to expose students to different types of situations and favour different levels of teamwork through their pedagogical experiences. On one hand, if the most complex dynamic is introduced too soon in the learning process of students, they risk to not be equipped to perform as it is too complex. On the other hand, if projects are not planned in order of complexity, students will not acquire relevant and varied teamwork experiences. The distinctions between team dynamics are important as different kinds of situations call for different types of teamwork. The next section will introduce some of the reasons why teamwork is crucial in the training of future designers, and why the most complex form of teamwork (collaboration) should be practised by design students.

Benefits and challenges of learning teamwork skills

Teamwork opportunities present a series of benefits that are important for the training of novice designers. Among other things, teamwork allows creating links and associations of ideas between fields of knowledge as a whole (Boud & Falchikov, 2006; Carroll et al., 2014). Keeping students active, team projects contribute to student motivation, autonomy, transversal skills development, and deeper learning (Blumenfeld et al., 1991; Davies, 1996; Oxford, 1997; Shepard, 2000; Helle et al., 2006; Scallon, 2007). When facilitative, teamwork encourages a less timely project process, while also allowing dealing with more complex issues (Stempfle & Badke-Schaub, 2002; Kleinsmann et al., 2007). When regressive, teamwork can lead to improper decisions, unsuccessful organisation, limited knowledge sharing, and the initiation of a stressful environment (Tessier, 2021).

The lack of structured approaches to implement teamwork within design curricula results in recurring challenges that are reported by students, teachers, and researchers. One recurrent challenge touches on the difficulty to bring students to collaborate, as it is a complex dynamic to put together. Previous studies have noted that most students tend to work in teams according to less complex dynamics, such as cooperation or coordination, by distributing tasks

and limiting exchanges (Davies, 2016; Zahedi & Heaton, 2017). This tendency has also been noted in the professional world where Stompff and Smulders (2013) have observed that recurrent division of labour within teams leads to a lack of global vision resulting in fragmented solutions. However, although collaboration might ask for increased efforts from team members, important benefits should result in higher quality projects (Tucker & Reynolds, 2006). Such benefits should be explicitly communicated to students, so they can consider the added value for their project. Otherwise, they might not understand why it is worth investing the time and the efforts. An important challenge to overcome is, therefore, the explicit integration of collaborative experiences into the workshop formation of design students. This objective seeks increased social relevance by contributing to a student's success and motivation while preparing novices to the reality of their professional practice. The next section will expose the details of the methodology that was organised to gain clearer insights about the reality of workshop team projects.

Multiple case study methodology

Wishing to gain a deeper understanding of the learning experiences of undergraduate students during their team projects, a multiple case study methodology was put together to access a complementary pool of experiences. Twenty-two undergraduate students were recruited to participate in the research from various design programs offered at the Faculty of environmental design of the University of Montreal (Canada; industrial design, interior design, urban design). The participants were accepted in the research if they were working as a team on a workshop project during the period of data collection. For ethical reasons, all participation was determined on an individual basis (which sometimes resulted in having only one team member to comply with the research). Still, the participants of Group E worked in pairs and all teammates accepted to join the research. According to the pedagogical project, data collection varied between five to seven consecutive weeks. Participants were of various training levels and in strategically different learning situations to provide a scope of experiences. All participants were engaged in a team workshop project specific to their educational program and received instructions for their projects from their workshop tutor (their participation in the data collection was non-mandatory and considered additional to their pedagogical training). The research tried to work the design projects without disrupting the unfolding of the workshops. The project topics were varied and whether the team was marked for teamwork or not was left to the discretion of the workshop tutor. The contextual information shared in Figure 1 is organised according to five distinct groups that will help us later to differentiate the results according to the training levels of the participating students.

