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The emergence of leadership in pre-service teacher education students' collaborative learning in the context of maker education project

Master's Thesis in Education

FACULTY OF EDUCATION AND PSYCHOLOGY

Master's Degree Programme in Learning, Education and Technology

University of Oulu

Faculty of Education and Psychology

The emergence of leadership in pre-service teacher education students' collaborative learning in the context of maker education project (Md Sharif Hosen Shak)

Master's thesis, 98 pages, 2 appendices

May, 2023

While talking about ways to effectively improve teaching and reform schools, teacher leadership is an essential issue. Teacher leadership is considered as a crucial skill to make an influence on pupils both within and outside of the classroom. Therefore, future teachers need to acquire the leadership skill to be effective during their teaching practice. There has been growing interest in maker education in different educational context which can be fostered through collaborative learning. Maker education emphasize on collaborative learning approach to benefit the group optimal success. During the maker-based group collaboration there are possibilities for the future teachers becoming as emerged leaders. While previous studies explored the emergence of leadership in children makerspace-based group collaboration, it needs to be focused on the pre-service teacher education context. To address the issue, this qualitative thematic deductive and inductive analysis study identified emerging leadership qualities within eight pre-service teacher students who have the common educational background or teaching experiences. A number of emerged leadership moves identified focusing on which moves occurs mostly and two leadership types emerged during maker project collaboration. Data analysis depicts that students have taken all four leadership moves at various situation while students mostly taken the role of seeking out resources as well as coordinating joint work. Most of the interviewees agreed that during the collaboration in their maker project they have shared different leadership moves rotationally with others which indicate that there were shared leadership emerged although there were evidence of individual leadership in two groups. key findings of this study highlight that leadership moves and shared leadership approach can be effective at successful maker project group collaboration. In the discussion and conclusion part of this study have shown that extended empirical evidence for the emergent leadership in maker based collaborative learning and provided insights and suggestions for future teachers and researchers.

Keywords: Collaborative learning, Maker project, Maker education, Leadership, Leadership moves, Shared leadership, Emergence of leadership.

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Introduction

Nowadays the educational system is experiencing huge transformation, where teacher leadership is a key topic when discussing how to better transform teaching and reform schools (Billingsley, 2007; Little, 2003; Smylie, 1995). By instructing and motivating the younger generation, teachers play an integral role in influencing the direction of society. Teachers who have the skill to impact students both inside and outside of their teaching environment are said to be performing teacher leadership (Danielson, 2006). Therefore, it is essential for instructors to have leadership qualities that allow them to provide students with a practical example of demonstrating democratic leadership and shared accountability in the school and community settings (York-Barr & Duke, 2004) which ultimately, make enhanced educational and social benefits them (Jackson et al., 2010).

In recent decades, maker activities have gained popularity throughout the STEM education sector by the advancement of variety of materials and widely available technologies (Lin et al., 2020). It not only improves students' technical abilities but also other learning skills like cooperation and collaboration (Vuopala et al., 2020). As a pedagogical approach, maker education promotes more practical, hands-on, innovative and meaningful designing and learning experiences in a collaborative learning environment (Hughes, 2017). It also encourages problem-solving skills, critical reasoning, and learning from failure and collaborating (Hughes, 2017).

Future teachers have to be prepared with 21st-century skills throughout their own education, as fabricating tasks in the maker environments need precise task design and teacher support throughout the process (Vuopala et al., 2020). Besides, education institutions which prepare future teachers should also be prepared to teach their students how to maximize maker spaces' affordances for learning (Vuopala et al., 2020). A variety of the advantages of makerspaces in education have been demonstrated by researchers to support this point of view, which involves the development of computational abilities (Martin, 2015), technical understanding (Davidson & Price, 2017), and global competencies like collaborating (Vossoughi & Bevan, 2014), adaptability (Hughes, Fridman, & Morrison, 2016), innovation and creativity (Tan, 2019), solving problems (Blikstein, 2013), and design-based reasoning (Sheridan, Halverson, Brahms, Litts, Jacobs- Priebe, & Owens, 2014).

In maker project, working together and solving problems as a group is a key component (Pepler et al. 2016) which means collaboration is the key to make education. During collaboration n

in makerspaces students determine what to make, how to proceed and define the way of collaboration within the group (Leskinen et al., 2021). Collaboration is seen as becoming crucial in makerspaces because it allows students to have an active role concerning what and how they think and generate allowing it up to them to decide whether the task is determined how the teamwork proceed (Dixon and Martin 2014; Martin 2015; Pepler et al. 2016). Moreover, during collaboration there are possibilities of different roles emerging among group members as socially shared activities are happening during collaboration.

Besides, in the maker education context students are open to each other for collaboration inside and outside of the classroom setting for designing novel solutions which give them the opportunity to understand, learn and interact with each other, which helps them to improve different social skills, leadership is one of them (Hennessy and Murphy 1999; Howe and Zachariou 2019). Maker environments tend to encourage learners' leadership skills and initiative in managing their tasks and social interactions because of their innovative, team-based, and student-focused character (see, for example, Martin 2015). In makerspaces which focus on creativity, student centric and collaborative problem solving in nature are supportive to develop students' leadership to organize their tasks and keep mutual relationships with group members (Martin, 2015). Yamaguchi, (2001), pointed out that, mastery conditions offer a more favorable atmosphere than performance situations for the formation of leadership, and the emerged leaders influenced the performance of the group (Li et al., 2007).

Dinh et al. (2014) mentioned that emerging leadership is an approach resulting in team members' role as leaders being acknowledged by their peers. As to several other academics (Hogan et al., 1994; Lord et al., 1986; Judge et al., 2002), leadership emergence can be defined by contrasting it with effective leadership and concentrating on the key role emerging. The concept of leader emergence describes whether or how much a person considers themselves to be a leader (Judge et al., 2002). The impression of leadership among groups—typically those without assigned leader—is referred to as the emergence of leadership (Lord et al., 1986). Leadership emergence is not always associated with the rise of a single leader. Two leaders can emerge in leaderless groups, these leaders are the task specialist and the best-liked member (Prince, 1986; Wheeler, 1957).

However, previous studies have found a connection between leadership emergence to leader as they mentioned that leadership emergence is simply another name of leader emergence, which is a process by which a person takes on the role of leader in a novel team (Hogan et al., 1994;

Judge et al., 2002; see also Carson et al., 2007). A further focus is given by Hogan et al. (1994) who described most of the research on emerging leaders reveals the factors related to somebody getting regarded as a leader-like. The concept of distributed and focused work leadership in groups was initially put out by Gibb, (1954). The early academics who noted that "leadership is the leading position of a person or a number of people in a group" included Mumford (Bass, 1990). Despite leadership is considered a crucial part for successful collaboration (Li et al., 2007; Yamaguchi 2001), there is less concentration on emergence of students' leadership in maker education and how it is connected to students' collaboration (Leskinen et al., 2021).

This study set out to examine how student leadership develops in maker projects and how it connects to students' successful collaboration, however, it has unexpectedly less focused. Although, In the most recent study regarding leadership emergence in makerspace by Leskinen et al., (2021) focused on this phenomenon but it has explored based on the school-based makerspace context. However, most studies of the field of education have failed to focus on emergence of leadership in maker based collaborative learning settings in the context of pre-service teacher students' perspective. Thus, in this seek to address which leadership moves emerges in students group activities in maker education and how those turn of leadership is related to effective group collaboration.

Theoretical Framework

2.1 Collaborative learning

Traditional teaching methods, such as lectures, are thought of as passive instructional strategies because they give students slight opportunity to collaborate and take control of their own achievement. Through interaction and teamwork, learners actively take part in the learning process in group learning (Scager et al., 2016). According to Scheckel (2017), collaborative learning has higher learning benefits than traditional methods because it helps students develop team and critical-thinking abilities, which are crucial in modern society. Students benefited mostly while collaborating in a group (Johnson et al., 2007). Collaboration is a process of learning where learners in a group share learning approaches by negotiation and coordination of group learning goals and processes (Roschelle and Teasley, 1995). As the collaborative learning process includes discussions, negotiations, and reflection during the task execution, it could lead to effective information processing compared to individual learning (Dillenbourg, 1999; Baker, 2015).

Collaborative learning is a learning approach in which students needed to work together to reach a mutual learning goal (Slavin, 1987). Näykki et al., (2019) stated that collaborative learning is effective and has gained acceptance in different fields, learning settings and age groups, especially in higher studies and school level group collaboration (Kalaian & Kasim, 2017). Collaboration improves the learning performance of students and their social skills which are required for their future profession (Scage et al., 2016).

There are slight differences between collaborative, cooperative, and team-based learning by their definitions, although usually these are used for the same concept (Kirschner, 2001). Students engage in small-group activities where they contribute their knowledge and expertise in collaborative learning where teacher's role typically a facilitator in these student-driven group work (Kirschner, 2001). There is a positive relationship between collaborative learning and student achievement, effort, tenacity, and motivation has been shown by empirical studies over a number of decades (for reviews, see Slavin, 1990; Webb and Palinscar, 1996; Barron, 2000; Johnson et al., 2007). When students engage in high-quality social interaction, such as discussing critically, collaborative learning could enhance deep learning (Visschers-Pleijers et al., 2006).

According to Van Boxtel (2000) understanding complex methods and concepts in science education requires a deep-learning method. In order to comprehend these concepts, students must undergo an intellectual transformation process, which is especially activated in collaborative learning environments where students interact by critically answering, explaining and challenging, asking questions one another (Van Boxtel et al., 2000; Linton et al., 2014). While in this context, social interaction is essential for successful collaborative learning (Volet et al., 2009). The quality of participants' interaction within the group is the success factor of learning. Student interaction which requires to be arranged in a way that encourages active engagement of participants and organize mutual learning opportunities of group members (Scager et al., 2016).

According to Goodfellow, (1995) collaborative learning has three types of groups which are formal and informal collaborative learning and cooperative base groups. Formal collaborative learning groups could consist of three to five members to complete an entire learning task while informal collaborative learning groups organized instantly to make sure students' attention to the learning resources which might last few minutes to one session period while the formal learning group usually last longer like from one class to several weeks until the assigned task has completed. However, in cooperative base groups are often used in higher education programs and typically remain continue for a year or longer. All of these groups include those students who have consistency in their study (Goodfellow, 1995).

There is an important aspect of discussion which makes collaborative learning successful. According to research, the effectiveness of student discussions in collaborative learning groups depends on their ability to negotiate the argument (Teasley, 1995; Chinnet al., 2000), clarify their ideas to their peers (Veenman et al., 2005), and incorporate and build on one another's ideas (Barron, 2003). Explaining and discussing topics with one another can lead to a deeper understanding, figuring misconceptions, and strengthen the links between new and previously learned information (Wittrock,1990). It is crucial to figure out how to set up collaboration in a way that encourages these kinds of interactions.