	Group A	Group B	Group C	Group D	Group E
Discipline	Interior design	Urban design	Industrial design	Interior design	Industrial design
Age range	18-23	20-40	22-24	35-36	22-33
Training year	First year	Third year (final)	Third year (final)	Fourth year (final)	Fourth year (final)
Type of teamwork	Disciplinary	Disciplinary	Interdisciplinary	Interdisciplinary	Disciplinary
Number of participants	4	4	4	2	8
Data collection *(Length in weeks)*	6 weeks	7 weeks	5 weeks	5 weeks	6 weeks
Project topic	Redesign of a school library	Planning of a vacant lot	Design of opera costumes	Design of opera sets	Varied thematic projects

Figure 1. Portrait of participants

All participants were asked to fill weekly questionnaires organised around 3 questions:

- What is your project and how has it evolved this week?
- What were your team's challenges and how could they be solved?
- How were your team's decisions taken?

The questionnaires were designed to take less than 20 minutes to fill to encourage students to participate in the research. They offered information about the present events of the participating students. The content of the questionnaire was explained in more detail as part of a past publication (Tessier & Zahedi, 2019).

The questionnaires were combined with a one-to-one interview at the end of the workshop projects. These interviews provided clarifications on the reported experiences described by the participants. They allowed the researcher to dig deeper into the challenges reported by the student and to gain a more accurate comprehension. Most of all, the interviews contributed to the understanding of the participant's vision of his or her experience. Interview questions were organised to bring the participant to gain perspective on his experience, develop its reflectivity regarding his team's situation, and propose alternative ways to overcome or address his team's recurring challenges in the future.

This multiple case study methodology resulted in a mass of data from which sense needed to be made by finding patterns and creating meaning through data analysis, which is described next.

Data analysis

All data from the questionnaires and the interview verbatim were transcribed in the coding software MAXQDA. A coding process was motivated to gain a sense of the data based on the stories and experiences of multiple individuals. An open coding strategy allowed us to create links and compare the different groups by converging from "raw data to a standardised form" (Babbie, 2008, p. 355). Coding was focused on the lived experience of each participant and the influencing factors of teamwork. Codes were not defined in advance but emerged according to our interpretation of the data. The coding process started from Group A to Group E and was refined through multiple readings of the verbatim transcriptions. A total of 97 codes emerged from the coding process. Cross-verification and code organisation allowed us to combine or delete some of these codes, resulting in 33 codes describing the teamwork experiences of the 22 participants. Moreover, all codes were organised into five categories (zones), corresponding to thematic groups around a shared topic:

- Personal zone: Refers to features and motivations of team members
- Project zone: Refers to factors that facilitate or complicate the project
- Organisational zone: Refers to team management, division, and prioritisation
- Learning zone: Refers to new knowledge or skills developed in line with the project
- Social zone: Refers to the emerging relations between individuals through interactions

The codes as categorised in the five zones were interpreted as characteristics of teamwork learning experiences. All characteristics were analysed across the set of data, which allowed the

identification of 81 analysis factors (see Appendix), increasing our specific understanding of the data. These factors emerged from the code analysis by looking for patterns to gain a deeper understanding of the various dimensions of each characteristic. In other words, the factors were identified as part of the analysis of each specific code by trying to differentiate the ways that were put in action by the participants. This process led to a clearer categorisation of the new information. Unfortunately, the scope of this article does not allow us to provide more details of the descriptive factors. Still, a good example would be according to characteristic 2.2 – Expressing ideas that is associated with three factors: (a) Proposing ideas individually, (b) Combining ideas, (c) Fixation (see this characteristic in the Appendix). These factors provide alternative stages in a team's effort to communicate possible insights according to a person's effort, a team's contribution or not being able to do either of these possibilities. Factor A was identified in all groups, Factor B only in some of them (Groups A, C, and E), and Factor C, only in group E. These distinctions across groups of students show that not all students did achieve to combine their ideas as part of their teamwork experience. Moreover, investigating deeper into group E's difficulties translates the high complexity of their projects, resulting in a decline of some students' abilities to generate ideas.

Such an analysis was carried for every characteristic, shedding light on the similarities and distinctions between each group. The analysis also guided the identification of the characteristics and factors that were predominant in the teamwork experiences of each group. Also, it underlined in particular which challenges were considered optimal for learning or too difficult concerning a certain learning context (for ex.: level of training or disciplinary/interdisciplinary). Such distinctions motivated the connection with the theoretical concept of the zone of proximal development, which is explained next.

Zone of proximal development

The zone of proximal development is a fundamental concept of the sociocultural perspective, which was introduced by Vygotsky (1978). Through his study of children's development, Vygotsky came to understand cognitive growth as a continuous process according to which present abilities offer clues of one's future capacities.

The zone of proximal development is often illustrated as proposed in Figure 2. This representation shows the various stages that a learner encounters as part of his learning process. Still, the zone of proximal development is not entirely based on the sole learner but is also influenced by external support being provided to the learner as he develops more autonomy. Therefore, as shown in Figure 2, the central part of the model (Zone A) indicates all abilities that are mastered by an individual and that can be accomplished autonomously. The next section of the model (Zone B) translates what the learner can do with the help of a peer, teacher, or adult (often said to be a more capable peer). Finally, the external zone of the model (Zone C) identifies what the learner is not able to do either alone or with external help.

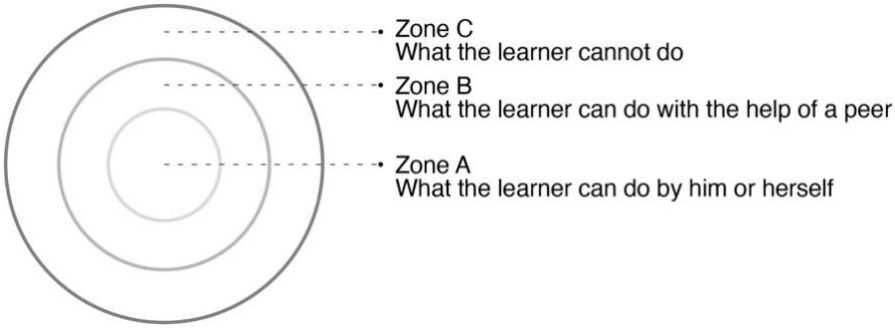

Figure 2. Zone of proximal development

As part of the described learning process, social interactions are crucial for the learner to progress across the zones. Travelling in the model translates into a cyclic process as the learner gains more autonomy for certain abilities, tasks, or knowledge. This program enables the learner to access more complex fields of knowledge, for which he or she needs external support. As part of this research, the concept of the zone of proximal development was judged highly relevant to help in the organisation of the collected data since it is primarily based on social interactions, which is also the basis of teamwork. Accordingly, the concept of the zone of proximal development is interested in socially constructed knowledge. Also, the concept was found particularly interesting as it allows a multi-level analysis. The levels allow a systemic understanding of the studied situation by considering all of its active components: the independent actions, the collective activities, and the socio-cultural context, which are relevant for the study of complex activities, such as teamwork.

Zone of proximal development for teamwork skills model

The interactions that emerged between the data collected, the analytical interpretation, and our comprehension of the zone of proximal development guided the development of an integrative model. The factor differentiation allowed to distil and categorise the characteristics and factors according to different stages. Figure 3 identifies the classification of the characteristics and factors shared in the Appendix of this paper into the 'zone of proximal development for learning teamwork skills' model. Characteristics were classified into the model according to their importance in the discourse of each group of participants. As a matter of fact, some characteristics or factors are specific to a stage in the model (when identified at a specific level), while others are transversal (when identified outside of the model, near the zone title). Two zones of the model were left blank since no specific characteristic allowed to differentiate this level from the others.