Years of research on group work have led to the identification of a number of variables that could improve the efficiency of collaboration which could be identified as primary and secondary factors(Scager et al., 2016). The scenario of successful collaboration is that participants are engaging in constructing, monitoring, and guiding mutual learning processes (Barron, 2003; Näykki et al., 2017; Isohätälä et al., 2020). It is to be counted and understood that with whom you are collaborating, what subject is being worked and how participants interactions affecting

each others are crucial factor for successful collaboration (Linnenbrink-Garcia et al., 2011; Miyake and Kirschner, 2014).

It is also a matter of group collaboration to figure out how consistently it works within the group, and group composition and group settings. To get consistent group interaction it is recommended that groups design should be small (e.g., up to five members) for the primary factors (Lou et al., 2001; Johnson et al., 2007). With respect to group composition, mixed ability (Webb et al., 2002), equal participation (Woolley et al., 2015), creativity (Kozhevnikov et al., 2014), and open and ill structured tasks (Gillies, 2014) could improve the group efficiency and effective collaboration (Scager et al., 2016). Positive interdependence theory is one of the best-founded theories explaining the quality of interaction in collaborative learning when it comes to secondary or intermediate factors affecting group work (Slavin, 1990; Johnson and Johnson, 1999, 2009; Gully et al., 2002). Among group members, according to this theory, improving collaboration is accomplished when students believe that everyone's contribution is critical to the group's success in completing the assigned activity (Johnson and Johnson, 2009).

Individual accountability and promotional interaction result from positive interdependence. Individual accountability is defined as feeling responsible for one's own work as well as facilitating the work of other group members. To avoid free riding, a sense of mutual accountability is required (Johnson and Johnson, 2009). According to the definition, positive interaction involves students supporting and helping one another to achieve mutual goals by considering both group dynamics and the course theme (Johnson and Johnson, 2009). The theory of connected learning offers a framework for comprehending how participants might co-learn while using a wide range of resources, skill sets, and knowledge to find solutions (Herro et al., 2021). It makes the argument that when motivated by play or tinkering, which are frequently encouraged in making activities, working together to solve problems that learners care about can present multiple opportunities to collaboratively solve problems and advance individual and collective expertise (Herro et al., 2021).

Previous studies on collaboration and groupwork in the classroom context beliefs about the importance of giving students chances to work and play collaboratively (Williams & Sheridan, 2006). In order to complete a task or solve a problem jointly, Roschelle and Teasley (1995) defined collaborative learning as a coordinated effort in which knowledge is distributed to build common ground of knowledge understanding. Their research demonstrated how participants could solve problems successfully if they paid attention to collaboration at important phases of

the problem-solving procedure. Barron (2003) observed that the extent of social interactions influences learning, discovering that effective groups acknowledge and discuss each other's ideas and draw on prior conversations before solving problems, whereas less successful teams frequently ignore or reject one another's ideas. Successful team members can later resolve comparable issues by themselves. Early studies determined how makerspaces and making affect social skills and participation. Recent research on making, for example, challenged the proper engagement because access to the makerspaces is frequently restricted (Martin et al., 2018).

2.2 Maker education

The maker movement has grown into a global phenomenon, with an increasing number of individuals engaging in innovative design and creation of artifacts in makerspaces and online communities (Halverson & Sheridan, 2014; Sung, 2018). The movement gained popularity in the United States in 2006 through companies like Make Media and its publication MAKE magazine (Blikstein, 2018; Halverson & Sheridan, 2014; Hira, Joslyn, & Hynes, 2014; Sang & Simpson, 2019). Maker Faire, hosted by Make Media owner Dale Dougherty in 2007, further promoted the movement (Bullock & Sator, 2015; Sung, 2018). These events have attracted DIY enthusiasts, hobbyists, engineers, inventors, and educators, who have praised the maker movement for its ability to bring people together to collaborate, discover, and share their hands-on making activities and artifacts. Maker Faires have continued to expand both in the U.S. and internationally, with over 1.44 million people from 28 countries attending in 2016 and this growth includes the White House Maker Faire in 2014, which has sparked research and development in educational programs (Sung, 2018).

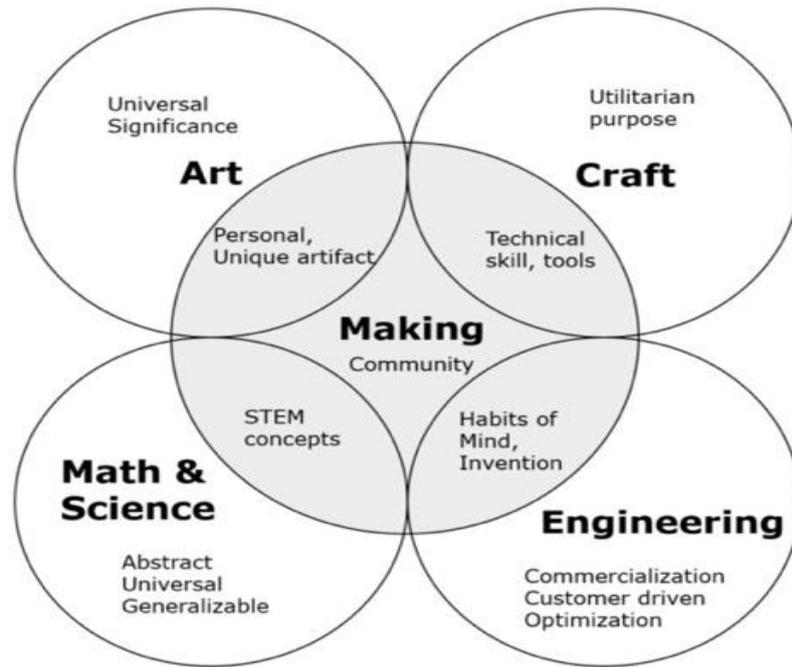
The maker movement was originated from the Do it Yourself (DIY) culture (Lam, 2022). Participants in maker project implement the theme of learning by doing together by accepting do it yourself (DIY) approach (Singh, 2018). DIY "do it yourself" an open-source ideology, which aims to promote technologies through providing it available to all people. In this context, open-source machines (e.g., the 3D printer, CNC machine, laser cutter, and other different machines, etc.) are ones whose mechanical layout, technological devices, and software have all been made freely available to everyone (Pernia-Espinoza et al., 2018). This concept makes it easier for students to take their first steps toward comprehending the technological concepts behind various machines (Pernia-Espinoza et al., 2018). As a result, students can quickly perform "hands-on" tasks like machine adjustments, upgrades, or even more significant invention. This could

improve their capacity for invention and creativity while also fostering their capacity for varied thought and evaluation (Pernia-Espinoza et al., 2018).

A significant transformation from business-related members funded makerspaces to public, government-sponsored makerspaces in cultural institutions, e.g., museums, libraries, and currently in academic makerspaces has become typical, facilitating informal approaches to learning and creative environments for every kind of student groups (Cohen et al., 2017; Gilbert, 2017). This is an important educational process which concentrates on developing, constructing, adjusting, and/or redesigning materials for playful or beneficial ends, with the goal of creating a product of some kind which could be used, interacted with, or displayed (Martin, 2015). In the process individuals need to engage by using their creative abilities, making, and helping to build objects that are important to them individually or for the wider community (Bullock & Sator, 2015).

Making in education, which places a focus on the creative process of producing things, develops into a distinctive strategy for encouraging students to investigate, interact with, acquire knowledge in both formal and informal contexts (Fleming, 2015). Making something to resolve a challenge involves combining expertise and skills from multiple disciplines, which is known as maker education (Kim et al., 2020). Maker education is defined by an affiliation where several disciplines, including math, physics, engineering, art and craft, and making, are intricately mentioned and can even be used to the social sciences and Humanities study domains (Kim et al., 2020). In Marshall & Harron, (2018) study, they mentioned in the figure 1 how art, craft, math and sciences and engineering are connected to making and each other. It resembles project-oriented learning since it concentrates on project activities, problem-oriented learning as it attempts to address a problem, and design thinking as it creates something according to the demand (Kim et al., 2020).

Figure 1. *Relationship between making and art, craft, math, science, and engineering.*



Note. This image has been adapted from the research conducted by Marshall & Harron, (2018).

Maker education is a method of instruction that is closely related to competence and convergence education. In maker education, real-world examples are utilized to inspire the creation of outputs that leverage the interdisciplinary knowledge of many different topics to address them. Besides, it can help students to develop their social skills like collaborating, interacting, and teamwork (Kim et al., 2020), as innovation is promoted and aided through makerspaces (Oswald & Zhao, 2021). Recent research found that this type of learning method has become important for future education because of its dual emphasis on convergence and competences (Seo & Lee, 2018).

Nevertheless, little research on maker education has been done, and even fewer has been done on teachers or future teachers (Seo & Lee, 2018; Papavlasopoulou, Giannakos, & Jaccheri, 2017; Kim & Lee, 2019). Teachers have a crucial role in curriculum development and instructional material selection since they are the primary stakeholders in both processes. Maker education can only be implemented in educational settings when instructors are aware of it, agree with its benefits, and are ready to embrace it (Kim et al., 2020). Therefore, research on teachers and pre-service teachers is crucial to the field of education. Next, the foundation theory of maker education with its connection to collaborative learning and its effectiveness will be addressed.

Making is a multi-faceted concept comprising both a person and an activity phase (SINCAR & ÖNEN, 2021). On the one hand, making potentially connected to activities that may be created with learning objectives focused (Harron & Hughes, 2018) and helps students for shaping themselves (Lindstrom, Thompson, & Schmidt-Crawford, 2017). Constructivist educational theories and philosophies (Halverson & Sheridan, 2014; Harron & Hughes, 2018) are related to the making of which humans taking place at the center (Hira & Hynes, 2018).