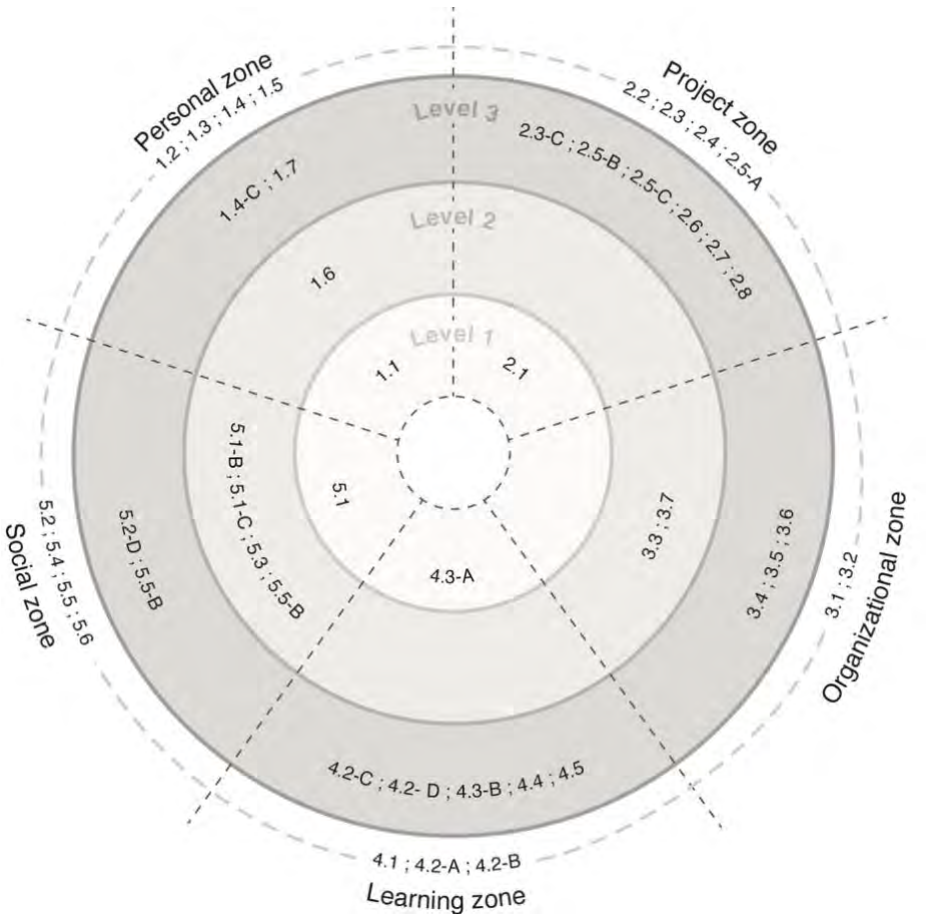

Figure 3. Distribution of the characteristics and factors in the model (all codes are associated with the Table in the Appendix)

The following Figure 4 is a synthetic interpretation of the 'zone of proximal development for learning teamwork skills' model shared in Figure 3, which is strongly inspired by the initial zone of proximal development model. First, it shares the same circular shape divided into increasingly complex levels. Secondly, the levels of complexity also imply that skills from a previous level need to be mastered before being able to perform correctly in the next level. Thirdly, the learner's development is supported and encouraged by external peers such as teammates, workshop tutors, and others. Group learning directly contributes to the development of teamwork skills.

Still, some differences are noted. First, it is divided according to the five categories that emerged from our analysis process, creating zones of skills to master. Secondly, it is composed of four different circular levels. The core of the model represents the prerequisites that are requested by academic institutions. The next circle is concerned with first-year students (Level 1), integrating a new environment based on high standards. As part of the personal zone, the participants corresponding to this stage showed they needed adaptative skills to adjust to the requirements of their undergraduate program. Similarly, the other zones also translate the need to acquire disciplinary-specific tools and skills to ensure a good progression throughout the following stages. Therefore, the project zone is set to understand and master the design process and the organisational zone seeks the development of organisational skills to facilitate task division among team members. The learning zone is specific to mastering some of the basic

tools of the designer such as drawing or using software. Finally, the social zone asks to work on communicative skills, so students can share time with other individuals, recognise each other's forces and manage conflicts. These characteristics associated to level 1 were mostly identified in Group A, which was starting its second year of study during the process of data collection.

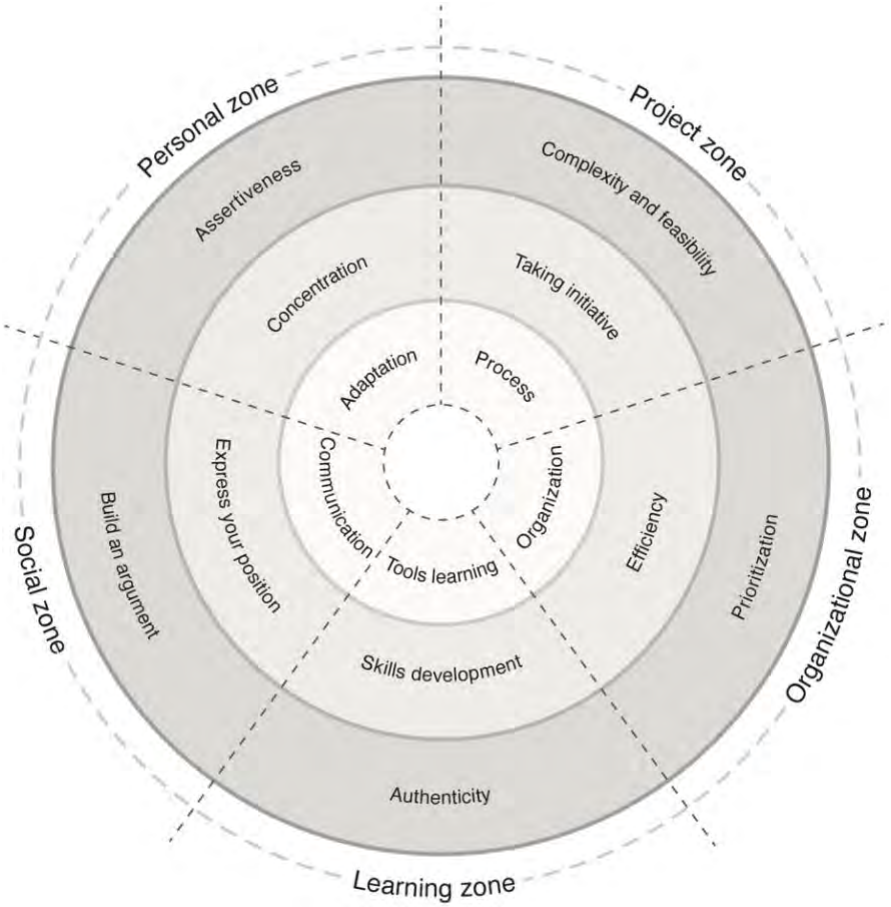

Figure 4. Zone of proximal development for learning teamwork skills model

The next circle is related to second- or third-year design students (depending on the curriculum; Level 2). A different set of skills are identified in continuation with what was acquired in the previous level. Interpersonal relations tend to grow into friendship as students get to know each other: therefore, the personal zone seeks concentration to stay focus and not be disturbed by workshop stimuli. Next, the project zone is associated with students' initiatives to navigate more fluidly in the design process, take action and propose frame structuration. The organisational zone is concerned about efficiency to gain autonomy to formulate and accomplish tasks. The learning zone is related to skill development as a global improvement of disciplinary-specific and generic abilities. Lastly, the social zone corresponds to the development of the capacity to defend an opinion or a position. As communication and relational skills should be practised during various project experiences, one also has to be able to build its own perspective.