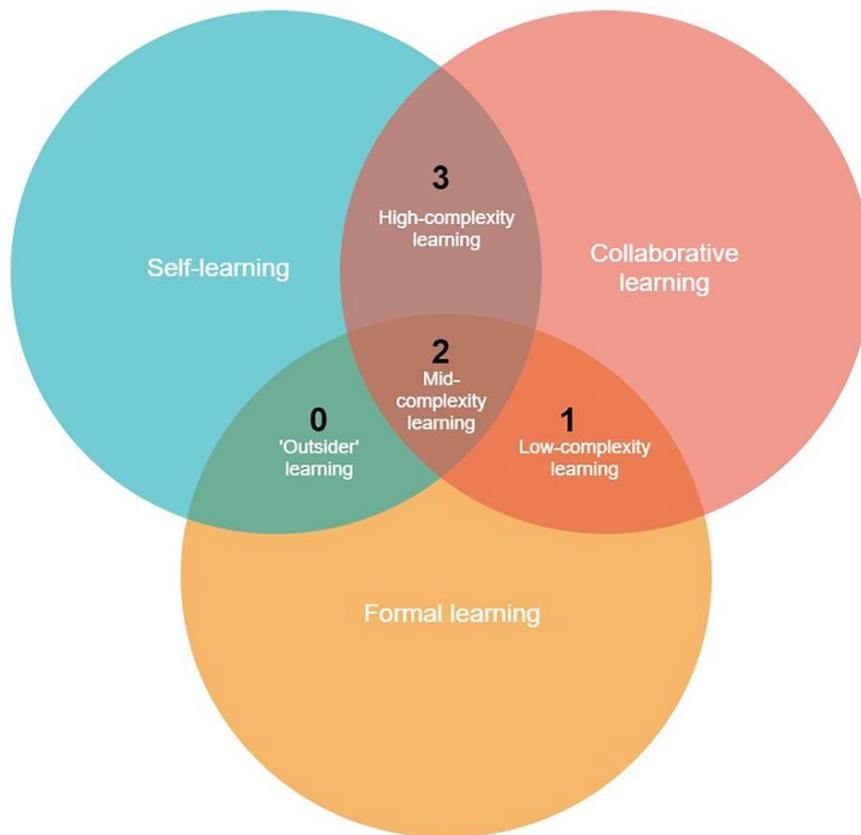
Another element is that it gives students with the resources they need to succeed by allowing them to integrate their work into a wider social framework, develop analytical skills, and critically evaluate and challenge their personal experiences (Harron & Hughes, 2018; Martin, 2015). Constructionism theory is the core of Maker education where it depends on making and learning (Kim et al., 2020). Seymour Papert, coined the term "constructionism" to describe a movement in education that has its roots in maker education. The phrase "learning-by-making" perfectly captures his views on education (Harel & Papert, 1991). He believed that during the entire procedure of taking concepts to practical things that others could benefit from and share, students learnt significantly from this process (Ackermann, 2001). This notion eventually has turned to the basis to maker education of learning by making subsequently (Kim et al., 2020).

Engineering, library, teachers, and members of other professions are among the people who are drawn to the Maker Movement because of its swift growth (Martin, 2015). In educational settings, makerspaces with both low- and high-tech equipment offer participants a variety of options, such as collaborative learning, group members supported making, building communities, cultural involvement, and experimental tasks (Bers et al., 2018). Each one of these components of makerspace environments support students in the development of their identities, social skills, and technical skills, and potential (Paganelli, Cribbs, Huang, Pereira, Huss, Chandler & Paganelli, 2017). This is why, teacher education courses need to be given the duties of providing makerspaces in order to equip instructors with that information.

The collaborative character of the lessons and the possibility for transformation in education offered by makerspaces are discussed through literature on the most efficient ways to support career growth (Kennedy, 1999). Student growth and prospective can be enhanced by setting up that makerspace for both learning and innovation. A valuable talent for learners in this 21st century is the capacity to use technology tools and gain new abilities and skills to produce different artefacts (DES, 2016; NCCA, 2009, 2017). Moreover, Oswald & Zhao, (2021)) found

that collaborative learning is the core concept of makerspace where participants exchange various skills among them. While sharing knowledge to each other in collaborative learning, learning rate improves hugely in maker project. In their research, Oswald & Zhao, (2021) also observed and identified that in makerspace, collaborative learning was faster and effective when it mixed with formal and self-learning. Therefore, in this type of learning setting it is appreciated that participants act as self-learner, collaborative learner, and formal learner. During interaction between these three major modes of learning, there are different combining zones of learning approaches emerged in which Low complexity, mid-complexity and high complexity of learning shows the hidden aspects of collaborative learning in makerspace which mentioned in figure 2 (Oswald & Zhao, 2021).

Figure 2. *Interaction between the three major modes of learning.*



Note. This image is extracted from the research paper written by Oswald & Zhao, (2021).

“Community interaction” depicts to interaction process of members during the collaboration in maker activities while “learning” is the central of makerspace, all group members and individual interest. In “community capacity” is to spread knowledge among the group members since sharing knowledge is core of collaborative learning. Then “management” which hugely impacts

community resources management (Oswald & Zhao, 2021). During the collaboration in makerspace, members develop new skills sets. Collaborative learning in makerspace not only provide technology skills, even it offers acquiring various soft skills which can help to move forward toward career development. Maker education does not only accommodate technological learning but is also effective at developing soft skills (Oswald & Zhao, 2021). Some research on collaboration found that students' engagement about new thoughts are crucial for shared knowledge construction and identification and development of new thought process (Miell and Littleton 2004; Rojas Drummond et al. 2008, 2014).

In addition, development of 21 century skills is crucial in this technology driven era while makerspace could play a vital role to grow different soft skills among learners to cope up with this challenging time. Sanabria-Z et al., (2020) identified that, by maker culture, a set of 21st century skills e.g., collaborative and creative problem-solving approach developed among students. Taylor (2016) in his paper concluded that "makerspace" activities might be adapted into lessons that support 21st-century learning objectives. To put it another way, the making-based learning experience can stimulate and foster students' creativity and innovation as well as other 21st-century skills (Blikstein, 2013; Iwata et al., 2019; Pitkänen et al., 2019). Gruen (2018) discovered that making helps people become better communicators and critical thinkers by improving communication skills. Hughes et al. (2019) found that students can improve their problem-solving, teamwork, empathetic thinking, and social skills through Making.

By their research, the authors found that students learned 21st-century capabilities successfully (Konstantinou et al., 2021). They concluded after their Makerspace related literature review by indicating in makerspaces people work collaboratively, interact, and enhance various new century important skills and expertise, for becoming skillful, advanced in technological literacy and subsequently excelling in future job careers and personal lives (Konstantinou et al., 2021). Employers are seeking candidates with a variety of abilities and talents, including adaptability, analytical skills, problem-solving abilities, and collaboration (Konstantinou et al., 2021). It is also mentionable that soft skills are necessary for job seekers to secure a job in nowadays however, there is a lack of graduates with the necessary soft skills for jobs (AbuJbara & Worley, 2018).

Considering how makerspaces affect those abilities is therefore promising and beneficial, it is also to be focused that additional research is needed to understand what and how "learning by making" might be accomplished (Konstantinou et al., 2021). Makerspace research is yet in its

preliminary stages. Further study is desired in the fields of Deep Learning in Education and Academic Achievement, Maker Curriculum Integration, Design of Successful Maker spaces Settings, Enhancing different Skills, and Digital Literacy Competencies (Konstantinou et al., 2021). In this current research, it is going to identify how “leadership” a 21-century skill emerges during the maker project collaboration.

2.3 Pre-service teacher education

Teaching is a complicated profession that requires systematic approaches for fostering instructional and skills enhancement, dealing with activity in the classroom, fostering student interests, special needs, and well-being in all aspects of students (Laurillard et al., 2013). In the empirical research on pre-service teacher projects, Cohen, Hoz, and Kaplan (2013), outlined important areas for novice educators to grow and learn, which comprises the necessity to promote innovative distinguishing learning experiences, to be adaptable to students' needs, behaviors, and problems and to be flexible to constantly developing policies, board directives, educational institutions objectives, and substantial societal transformations.

In recent years, as a global outbreak impacted the worst disruption of education in the history of humankind, educators across the world displayed their abilities for immediate responses and adaptability (United Nations, 2020). Based on data from the UN's (2020) statement on education amid COVID-19 as well as afterwards, shutdowns of schools globally had consequence on roughly 1.6 billion pupils in around 200 countries. Although online learning hasn't been completely effective, it is evident educators have an overall capacity for adjusting, creativity, and modifications in the novel approach of teaching and learning (Reimers, 2021). In order to incorporate cutting-edge pedagogical approach which can foster global competencies while utilizing technological resources in significant and innovative ways, these programs for pre-service educators may include lessons and teaching methods that cover making approaches including case and project-centered learning (Bullock & Sator, 2015; Lock et al., 2020).

Although in-service and pre-service teachers who have experienced maker-centered learning often possess a favorable attitude, pedagogy is not supported at majority of higher education institutions for teacher training. According to Cohen and colleagues' (2017) in their nationwide study, only a little over seventeen percent pre-service programs had access to a makerspace or fabrication lab, even though roughly fifty percent of them had the chance to cover some of the technological and making-related themes. Pre-service teachers who participate in makerspace-

based activities as a part of their training for the classroom frequently express frustration with the machine's difficult learning process (Corbat & Quinn, 2018) or feel that the methods go against their conception of what classroom instruction entails (Sator & Bullock, 2017). Moreover, future teachers might become perplexed if training programs lack sufficient time to define terminology that is frequently connected to making (Sator & Bullock, 2017).

The empirical research on the maker movement conducted by Papavlasopoulou, Giannakos, and Jaccheri (2017), got 43 research articles that matched their inclusion criteria's. That research was restricted to workshops without following classroom settings. They demand further research, especially in classrooms settings, to ascertain which elements of making are more successful, and with which pupils. Therefore, more work needs to be done to improve the knowledge of making in official STEM school settings, its efficacy to accomplish STEM educational goals, and the ways training programs for teachers can support its genuine execution (Marshall & Harron, 2018). A collaboration with future educators who received maker pedagogical training and technological equipment is one additional prospective technique for future professional growth for current teachers that is highlighted by researchers Winter and colleagues (2021). With the help of such an environment, future teachers may get actual coaching experience while in-service teachers may foster maker pedagogic peer-learning (Winter et al., 2021).

Now in the following part it is going to be focus on leadership skills in pre-service teacher maker education in collaborative learning settings. Leadership skills are not innate in educators. Before engaging in teaching positions, it is important to develop leadership skills. The progress of preservice teachers depends heavily on their acquisition of teacher leadership. At the outset teacher leadership development is crucial to advancing preservice teachers' teaching abilities and developing excellent future educators (Wang et al., 2022). According to Beijaard et al. (2004), teacher identity affects how instructors decide on the subject matter to teach, how they conduct their instructional procedures, and how they interact with fellow teachers and learners. Additionally, it is essential for preservice educators to have a thorough understanding of teaching and to pursue ongoing professional growth (Izadinia, 2013). In order to assist preservice educators, evolve into emerging leaders in their fields, training programs for teachers need to give particular emphasis on nurturing and promoting the change of the teacher's responsibilities (Wang et al., 2022).

The leadership capacity of educators without formal identities is often ignored, despite the fact that teacher leaders with leadership skills likely to take teacher leadership positions more efficiently (Hu & Gu, 2012; Zhang et al., 2014). Even fewer studies have been done on educator leadership among future educators. The emerging characteristics that reveal the prospects for leadership roles among preservice teachers are still little explored (Wang et al., 2022). The efficiency with which preservice educators teach while on their school-based practicum experiences reveals how well-prepared they were for the position (Wang et al., 2022). Preservice teachers' ability to manage and lead others has an influence on both their career goals and how well they teach throughout training practice (Reeves & Lowenhaupt, 2016; Suhre et al., 2022). In order to develop preservice teachers' leadership, teacher training programs need to do so (Wang et al., 2022). It can support pre-service teachers' efforts to reach their maximum academic potential and speed up their academic and career growth to develop into accomplished teachers (Rutherford, 2006).

Teacher training Although an increase within research on making in education and the movement's obvious appeal (Halverson & Sheridan, 2014), there has been little evidence of its effectiveness in achieving any of its stated learning objectives (Marshall & Harron, 2018). There hasn't been much study done on successful maker teacher preparation. Instead of in conventional classrooms, a large portion of research with peer review has been conducted in informal settings (Marshall & Harron, 2018). In terms of mindsets and values, studies using brief making activities with teachers in both pre- and in-service typically reveal positive outcomes (Jones, Smith, & Cohen, 2017). Making was viewed positively by educators participating in that research as being in line with the teaching methods encouraged by their training programs, such as project-based learning (Marshall & Harron, 2018). Therefore, in this thesis, this gap was identified and focused to investigate how pre-service teacher students emerge as leader in their collaboration during maker project.

2.4 Leadership

The effectiveness of collaboration among educators is significant (Hargreaves 2019; Ronfeldt, Farmer, McQueen & Grissom 2015). It should be one of the several fundamental experiences at the beginning of a teacher's professional life amid their pre-service teacher training program. This is but one among several criteria that define effective educational organizations (Brown,

Hartwell & Thomas 2018). Numerous studies have shown that teachers who collaborate in collaborative environments tend to be satisfied regarding their roles and have beneficial outcomes on student achievement (Goddard, Goddard, & Tschannen-Moran 2007, Hargreaves 2019, OECD 2018). Regardless of ample research promoting the importance of teacher collaboration, it isn't quite clear that entails in pre-service programs teachers and the advantages of learning through purposefully planned and facilitated collaborative activities (Ying & Ho, 2015). Their research intent was to find out the relationship among pre-service teacher students, collaborative skills specifically leadership quality and maker education collaborative projects success (Ying & Ho, 2015). In the following parts, the theory of leadership, its definition with different leadership moves and focusing shared leadership typology will be described accordingly.

Although there are numerous theories regarding leadership (as cited in Bass, 1990), this research based on the theoretical base of leadership is behavioural complexity (Quinn, 1984). According to this viewpoint, effective leadership involves playing several roles at once. Based on how adaptable/stable and internally/externally oriented a person's behavior is, this theory identifies eight basic leadership duties, such as innovator, broker, producer, director, coordinator, monitor, facilitator, and mentor (Xie et al., 2018). According to empirical research, leaders who can perform multiple roles are seen as being more efficient, even though certain roles require different levels of flexibility and attention than others (Dension, Hooijberg, & Quinn, 1995).

Now turning to emergence of leadership, for many years, empirical studies with adults have focused on the emergence of leadership in collaborative teams (Li et al., 2007). Knowledge of emergence of leadership is crucial since small teams are formed to perform tasks or solve problems, and those who lead the team have a significant impact on both the process and final outcomes of the groups (Bass, 1990). According to a number of previous studies, Leadership is thought to be a complicated and emergent process (Li et al. 2007, Mercier et al. 2014, Siewiorek et al. 2012, Sun et al. 2017). Miller et al. (2013), Richmond and Stirley (1996), and Yamaguchi (2001), in their publication identified and stated that, the emerging nature of leadership takes place by interactions among members of a group whereas Shin et al., (2004) mentioned leadership is also as an interpersonal concept instead of a distinctive one.

To focus on development of leadership in pre-service teachers, Thomas & Brown, (2019) in their research found that pre-service teachers who took part in collaborative learning were also learning crucial teacher-leadership skills. Pre-service teacher leadership growth is beneficial in

the development of both informal and formal leadership roles in schools (Pineda-Baez, Bauman, & Andrews 2019). Thomas & Brown, (2019) also identified leadership is a well-known important factor in improving student learning, which is equal after the standard of training. They suggested that to foster the development of teacher leadership abilities, pre-service teacher preparation programs should consist of group collaborative work exercises created as a collaborative investigation process (Thomas & Brown, 2019). Increasing collaboration and leadership abilities may aid in keeping new teachers in the field, enhance instruction, and ultimately benefit student learning. (Thomas & Brown, 2019).

Turning to leadership moves, studies mentioned that leadership is demonstrated by different leadership moves such as commencing actions, assigning different roles, and regulating and managing the regular activities of the team (Kantor et al. 1993; Mawson 2011). According to Yamaguchi (2001), leadership styles are influenced by how learners view group activities particularly in collaborative work, competing tendencies can foster leadership domination and interpersonal problems. This leadership, outlined by Buchholz et al. (2014), might show up in interactions that neglect fellow participants, reject other's views, keep direct influence over the activity and the tools employed, and as a result, undermine or even negatively impact collaboration. On the other hand, Yamaguchi (2001) found that a focus on acquiring new abilities while working with others can promote shared leadership and participation by students in a collaborative project. Making leadership decisions that reflect a positive tone, a respectful approach toward others, and an openness to various viewpoints may, in turn, foster fruitful cooperation (Sun et al., 2017).

In this research it has been demonstrated students' leadership occurred by adopting various actions which is called leadership moves. The current study has adopted from Leskinen et al., (2021) work on leadership assessment in the school-based makerspace children collaboration context. In their study, they coined the leadership moves terms e.g., coordinating joint work, exploring new ideas, seeking out resources and offering guidance and supports conceptually adapted from Sun et al. (2017) modified the leadership moves which originated in the Li et al. (2007). They also examined student leadership by investigating the leadership moves used in group discussions on collaborative reasoning and discovered moves that regulated turn-taking, forming arguments, planning, and arranging the work, and directed the subject matter of discussion (Li et al., 2007).

Besides the aforementioned types, Mercier et al. (2014) discovered moves that contributed in the successful achievement of a team's objectives by offering novel concepts during collaborative tasks and which moved forward the team intellectually. Furthermore, Sun et al. (2017) modified the leadership moves which originated in the Li et al. (2007) study to fulfill a mathematical task. The leadership moves noted in Sun et al.'s (2017) study comprise task distribution, solution proposal and justification, planning and organization, and acceptance seeking. According to previous research on leadership moves (Li et al. 2007, Sun et al. 2017) organizing, planning, and finding consensus while collaborating can increase participant's coordination and can result in proper participation. Additionally, it shows how leadership moves that turn out argument and offer innovative ideas can increase the group outcomes (Li et al. 2007, Mercier et al. 2014, Sun et al. 2017).

2.4.1 Individual leadership

According to Northouse (2019), leadership is the process through which one person persuades a group of others to accomplish a shared objective. This study concentrated on person focused leadership style. Transformational leadership, which employs influence strategies including guidance, support, and encouragement (Bass, 1998; Judge & Piccolo, 2004), is person-focused leadership. As their name implies, transformational leaders help others change by acknowledging their special needs, showing them individual consideration, stimulating their minds, and looking optimistically into the future (Bass, 1998; Bono & Judge, 2004; Eagly, Johannesen-Schmidt, & Van Engen, 2003).

Bass' Transformational Leadership Theory, published in 1985, served as one of the foundations for the guiding to this research investigation. Transformational and transactional leadership are two different categories of leadership, according to Burns (1978). There was always a conversation between leaders and followers, which led to the development of both ideologies of Transformational and transactional leadership. The leader would therefore be regarded as employing either a transformational leadership style or a transactional leadership style, depending on the outcome of that engagement. According to Goethals et al. (2004), a transformational leadership style involves leaders offering a greater purpose than merely completing goals, one that will satisfy a higher order of demands, and making it their mission. Contrarily, the transactional leadership style would involve straightforward, uninteresting, and useful exchanges, much like commerce. Leadership that is viewed as an exchange between a leader and a follower, where

the leader gives the follower what they want in return to receive what the leader wants, is known as transactional leadership (Judge & Piccolo, 2004).

Despite being studied and debated independently from collaborative leadership, transformational leadership emphasizes a "shared goals" perspective, which is comparable to collaborative leadership. Transformational leadership raises member awareness of shared interests and aids in achieving group objectives. In contrast with transformational leadership, transactional leadership concentrates on advancing the personal interests of both leaders and followers while fulfilling contractual commitments between the two (Bass & Avolio, 2004). The efficacy of transformational leaders, in contrast, results from their capacity to exhibit excitement and confidence, define ideas for sustainable efforts, and communicate effectively and regularly (Taylor, 2010). In order to inspire creativity in followers, transformational leadership places a strong emphasis on emotions and ideals. Leaders within this structure assume responsibility for and actively encourage the academic and career growth of followers since they are seen as a multi-faceted and rich resource rather than just basic task-performers (Bass & Avolio, 2000; Garc'a Morales et al., 2012).

Dominant leadership is also one kind of individual leadership approach. Since dominant leadership may cause difficulties and contradictions among fellow students (Lee et al. 2005), previous research on leadership reveals that this dominating leadership style could hinder a group from accomplishing its objectives (Sun et al. 2017). In their study findings (Leskinen et al., 2021) they found in one group there was a single individual While other participants had little opportunity to participate, the individual dominant leader was in charge of directing the action. Overall, the way the students interacted led to arguments and the inability to integrate different points of view in the group project since the dominant leader's position overrode those of others.

2.4.2 Shared leadership

In this thesis it has been investigated that which type of leadership emerged during the maker project collaboration and found that effective in collaborative learning context. To focus on this the shared or distributed leadership approach will also be considered and analysed along with individual dominant leadership approach. Distributed or shared leadership is being studied in this thesis because the context is maker project based collaborative learning. Shared leadership and distributed leadership are considered same in this research. A collaborative team may have

several leaders (Pearce & Conger, 2003; Xie et al., 2018) which means leadership can be distributed among different group participants in a group collaboration. Distributed leadership becomes attainable by teammates who act in harmony as the team's leaders (Xie et al., 2018). When groups are managed by its members if there are no defined leaders, the collective leadership concept is far more dominant (Barry, 1991). According to empirical research, collaborative leadership is better at maximizing the intellect and creativity of the group to improve the effectiveness of the group (Wageman, 1997).

In educational settings, a student often teams up with peers and completes academic tasks together without instructor's intervention all the time (Xie et al., 2018). Gressick and Derry (2010) used empirical evidence to show that balanced leadership offers effective groups. They also claimed that participation in different leadership roles by everybody is the optimum prerequisite for effective collaborative learning. Additionally, shared leadership frequently develops because of everyone's involvement (Carson, Tesluk, & Marrone, 2007; Spillane, 2005). Even if there are some defined leadership roles assigned formally, such as project manager or timekeeper, or any other moderator appointed by the instructor, other members may also work together to take on informal leadership responsibilities (Carte, Chidambaram, & Becker, 2006; Neubert & Taggar, 2004).