The last level (Level 3), which leans towards the professional world, corresponds to third- or fourth-year design students (last year of an undergraduate program). These students should be transitioning towards their future community of practice as they acquire a certain skill set in

interaction with professionals. The personal and social zones seek similar objectives in the construction of the professional identity of the student: affirmation of self and building an argument. The project and the learning zones both translate the authenticity of the proposed learning situations, the increased complexity of the project, and the feasibility of the proposed solution. The organisational zone seeks to facilitate prioritisation during projects to meet the deadlines, comply with constraints, propose a realistic timeline, etc.

Overall, each level of the model corresponds to a specific range of training years but achieves coherence throughout a curriculum by progressing from an individual perspective through a more complex collaborative attitude. As proposed by the zone of proximal development, external social support is fundamental to skill development. As stages are crossed by the students, it was noted that more actors join in the process to contribute to the project with their specific expertise. In the first level, it is mostly the teacher that contributes as external help to the team project. At the second level, the peers or class colleagues are solicited for advice on ideas or the project. Finally, the third level seeks more complex design projects and asks for the input of professionals or potential users according to specific domains of expertise to complement students' knowledge. Lastly, the dashed zone outside the model represents the transition with professional practice. As learners finish their studies, it is crucial to favour mutual exchange between students and experts to enrich their formation by introducing them to the basics of practice. Before concluding the paper, the next section will discuss the pedagogical potential of the model to favour collaborative dynamics in studio projects.

Pedagogical potential of the model

The "zone of proximal development for learning teamwork skills model" offers more than a picture of the stages that many design students go through during their formation. As it is well known, many design programs are built on very similar Bauhaus-inspired project-based structures, supporting the significance of this research's contribution. The model underlines the importance of acquiring strong disciplinary bases to support the development of skills and autonomy across the various zones of the pedagogical experience and for lifelong learning through professional practice. In summary, the first zone is focused on understanding the design process, which is crucial to master different types of tools, methods, and idea generation techniques. The second zone is concerned about developing social relations and developing the previously acquired skills and the third zone values the integration in the community of practice with direct interactions with experts, internships, or external guest jurors. For the present discussion, we will tackle three potential benefits of the model if integrated in design education: a framework for pedagogical alignment, a perspective to develop reflectively and proactively, and a tool to motivate more complex collaborative dynamics.

A framework for pedagogical alignment

Biggs (1996) raised the importance of planning a constructively aligned curriculum to provide a coherent structure to the learning process and increase students' investment in diverse categories of knowledge. Constructive alignment seeks to implement a structure between teaching, learning, and assessment practices of a class or workshop, but also, more globally, throughout the educational strategies and learning experiences of a curriculum. Such coherence supports deeper learning and a better understanding of the aimed objectives.

In that sense, our model for learning teamwork skills offers a clear structure and sequence to develop the autonomy of students for teamwork dynamics. The model proposes a progression from individual actions to collaborative initiatives by using the design project as its main motivation, guiding students from the centre of the model to its periphery. In that sense, the learner gains autonomy to accomplish teamwork in more complex contexts as he or she progresses in the model.

The proposed model can be used to prepare teaching activities according to students' training level and to assess learning according to each characteristic's factors and whether the learner is lower or above the attended level. Moreover, the model can also be presented and explained to the students for them to take part in the judgement of their performance. By using the model as a reference point among pedagogical actors, teachers, learners or their teams can pinpoint the zone(s) where they feel less confident and envision where they should be aiming. By understanding the global picture, design students would be empowered to reflect more deeply on their abilities and skills.

A perspective to develop reflectively and proactively

The proposed model, based on the zone of proximal development, also supports the development of a reflective practice by perceiving the global picture and allowing further discussions between the actors involved. During the interviews of our data collection, the participants were invited to discuss further the challenges they faced. The researcher tried to create a dialogue to deepen the reflective perspective of the participant on its own experience. When successful, the participant was able to propose concrete ways to improve their attitude, take actions or strengthen their team relationship and interactions. The capacity to find solutions based on their interpretation of the situation can demonstrate an active cognitive process and a desire for change. As Argyris and Schön (1977) demonstrated, professionals work according to their tacit knowledge, indicating that a large part of knowledge unfolds through imitation, observation, and interaction.