Shared leadership is happened when team members act as leaders together (Xie et al., 2018). In self-managed teams when no designated leaders have been assigned, a shared leadership approach is even more apparent (Barry, 1991). Leadership can also be seen in interactions when there is a high level of understanding and responsibility for the group task (Shin et al. 2004). In collaborative group everyone has the opportunity to take initiative of leading the team project (see also, Li et al. 2007). However, leadership is a reciprocal process, where the validity of one's role as leader is determined by if fellow teammates follow the lead (Li et al. 2007; Mercier et al. 2014; Sun et al. 2017). Apart from that, a study by Volet et al. (2017) showed that group members adaptability in switching between the roles of leaders as well as followers increases group cohesiveness and effectiveness; if there are more flexibility in shifting the roles, the more efficiencies and adaptiveness will be there in collaboration (Volet et al. 2017).

The concept of distributed leadership is frequently used in research on education field (Harris & DeFlaminis, 2016; Spillane & Orlina, 2005). It has mostly been used to investigate how instructors make decisions in classrooms (Gumus et al., 2016). Although there is controversy and disagreement related to this notion, it remains a significant concept in educational practice,

and new perspectives of distributed leadership keep going to develop the theoretical knowledge of leadership as a social phenomenon and the processes its distribution (Harris & DeFlaminis, 2016).

According to Gumus et al. (2016), distributed leadership is typically described to be shared, assigned, and scattered to members. The leadership is not just limited to those who have official leadership positions, but it presumes that impact can be broadly distributed (Harris & DeFlaminis, 2016). Distributed leadership is fundamentally an interpersonal method developed through the group interaction of people and their social context (Ho & Ng, 2017). The core of this concept of leadership is coordination among different agents, and a team to collaborate with. Thus, shared leadership is considered as emergent and dynamic approach (Ho & Ng, 2017). Although sharing responsibility with each participant is an essential aspect of distributed leadership, which does not mean instructors must hand over complete decision-making authority to pupils (Hairon & Goh, 2015). Hairon and Goh (2015) use the term "bounded empowerment" in this context, that matches well with the educational setting where tutors have formal control over learners but where initiatives are taken to analyze the relationship between learners and teachers in order encourage students to adopt more control of their own learning. Distributed leadership is also based on reliability, which means giving students control over their own projects and education (Hairon & Goh, 2015).

Prior research on shared leadership has mainly examined the interactions of a person's actions and the societal and physical structure wherein this type of leadership emerges from (Gronn, 2000; Spillane & Orlina, 2005). The activities inside any framework are seen to be maintaining or altering the relationships among different individuals under a certain social context (Gronn, 2000; see also Harris & DeFlaminis, 2016). Makerspaces have been argued to facilitate the distribution of leadership among both educators and pupils (Leskinen et al., 2021; Martin, 2015).

However, it is recognized that such doesn't seem to be typically the case (Mulcahy et al., 2015), yet the role of the educator remains crucial in this method (Rajala & Kumpulainen, 2017). Moreover, certain investigations involving learning environments where students are the focal point show that teachers may find it challenging to encourage students to take responsibility and authority of their task (Liu et al., 2021). Diverging from earlier research on the topic, this research set out to expand knowledge of distributed leadership dynamics with a focus on the interaction between group members during collaboration in maker project within pre-service

teacher students' perspective. It has been assumed that in a maker project, distributed leadership can be happened through shared decision-making and task contribution.

Aim and Research Questions

This study aims to explore what leadership moves emerged in pre-service teacher students' collaboration during their maker project collaborative learning which contribute to their successful collaboration. On top of that, based on the previous research suggestion that in collaborative learning shared leadership is effective and harmonized for the group atmosphere, smooth coordination, task accomplishment and positively impact on group success. Thus, it is also focused to investigate which leadership types emerge during the collaboration. To focus on the mentioned research aim, the following research questions (RQ) have been addressed.

1. What leadership moves emerge in future teacher students' group collaboration?
2. Which type of leadership emerges in this context?
3. How is students' emerging leadership related to their effective group success?

Research Methods

4.1 Participants

For this current research a total of 08 pre-service teacher international students from the University of Oulu, Learning, Education and Technology (LET) master's program (01 male, 07 females) were recruited. All the participants gave written consent to be participants in this study. It wasn't focused on the participant's age, gender, nationality, cultural background. However, participants are from diverse age groups and nationalities, but they had a common ground in teaching and education. This participants group were selected purposefully because they have bachelor's degree on teaching or have experience on teaching and doing this teacher training master's program so the core purpose of this research context is matched by selecting them.

Before taking part, the participants were given written documentation about the study's objectives and asked for their participation voluntarily. Each participant signed electronically their own individual consent and was allowed to cancel their participation at any phase of research. Throughout the data collection process, all interactions with participants were attentive through virtual environment to make the communication easier and instant. The research was carried out according to Finnish National advisory Board on Research Integrity's criteria for research ethics (TENK, 2019). All the participants' actual names were changed in order to maintain confidentiality.

4.2 Semi Structured interview as data collection procedure.

To perform the study, the data from the semi-structured interview was collected. The initial phase of the data gathering process was getting respondents consent on the university's suggested format and undertaking a form for risk evaluation to evaluate general data privacy concerns. The first phase was completed in (December 2022 to January 2023). The attendees were also given consent forms and research ethics. The interviews were carried out using the Microsoft Teams platform, which enables sharing of screens and recording interview sessions.

A total of 8 interviews were conducted, with eight participants. The overall duration was almost 5.30 hours, and the average participation time was 41 minutes (with a variation of 31 to 57 minutes). The participants were allowed to openly share their general impressions about the interview's structure, the interview questions. For further analysis, each recording was stored in

a suitable format. A flexible and adaptable method of getting interview data is the semi-structured interview (Kallio, 2016). The purpose of the interview intended to determine preservice teacher education students' leadership roles during the collaboration with their groupmates as well as how, overall, how their leadership development impact the overall group project and collaboration. There were three portions of the interview's script (see appendix 1) the triggering of understanding and typical questions regarding maker project and the artifact, group collaboration and leadership; 2) the identification of leadership role and leadership type among the participants; and 3) the relationship between emergence of students' leadership and its impact to the group success.

The semi-structured interview has been initiated with some broad questions to "check the foundations" on how participants are conscious of these ideas and to stimulate participants' previous expertise and knowledge linked to the subject of maker project: Can you briefly describe the maker project you took part in e.g., the product name, purpose, target users? In what ways was working on a maker project different from other non-making collaborative projects? Were specific roles assigned within the group? If yes, what were they and which role did you undertake? Then I questioned them regarding leadership in educational settings and how they see leadership in this context e.g., How would you describe "Leadership" in collaborative learning?

During the interview sessions, I might pose explanation or reverse the question in an easier way to the participants if they had difficulties answering to open-ended questions, such as for the question How would you describe "Leadership" in collaborative learning? If they didn't catch the question the questions were repeated in another way, for example, what is leadership in collaborative learning? or explained leadership and CL first and asked the question again. The goal of the study undertaken in this section is to comprehend students' first interpretations about leadership and collaboration and enable them to open up to a deeper discussion.

The foundation for the interview questions about leadership moves was taken from the (Leskinen et al., 2021), as they have adopted, modified and developed their perception of different leadership moves from (Li et al. 2007; Sun et al. 2017) according to makerspace context, they found 4 core leadership moves categories emerged during children makerspace group activities which coordination of joint work, exploration of new ideas, seeking out resources and offering guidance and support to their peers. Although their method of data collection video data analysis was different than this current study, their findings helped to identify and structure the current research interview questions regarding leadership moves.

Additionally, Leskinen et al., (2021) findings of leadership moves have been used as codes for this thesis data analysis. In the present study, participants were asked to recall which leadership moves emerged by asking some Yes/No type of simple questions to measure which one they took part in actively and which one they didn't. For this research, it was designed and applied a newly designed questions template with the adopted concept which was based on Leskinen et al., (2021) leadership moves, that consists of five questions for the first two moves coordination of joint work, and exploration of new ideas and then three questions for last two moves seeking out resources and offering guidance. I asked them to be detailed if needed to explain some questions more than just simply saying yes/no to find out the motivations behind their responses, intents.

In the last section of the interview, participants were asked how different leadership moves which emerge during collaboration help their group to reach a successful collaboration. In this part participants were asked if they see the leader's role effective or not according to different moves specification and how those related to effective group collaboration e.g., In your group, how members legitimate emergent leader's role when they started taking decisive action? Did they accept, interrupt, or reject the leaders' proposed action? Why did they do such a thing? (See appendix 1). This segment consists of long questions with different perspectives so that participants get enough time to discuss the actual scenario of their group process and collaboration.

4.3 Data analysis

It was a qualitative approach used to conduct the study. A content analysis was performed on the interview data analysis. The quantitative analysis was not applied due to the inadequate number of participants (Only 8 participated in the interview). The automatic transcription generation feature of Microsoft Teams was used to convert the audio data into text, which saved the researcher's time from generating manual transcription of the interviews separately. However, the transcripts were crosschecked manually to reduce the automated errors in the context for example when the respondent answered and had some irrelevant repetitive words, or chunks or unusual tones like "a, o, uh, umm," something like that which do not serve the original intention of the research have been deleted from the transcripts.

This study uses the content analysis approach to examine the semi-structured interview's findings. This kind may include convergence and divergence, connections and contrasts, and varied

degrees of evaluating and putting into practice the investigator's thoughts (Braun & Clarke, 2006; Hsieh & Shannon, 2005; Miller et al., 2018). The two main categories of content analysis methodologies are deductive and inductive. Deductive content analysis is conducted when there is already a pre-existing theoretical framework which can be used as a roadmap for coding and thematic pattern analysis. On the other hand, inductive content analysis focuses on the themes and patterns which the researcher develops naturally when they read and process the transcript and data.

In content analysis by examining text data e.g., interview transcripts, the main aim is to find different significant themes and patterns related to the data and research aim. Predeterminant codes may be used in content analysis, as well as the generation of new code throughout the process (Hsieh & Shannon, 2005). Galletta, (2013) concentrated on three different data analysis processes for the content analysis research approach. Researchers should first finish their own post-interview reflection during the initial phase, then save and arrange their data, prepare for thematic coding, and verify the transcript's correctness. The second step is to start early meaningfulness, which entails carefully reading every interview, noting important ideas, giving focus on statements, assigning to record ideas, and searching for themes patterns throughout transcripts. In the third phase, which is known as more interpretative waves The goal of the study will be discussed, along with specific interpretive options as well as detailed interpretive alternatives and the relationship between theory and data will be explored. In this study both deductive and inductive analysis were used to articulate research more research goal oriented. For the RQ1 deductive approach used, while RQ2 and RQ3 inductive approach applied.

I progressively went through the 10 processes listed in Table 1 from categorizing the participants to assessing the outcomes in order to examine the interviews and respond to RQ1, RQ2 and RQ3. For the first question and Microsoft excel a most reliable data analysis tool has been deployed to analyze Yes/No type data. However, NVivo, a program for qualitative data analysis, has been used to conduct the data analysis for the entire research.

Table 1. *Data analysis procedures for this master's thesis.*

Steps	Description	Steps	Description
1	All 8 interviews transcribed in the Microsoft Teams. Used Microsoft word for initial correction according to audio data.	6	In the second reading I checked the coding pattern for RQ2, found Shared or individual leadership types which I created as sub-codes for the initial identified main code leadership types, and I completed coding data for RQ2
2	For RQ1 I prepared pre-defined codes for Leadership moves developed by Leskinen et al., (2021) in their research findings. (4 main codes categories were found in their article: Coordinating joint work, exploring new ideas, seeking out resources and offering guidance and support)	7	When reading for the third time I focused on codes for RQ3 and identified 6 sub-codes for the previously defined code “Effectiveness of emerged leadership”
3	I skimmed and read of all interviews’ transcripts for the first time	8	I coded data in the fourth reading for RQ3 6 sub-codes.
4	While initial reading I coded the RQ1 according to pre-defined codes I found 16 more subcodes while defining the research questions and reading through the participants’ responses and at the same time took short notes manually with pen and paper for the 2 other RQs.	9	I conducted interrater reliability with the second coder in NVivo. 2nd coder, coded 1 transcript out of 8 which follows the minimum percentage of data cross-coding requirement for the Masters’ thesis.
5	Then I created 2 new codes for the other 2 RQs: Effectiveness of leadership moves and Leadership types.	10	Interpretation and analysis of the findings.

For the RQ1, I used pre-defined main coding scheme. Which are: Coordinating joint work, exploring new ideas, seeking out resources, and Offering guidance and support. Then according

to question patterns and participants responses I created 16 more subcodes where for the coordinating joint work and exploring new ideas I found 5 subcodes for each and 3 each for the rest two main codes (see Table 2).

Table 2. Coding category, rules, and examples for RQ1 (What leadership moves emerge in future teacher students' group collaboration).

	Category	Coding rule	Example	Cohen's Kappa
1	Coordinating joint work			1.00
1.1	Organizing the working processes	When students express that they have organized group activities.	"I organized the working process of my team and I'm the one who initiates this whole thing and then decides the timeline"	0.99
1.2	Managing group activities and conduct of activities	Taking the turns of management of group tasks and their processes.	" I was involved managing in some activity making and conduct as the group"	1.00
1.3	Assigning the tasks for group members	Assigning the other members and ownself different tasks to make the group work successfull.	" I did is like, OK, I asked hey, who would like to research about this section? Who would like to research about what, what does a good board game look like? And then someone would say, hey, I can do that. Is that ok?"	0.94

1.4	Promoting everyone's participation in the group work	Promote other members for equal participation if some members are less active during the collaboration process.	"when I felt like he's not contributing compared to how the others are I would say hey, Mr XYZ, what do you have to say on this? I haven't heard anything from you"	0.94
1.5	Setting agenda of work for others	Setting tasks agenda before and after meetings, and collaboration to make the meetings effective.	"Yeah,...when the deadline was approaching here."	0.96
2	Exploring new ideas			0.78
2.1	Making critical reflection on maker project concept	Having different reflective discussions with other members about the maker project concept for improvement.	"So at that time, yeah, I gave critical feedback it should be like this, not like that..."	0.93
2.2	Initiatives for Changing the materials used in the making activity	Taking initiatives for changing the materials if the emerged leader/s think of those materials are less effective for the final product.	"I realized some that some things could not legible like some icons we put not legible, change the fonts, change the size. So those are the things I had to change. Yeah."	0.50
2.3	Suggestion for changing the	Taking initiatives to change design of the	"we decided to put answers on card and then I changed my mind because it was	1.00

	design of the artifact	artifact if the leader/s think the design in difficult to finalize or any other complexities.	better to use technology and we use a QR code to scan to get the answer.”	
2.4	Exploration to adjust the materials to better fit in	Exploring various tools and techniques to make the final product.	”Initially we had like, OK, we'll have the answer directly on the cards, but then then then I went for QR code, I printed QR code on the card for the answer”	0.93
2.5	Proposed different alternatives for the design of the artifact	After exploring different alternatives for their solutions, propose the best alternatives which are effective and efficient for their group project context.	” I have proposed to make the product more easier not complex but make it more educational”	1.00
3	Seeking out resources			0.85
3.1	Finding out resources from different platform	Finding out written instructions/video tutorials, seeking help from teachers or peers	”I did. I went on Google to search for different escape room ideas...got some of my ideas from from the website”	0.98
3.2	Observing other groups working on the	Observing different groups for getting better ideas to make the group tasks easier.	”I saw that the other groups are also using those 3D objects for their games earlier we were thinking OK, we could make models”	0.91

	different challenge			
3.3	Using observation to guide groups design and making activity	After their close observation, if found anything effective related to their group artefact suggest and guide to adapt with the observed ideas.	” Yeah, it was like, OK, if they they are going with the 3D thing. We can also try that.”	0.76
4	Offering guidance and support			0.90
4.1	Finding instruction for the artefact design	Support in finding instructions, for making the final artifact	”yeah I told them guys like hey you see we need this and that and we did this and these are all the the missing part that we need to focus on and we talked about that.”	0.87
4.2	Describing something if needed more explanation	Sharing ideas and clarifying ambiguity by explaining if anyone doesn’t understand anything regarding the instruction, artefact or final product.	” anytime I didn't understand someone made me understand, same as for me and others.”	1.00
4.3	Active support to artefact problem solving	Not only commanding others but also actively supporting by doing own tasks to make the	”Yeah, I was also a team member. I was not really like someone who's only directing but yeah, I was the one who's doing the work.”	0.91

		group collaboration successful.		
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I created two distinct schemes for coding since I utilized two separate codes for RQ2 as well as RQ3. For RQ2, I started using pre-determinant main coding and afterwards assigned a new code to text that could not be classified using the initial coding scheme (Hsieh & Shannon, 2005). Pre-determinant codes such as Shared leadership and Individual leadership (see Table 3) in this master's thesis were based on the existing coding system coined by Leskinen et al., (2021). However, for RQ2, participants mentioned similar types of statement for the shared and individual leadership approach thus at some point multi-coding (code for multiple entities) approach has been applied. The identical sentences can be coded with two separate codes when it comes to coding interview transcriptions.

Table 3. *Coding category, rules and examples for RQ2 (Which Types of emergent leadership emerge) types of leadership.*

	Category	Coding rule	Example	Cohen's Kappa
1	Types of emergent leadership			0.79
1.1	Individual leadership	When a single participant took most of the leadership roles during the collaboration and other members are just following his/her direction and without contributing in any of the moves intentionally.	"I don't think they they contributed me a lot, so I would be I would be better off alone..."	1

1.2	Shared leadership	Different participants took different leadership roles at the same time or different times.	<p>"the roles were, uh, varied from step to step and in every step our roles, you know, were changed."</p> <p>"we had, like shared leadership"</p>	0.79
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For the effectiveness of emerging leadership, I divided the code category to six subcodes and then ended up by developing all six codes while reading the interview transcripts, which took several times readings. It was simple to figure out subcodes related to RQ3 and there was no code selection to multiple factors because for this research, the objective was very focused and in line with the research questions. The data used to analyze RQ3 were used to figure out whether the emerging leader during collaboration was successful in the project's final artifact, general group atmosphere, and collaboration process applied analysis of content to create this code, and thus I didn't use any preexisting codes; instead, the codes were derived from the participants' responses. According to Hsieh and Shannon (2005), this may be a benefit of content analysis as the data originates from the various viewpoints of the individuals who participated and constructed on actual facts without applying predetermined theoretical points of view. Finally, 6 coding categories were created: Legitimizing leaders' role by accepting their actions, Improvement of overall project, Influential coordination, Effective at finding out resources and supportive to final outcome, Effective support and guidance for the final outcomes and Smooth group atmosphere and collaboration (see Table 4).

Table 4. *Coding category, rules, and examples for RQ3 (Different leadership moves towards successful maker project collaboration) Effectiveness of emerged leadership.)*

	Category	Coding rule	Example	Cohen's Kappa
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1	Legitimizing leaders' role by accepting their actions	Group members accepting the leader/s' role or if they have argument, they argue with proper reasoning	"I would say most of the time. It was accepting. It was less of an interruption, more of an acceptance and and and giving suggestions..."	0.92
2	Improvement of overall project	When the group participants uttered that the emerged leader/s help to improve the overall artifact and collaborative environment	"I think it's the nature of a collaborative activities constantly a new idea emerge and sometimes change..."	0.79
3	Influential coordination	When the emerged leader/s took the coordinating role it influences the overall group tasks positively	"leadership was effective in collaboration and it actually made us reach the final goal..."	0.88
4	Effective at finding out resources	Better at find out resources for the group that supports group	"I think it it was it was very effective. I'll give the example of the meterial..."	0.98
5	Effective support and guidance for the final outcomes	Efficiently guide and support group members when need	"leadership is supported me with a positive sentences and some guidance sometimes and it was really effective"	0.94

6	Smooth group atmosphere and collaboration	Emerged leader/s made the overall group atmosphere and collaboration very smooth by resolving any group complicity	"I have to say that our group atmosphere was really positive and and it led to you know our active participation in group activity"	0.96
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4.4 Validity, reliability and ethical issues

While planning a study, evaluating the findings, and assessing the study's quality, it is important to consider reliability, trustworthiness, and validity (Cypress, 2017). Both the reliability and validity of the data cannot be assessed in qualitative research using predefined criteria, according to Mills et al. (1987) and Stenbacka (2001). Qualitative research's reliability and validity may be determined by the validity and reliability of the data collecting and processing processes. NVivo was used for all of the coding. The Cohen's kappa coefficient, the most frequently used summarizing metric to assess intercoder reliability, was evaluated with a second coder to ensure objective reliability of coding (Xie, 2013). Additionally, it considers the level of agreement that a person might expect from coincidence. Each of the nodes and the source combination is given its own Cohen's kappa coefficient calculation by the software NVivo (QSR, 2022). The second coder for the inter-rating test was chosen from among those who did not participate, but they had to have basic idea about the current study themes and knowledge about coding rules. 2nd coder had to carefully review the interview transcript then code the content in line with the rules for coding mentioned in the second and third tables. It took rounds of discussions and negotiations about the conflicting codes with the second coder, then the ultimate outcomes were determined.

I applied the threshold parameters of Fleiss et al. (2003) to analyze the findings. They determined that the average level of consensus for the key codes were "very good" (0.75 - 1.00), Overall outweigh for the interrater reliability of this thesis data Kappa is 0.84 which is in very good segment according to Fleiss et al., (2003). The major 4 codes in the leadership moves category were in "very good" (0.75 - 1.00), despite the fact that 1 sub-code got 0.50 rating which

was the lowest among the entire data set. For the 2nd and 3rd segment of leadership types and effectiveness received the "fair to good" rating (0.41 - 0.75), with no codes lower than 0.79 rating. Furthermore, all the RQ3 codes fell within the "very good" category.