Proactively, the observations that students make on themselves allow for sustained mediation by and for the students in relation to their practices and needs. The student can compare his behaviours with himself or with his colleagues in terms of his progress, skills, and challenges. In our proposal, feedback is constructive since it brings new knowledge to the student while being framed by a structure motivating collaborative design. Therefore, it is possible to see how the model for learning teamwork skills could support the analysis of one's actions and behaviours, resulting in a more autonomous, constructive, and reflective practice. Offering common reference points to initiate conversation, the model should lead to a more thoughtful practice in the hopes of developing reflective habits and promoting collective behaviours in the attitudes of future professionals.

A tool to motivate more complex collaborative dynamics

Students generally choose to distribute work to focus their efforts on the tasks at which they already excel, limiting their interactions to the minimum. This mindset promotes time and task efficiency over a more integrated project process and the development of new skills. As mentioned by Tessier (2020), coordination, cooperation, and collaboration can be organised according to their level of cohesion. These levels were confirmed in the data we collected, as similarities were identified according to the levels of cohesion and the stages of the model. For

example, coordination was identified predominantly in the behaviours of participants associated with level 1, cooperation to participants of level 2, and collaboration to participants of level 3. Still, we confirm the limited presence of collaboration, except for teams that conducted complex projects. This tendency was also observed by Zahedi (2019). Only the participants of Group E, which were the most advanced in their formation, showed the most collaborative behaviour by working together, building shared comprehension, using boundary objects, negotiating through their complementary forces, and sharing common objectives.

This limited presence highlights the necessity to favour an explicit pedagogical strategy for implementing more complex team dynamics into design training. As students progress in their formation, they should be exposed to varied dynamics to build a complementary repertoire of experiences. As we observed with the analysis of the multiple case studies, the lack of explicit training on team dynamics slows down the adoption of more complex team dynamics and diminishes the potential benefits that teams could implement in their projects. On the one hand, task complexity encourages the adoption of collaborative behaviours as efforts have to be combined to propose a valuable solution in line with its initial context. On the other hand, too much complexity blocks team members and promotes less complex dynamics (such as coordination or cooperation). The social scope of design should be considered as a whole, as soon as the first-year students integrate their design program to introduce such disciplinary values into their mindset. Despite the levels of cohesion between team dynamics, teams are guided by the centrality of the object in the project process. As mentioned by Geisler and Rogers (2000), the object to be produced is what directs and coordinates the project's efforts.

Conclusion

In conclusion, educational institutions should concentrate on renewing their practices and developing their strategies to ensure that novices are ready and confident to perform in professional projects. Greater awareness to the pedagogical expression of teamwork skills would allow constructive alignment throughout the educational experience. Still, full pedagogical coherence can only be achieved when all principles are applied as an integrated program approach (which might be difficult to implement in the short term).

This brings us to identify some of the limits of the framework presented in this paper. First of all, the proposed model is based on limited data. Although we were faced with an important mass of verbal and written data from our participants because of the longitudinal scope of the data collection strategy – only 22 students were enrolled in the study. In that sense, the study is exploratory as it allowed to investigate broadly a new context. Secondly, participating students were part of the same context of study (i.e. all enrolled at the same university). Efforts were made to recruit students from various programs and training levels, but since they are all from the same teaching institution, chances are high that they share very similar philosophies and visions. Finally, a last limit is also due to the exploratory nature of the study: there has been no real-life implementation of the proposed model. Of course, we hope to be able to share future research reflecting on our attempts to implement the framework as part of various workshop team projects or as a program approach. In the future, we wish to study more varied learning contexts and apply the recommendations that were discussed in this article.