A number of ethical issues (Israel & Hay, 2006) were taken into account when conducting the research's ethical questions: integrity, preventing harm while performing good, informed consent for using participants' personal data, participant anonymization, confidentiality of private information, and plagiarism by following the principles of the Research Integrity of Finnish Advisory Board (TENK, 2019). Prior to participation, the participants received written information regarding the study and its goals. Each participant electronically signed their own individual consent form, and their participation was completely optional. All of the participants' actual names were changed to keep confidentiality. Programmes with an advanced level of technological advancement and security for the well-organized controlling of personal information, such as NVivo and Excel. The IT system restricted who could access processing of personal data. The study materials have been stored anonymously. All statements and comments made by participants are structured appropriately in this thesis. Nevertheless, participants may acquire something novel about the chosen topic throughout the data collecting procedure, which might potentially affect their understanding and later utilization of this knowledge. Participants are liable for this because they were informed about the issue beforehand and they gave their consents.

Results

This section provided sequential responses to three study questions. In order to answer the RQ1, the overall findings of the analysis of the Yes/No questions part about leadership moves were first stated, and then each sub-code were thoroughly examined. Regarding the categories of emerged leadership, including shared, individual, and dominant types of leadership, the RQ2 response was taken into account. The key justifications for the effects of emerged leadership in collaboration are revealed in the RQ3 response.

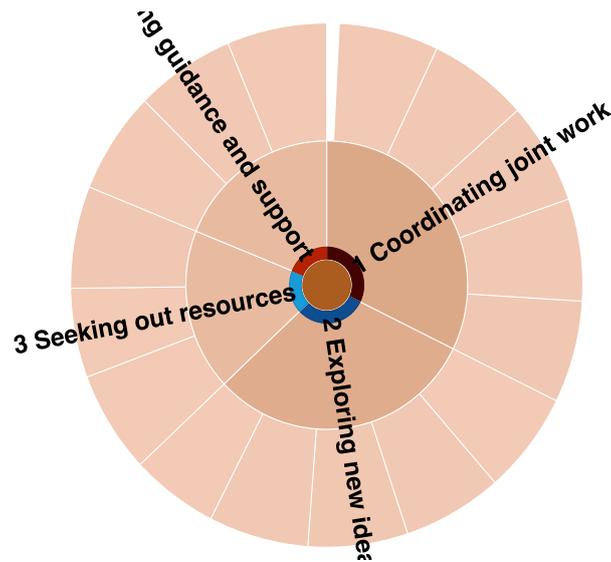
5.1 What leadership moves emerge in future teacher students' group collaboration?

5.1.1 General results

In the first part I used two different approaches to identify different leadership moves which emerged during group collaboration. First, I analyzed the researcher's personal memo while conducting the interview and then analyzed the interview data for supporting the first method. In manual analysis of researcher's memo while participant's responding Yes/No part, respondent was free to answer that part in a descriptive method if they needed. In most of the answers they justified their responses by extending their answers. Thus, I took manual note to analyze in a quantitative approach to measure which moves mostly performed by the participants. It was found that participants were more willing to participate in their collaboration by taking different turns. However, participants in some roles did not participate actively rather they followed others direction. I generated a visualization (see table 5) as shown in Figure 5, Yes/No questions memo results have been colored green (for Yes answers) and red (For No answers). To protect the identities of participants, all of their names were changed.

(Figure 3) shows distribution of four main leadership moves in which students mentioned they have taken 5 turns for coordinating joint and exploring new ideas. However, students taken less turns for the last two moves, 3 for both seeking out resources and offering guidance.

Figure 3. Distribution of four leadership moves identified while questioning Yes/No part during the interview sessions.



In table 5, responses for the RQ1, which was in 2nd section of the interview questions (Yes/No), (See Appendix 1, section 2) for 4 main leadership moves with 16 turns. Although this section questions were designed to identify which type of leadership moves emerged most by asking yes/no type questions that can reflect students' leadership emergence during their maker project collaboration, but the participants were given flexibility to extend their responses if needed. Most of them extended their answers which have analyzed through NVivo software, and I have taken the short note for Yes/No answers (See table 5).

Table 5. *Summary of participants answers metrics collected manually (Researcher's memo).*

Leadership moves/Participants

Alina Joanna Nicole Tara John Katarina Natalia Flora

Part 1: Coordinating joint work								
Organizing the working processes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Managing group activities and conduct of activities	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Assigning the tasks for group members	No	No	Yes	Yes	Yes	Yes	Yes	No
Promoting everyone's participation in the group work	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Setting agenda of work for others	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Part 2: Exploring new ideas								
Making critical reflection on maker project concept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initiatives for Changing the materials used in the making activity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Suggestion for changing the design of the artifact	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Exploration to adjust the materials to better fit in	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Proposed different alternatives for the design of the artifact	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Part 3: Seeking out resources								
Finding out resources from different platform	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observing other groups working on the different challenge	Yes	Yes	Yes	Yes	No	No	No	Yes
Using observation to guide groups design and making activity	No	Yes	Yes	No	No	No	Yes	Yes
Part 4: Offering guidance and support to other group members								
Finding instruction for the artefact design	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Describing something if needed more explanation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Active support to artefact problem solving	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

According to the data of (table 5), the distribution of "Yes" responses rates is highest in exploration of new ideas part which was the most turn taking part among all 4 main moves. It has only 2 negative responses same as for the offering guidance and support.

Table 6. Participants' moves turn taking occurrences percentage.

	Leadership move	Example	Occurrences
1.1	Coordination of Joint work	“I organized the working process of my team and I'm the one who initiates this whole thing and then decides the timeline”	32 (80%)
1.2	Exploration of new ideas	”I realized some that some things could not legible like some icons we put not legible, change the fonts, change the size. So those are the things I had to change. Yeah.”	38 (95%)
1.3	Seeking out resources	”I did. I went on Google to search for different escape room ideas...got some of my ideas from from the website”	17 (71%)
1.4	Offering guidance	”yeah I told them guys like hey you see we need this and that and we did this and these are all the the missing part that we need to focus on and we talked about that.	22 (92%)

Although coordinating joint work has 2nd highest positive responses in number (32) but it got 3rd position for the positive responses' percentage (80%) (see figure 4). In contrast, seeking out resources was almost in the last place for getting positive responses for both number count (17 out of 24) and the least percentage (71%) (See table 5 and 6). In summary, according to table 5 and 6, exploration of new ideas and coordination of joint work were two most successful leadership moves from number count but considering occurrences percentage offering guidance was the most successful leadership move.

Table 7. *Participants' moves turn taking.*

Participant	Most actively taken turns (Yes)	Less taken turns (No)	Most actively taken moves
ALINA	13	03	Coordination of Joint work (04) and exploration new ideas (04)
JOANNA	14	02	Exploration of new ideas (05), Seeking out resources (03) and Offering guidance (03)
NICOLE	15	01	Exploration of new ideas (05), coordination of Joint work (04)
TARA	15	01	Coordination of Joint work (05) and exploration new ideas (05)
JOHN	12	04	Exploration of new ideas (05), coordination of Joint work (04)
KATARI NA	13	03	Coordination of Joint work (05) and exploration new ideas (04)
NATALI E	15	01	Coordination of Joint work (05) and exploration new ideas (05)
FLORA	12	04	Exploration of new ideas (05), Seeking out resources (03)

In table 7, it can be seen that which participant was the most active for taking the leadership moves turns. There were in total 16 leadership move turns in 4 moves. 3 participants (Nicole, Tara and Natalie) equalize the number of turns taking for the highest number by saying 15 times yes out of 16. On the other hand, John and Flora were the lowest turns taking participants in their own group, they said 04 times “No” answer and only 12 times yes which means they were the least active during the shared leadership turns taking in the group. While Katarina and Alina said 13 times “Yes”, Joanna took 1 more turn than them by saying “Yes” for 14 times. So, it is apparent that, Nicole, Tara and Natalie were the most active for shared leadership while John and Flora were the least active for shared leadership.

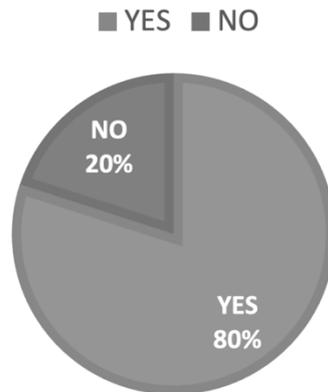
5.1.2 Part 1 results (Coordinating joint work)

Based on the data obtained, the following elements could be highlighted. In group tasks involving coordination, practically all participants participated in the shared role, however eight out of forty turns, individuals did not participate in the various subcodes of coordinated joint work. Flora was the least engaged participant in their group in adopting the leadership role in this first move. She took only two turns of leadership in this part out of five that indicates she made the least contribution to the group's coordination of joint work. Jonna has also been more passive in adopting this leadership role for her group. She took part in three other turns but did not perform in organizing group activities and assigning the group activities to others. On the other hand, Alina and John took 4 out of the possible Five turns to compete at the part. Tara was the most active participant in this section, taking over all five of the leadership turns in this first part. The findings demonstrate how maker project collaboration highly relies on participants coordination of group work, with 80% (32 out of 40) of turns were taken in this leadership move (see Table 6 and figure 3).

Additionally, there is a notable tendency among all participants in this leadership move for switching who takes the responsibilities of leadership. This indicates that participants who took the role of coordinating joint work often had a tendency to emerge as group leaders and have the ability to influence their group for effective collaboration. In this move, not all respondents take all of the turns; for instance, Flora only takes two turns (See table 5). However, based on the findings of the Yes/No type of question memos, the three participants (Tara, Katarina, and Natalie) recognized themselves as the most turn taking person for the Coordinating joint task leadership move (Participated all 5 turns).

Figure 4. *Percentage of coordinating joint work occurrences in all 8 participants during their group collaboration.*

COORDINATING JOINT WORK



During the interview session, participants in this move were more active and concerned about their roles and responsibilities. For organizing the working processes those who take this turn are more aware of the group coordination and success. The following statements regarding the turn of organizing the processes of group mentioned during the interview while asking Yes/No type questions. Although this part was Yes/No question type to measure leadership moves among the group members, participants were appreciated to elaborate more if they needed.

“Yes, absolutely. Almost all my projects, that's what I've done. I organized it, I organized, and when I say I organized the working process, it was like I would go to the slide that the teacher would have shared, like what is the criteria? What does the teacher want? What are the elements that are supposed to be in there in the task or the project? And then accordingly I would say hey guys like for example for the maker project... You're supposed to include 3D, other other elements, all of that. So that's how that's how I have always done. I organized the working process of my team and I'm the one who initiates this whole thing and then decides the timeline and we're like, OK, this is supposed to end on this day and then we don't talk about it ever after that.” Alina)

“I thought that making educational board game can be really practical to teach mathematics. So I wanted to do that and I was really excited. And to make it I was constantly organized the working process. And I can say that in somehow, I push other to do that in the best way, yeah.” (Natalie)

The next excerpt demonstrates that every participant performs this leadership turn (managing group activities and conduct of activities), demonstrating that they shared this turn and worked together when needed.