In conclusion, this article shared a research initiative that sought to understand teamwork experiences as design students live them. The analysis of qualitative data collected from 22

participants of various design programs and levels supported the development of a model based on the concept of the zone of proximal development. This model, which is shared as the main contribution of this article, gathers 33 characteristics of teamwork design projects distributed in 5 zones (personal, project, organisational, learning, and social). These zones are subdivided into three levels corresponding to introductive, mid-, and advanced levels. The model can be used in support of all three fundamental activities of educational practice by facilitating teaching and pedagogical tasks, supporting learning, and offering guidelines for self-assessment or co-assessment. Seeking for more coherence within the pedagogical strategies of a training program can only be more positive for the learners by bringing them to see the global picture, understand the need for complex team dynamics, and offer clear stages to reach mastery of design as a social practice. Using the project as its main motivation, the model works around complementary skills to achieve teamwork coherence, as designers often take on the fundamental role of group facilitators in the projects in which they participate (Kleinsmann et al., 2012).

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Appendix

Category (zone)		Code (Characteristic)	Factors
1. Personal	1.1	Adaptation to context	A- New to University B- International exchange student
	1.2	Personality traits	A- Situational traits B- Permanent

Category (zone)		Code (Characteristic)	Factors
	1.3	Motivation and engagement	A- Intrinsic motivation B- Extrinsic motivation
	1.4	Trust	A- Self-confidence B- Trust in teammates C- Trust in experts
	1.5	Stress management	A- Personal stress management B- Stress management of others
	1.6	Focus on the project	A- Friendship B- Work environment C- Attention disorder
	1.7	Affirm role or position	A- Communicate a role or skills B- Affirm experience
2. Project	2.1	Project activities	(Not detailed)
	2.2	Expressing ideas	A- Proposing ideas B- Combining ideas C- Fixation
	2.3	Taking initiative	A- Take action B- Passive attitude C- Question or doubt
	2.4	Shared comprehension	A- Share the same vision B- Lack of common vision
	2.5	Feedback on the project	A- Feedback from teacher B- Feedback from peers and colleagues C- Feedback and critics from experts
	2.6	Attention to details	A- Adopt a micro vs macro perspective
	2.7	Project complexity	A- Gap with previous experiences B- Seek peer recognition
	2.8	Project feasibility	A- Search for credible propositions
3. Organisational	3.1	Time management	A- Waste time B- Project organisation C- Time organisation D- Different work rhythms
	3.2	Meeting deadline	A- Project deadlines B- Sub-deadlines imposed by the teacher C- Sub-deadlines self-imposed
	3.3	Tasks management	A- Joint work B- Task division C- Individual work
	3.4	Personal responsibilities	A- Job B- Differing schedules C- Personal priorities
	3.5	Prioritisation	A- Prioritisation (hierarchy)

Category (zone)		Code (Characteristic)	Factors
	3.6	Disciplinary expertise	A- Respect disciplinary zones B- Promote a design approach
	3.7	Team habits	A- Facilitate the project process B- Regressive habits
4. Learning	4.1	Project tools	A- Lack of mastery of basic tools B- Lack of access to tools C- Mastery of complex tools
	4.2	Sharing new information	A- Communication information B- Mutual learning C- Lack of knowledge on an aspect of the project D- Search for external support
	4.3	Complementary skills	A- Skills complementarity B- Work method complementarity C- Strength diversity
	4.4	Inclusion of experts	A- Ask for help B- Base decisions on experts' knowledge
	4.5	Project authenticity	A- Compare pedagogical and professional approaches B- Professional concerns
5. Social	5.1	Getting to know each other	A- Team up with a stranger B- Prejudices C- Team up with friends
	5.2	Communication	A- Good communication B- Lack of communication or tensions C- Remote communication D- Communication with experts
	5.3	Team atmosphere	A- Positive atmosphere B- Avoid clashes C- Act with respect D- Lack of involvement
	5.4	Team hierarchy	A- No hierarchy B- Egalitarian relationship C- Leadership or hierarchical structure
	5.5	Agreeing together	A- Individual decisions B- Common decisions
	5.6	Team meetings	A- Personal responsibilities B- Fixed meetings