“Yeah, I did it (managing group activities) because initially we came up with a lot of ideas after I came up with two board games. One, it's like more like Monopoly influenced game board... then (I) thought OK, now we are going with another board game like that... Yes. Yeah, I did.” (Katarina)

In the turn of Assigning the tasks for group members, 5 persons conduct this role in the group. Most of the participants noted that they did the task assignment to other members when they are either with short time for the group project deadline or he or she initiated the task and have better understanding about the task complexities. But some members do this turn more passively by mentioning the following ways.

“I always like to assign (the group tasks)... You say like ohh can you do that? But like you are trying (to) assigning. I actually assigning thing. But (I) don't want anyone to feel negative about it, so (I) say, oh, OK, like hey, like I already taken this much. Can you also just do this one? Like I think you you are great at that (Appreciating and positively approaching while assigning the task) and then (I) just say something like that.” (Tara)

Yes, yes, I did it because I think our deadlines change then we had to hurry up in at that time. We were like, direct to others like, OK, you do this task and I will do this task like that. We did it. (Katerina)

Yeah, what I did is like, OK, I asked hey, who would like to research about this section? Who would like to research about what... And then someone would say, hey, I can do that. Is that ok? Yeah, in a way, I guess I was creating rules (roles) and then whoever wanted to take could take whatever they wanted to do. (Alina)

Then in the turn of Promoting everyone's participation in the group work some participants were active to make the collaboration smoother and interestingly they understood others issue if anyone doesn't participate actively or within the time. Some emerged leaders prompt other members who are not active at certain points of collaboration by asking questions to participate in the discussion and maker activities.

“I think I was trying to do somewhat, like make them understand...because we had someone that was always coming late and when the other person was complaining I was like, ohh no, she's busy with that. Just if we are to meet around 10 (making the time flexibility for her participation), just give her like 20 minutes more. She'll be here.” (Flora)

“Yes, I would say yes. One of our members wasn't very active at, not natural, I think it's a person who's very except, but we somehow knew that she had the mind to to contribute. So whenever there was need for some thoughtful for some thinking to be done, but would leave it up to them to take up the task. So say that was how (I) would promoted their participation.” (John)

“So, I’m going to answer my question very specifically how I was (by) giv(ing) you example, when I felt like he’s not contributing compared to how the others are I would say hey, Mr XYZ, what do you have to say on this I haven’t heard anything from you. So to promote, I would prompt and ask questions. Hey, what do you have to say? What did you figure out? What did you come up with? So in a way, making the person accountable to an extent that, you know, everybody’s contributing you, we also want to know how are you contributing basically.” (Alina)

Additionally, in the last turn of coordinating joint work move, feature which can be seen while collaborating, that they have set agenda of work for the group members. They emphasize the group agenda of work by stimulating other members.

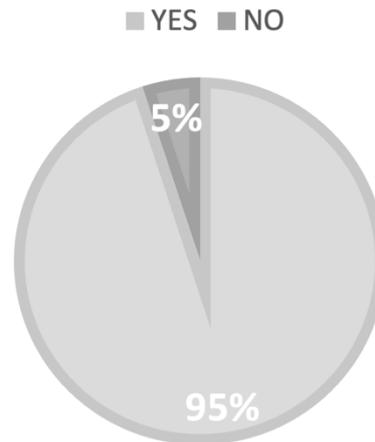
“Yeah. And in couple of meetings, we made A to do list and who is going to do what on then? Till when? And then? And we were just looking at doing those stuff before the meeting... who is going to take what? I was like, OK, I I’m taking this and this and that. And then she was saying I’m taking this and that and that. We were like OK, we need to give something to her. Let me (ask) just like, do you wanna take this one? Kind of you have already taken.” (Tara)

5.1.3 Part 2 results (Exploration of new ideas)

By analyzing researcher’s memo of leadership moves, it is found that Exploration of new ideas is the most contributing leadership move which most of the participants contributed. In terms of exploring new ideas there have been only two times out of forty turns when participants didn’t take part in this move. Catarina didn’t join in the turn of Adjustment to the materials and Alina in the turn of Proposing alternatives of the artifacts (see figure 2) sequentially. However, it is evident that out of the 40 moves, 38 (see table 6) were taken by participants, which makes it likely to say that everyone took their role more collaboratively and contributed to exploring new ideas than on the other three leadership moves.

Figure 5. *Percentage of Exploration of new ideas in group collaboration.*

EXPLORING NEW IDEAS



While interviewing participants in this leadership move, they described their approaches and expressed how they were engaged with different turns of this move. Surprisingly almost every member (two times answered 'No') answered positively by saying 'Yes' while asking exploration of new ideas related turns. There are almost 40 total turns cumulatively and the majority of these answered and explained by the following style. Flora used her previous observation for reflecting the group maker theme and their activities. She stated as follows.

“Yeah. before we did the escape room, I was we had this AI conference with Andy so and there was this lady that was talking about how they met and escape from for Nokia. Then I've been reflecting about the project theme and activities.” (Flora)

“then we couldn't recognize if it is our game comes and the team or steam. So, at that time, yeah, I gave critical feedback it should be like this, not like that and I think the other thing is when we are trying to minimize our game that we had three stations, so we had to ... be conscious about our time limit for that, yeah. You can say yes.” (Katerina)

For the turn of taking initiative for changing the materials used in the maker project everyone was participated and collaborated actively and contributed accordingly. Regarding the interview analysis result obtained, members were more spontaneous in this turn as everyone employ their previous knowledge and expertise regarding the group collaboration then they have given different proposal for modifying or changing the artefact materials used in the maker project. Nicole described her initiative in the following way.

“Yes, yes, that did happen. Yeah, we were making a board game and I initially thought of using 3D and laser cutter then it didn't work out. It would take 8 hours to print then I suggested just changing that.” (Nicole)

“Yes, yes. We initially wanted to use that was this material sort of wooden material, but I ended up opting for the for the cardboard box, so to say so, yeah.” (John)

It seems that while making suggestions for changing the design slightly or whole artifact participants were more descriptive. All respondents to this question answered positively except John who mentioned that he did not make any suggestions for changing their design as it was already fine with the initial concept. Tara described a very compact answer for this turn how their group adopted suggestions for changing the design.

“So, they were making logo (for the artifact) and I asked them like what our logo to them should be. So actually, one of my group mate said something. She had some idea since the other said yes, good idea. But I said that, hey, like this is very complicated and this is very colorful (Making others convinced for changing the existing idea by notifying it's drawbacks) and logos should be simple and memorable. We made a trial laser cutting and it didn't come out nice because it was very complicated. And I said hey guys, like every big companies has very, very simple logo (Logical reasoning) because logos should be simple ... But if you have so many things in one logo you cannot remember. And there wouldn't be any specific meaning.” (Tara)

In the last two turns of this leadership move (exploration of new ideas) exploring to adjust the materials and proposing different alternatives for the maker project artefact. Katerina was the only one who didn't take this turn actively. She stated like this:

“No, I don't think so. Right in my own case, I have but not done with others case...I make some comment, like let's go with this. You can put this picture then it will be nice like that, but not too much with the design.”. (Katerina)

However, Nicole's participation was more vibrant for the group atmosphere and final product because she explored that cards were not feasible for their group task and goal. Then she suggested after exploration for adjustment of materials QR code option would be more practical for their group.

“Yeah, I did that. I think I did that with cards. Initially we had like, OK, we'll have the answer directly on the cards, but then then then I went for QR code, I printed QR code on the card for the answer, not directly.” (Nicole)

In the end of this part the turn is proposing various alternatives to their current artefact. Only Alina was out of this role by stating that she didn't do that. While Flora said that “I have proposed to make the product easier not complex but make it more educational”. By proposing her alternatives, she tried to make the artefact easier for them which might ensure group collaboration. For the same question, John replied in this positive manner.

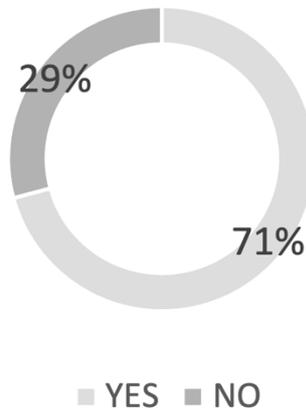
“Yes, yes. For example, initially, initially the plan I think was to to use the dice, but I ended up suggesting that instead of the dice we can use”
(John)

5.1.4 Part 3 results (Seeking out resources)

In finding out resources, the third move of leadership, participants were not active for taking turns. For example, John and Katarina performed only one turn out of three by only contributing to finding resources for the group. In addition, Tara, Alina, and Natalie took two turns each out of three (see table 5 and 6). On the other hand, Joanna, Nicole, and Flora were far more proactive and made all of these turns in this leadership move. In percentage although 71% (see figure 6) turns taken for this move yet about 29% turn were not accepted by the members. They did more observatory or just following other’s role for this leadership moves while collaborating in their maker project.

Figure 6. *Percentage of Seeking out resources for group collaboration.*

Seeking out resources



The results of the interview for the leadership move Seeking out resources shows that the first turn of this move named “Finding out resources from different platform” were mostly performed turn among all. In this turn, in general, everyone was very active to find resources out for their group to finalize the project while the other two turn more or less 40% turn were rejected by the participants. They said “No” while answering the questions for 2 other turns (Observing other groups and using their observation to guide their group. While answering for the first turn of this move, I noticed that everyone did their best to find out their possible best resources. Take Nicole and Flora’s responses as an example.

“Yes. Yes, I explored a variety of websites, even YouTube tutorials, of how a board game is designed, what is the mechanics of designing board game, how you shouldn't set up challenges and all that.”(Nicole)

“Yeah, yeah, I did. I went on Google to search for different escape room ideas. I saw a mom that was trying to like she used to design an escape room for our children at home. So, I got some of my ideas from the website...” (Flora)

For the rest two turns I am sharing two best responses how participant's deal with those two turns also. It is evident that there are reasons why they didn't take this turn by going through Alina's response for the second question (Observing other groups). She stated that “No, I didn't do that because we all three knew what we wanted so we weren't really looking at what other people were doing.” Which means they had already decided and enough ideas about their project thus they didn't go for it. However, some members still visited other groups to see their activities and get ideas for their group project.

“I have to, yeah to see what challenges they were having, especially with the printers, the machines is what you had to ask around because how are you using the 3D printer? (Asking questions for ideas) How are you using the the laser cutter because that one is more of you learn what what is working for others and what is not working for others. So size of cards like when you're printing, how do I print such a card?” (Joanna)

For the third turn, using observations to guide group design and making activities Nicole sees this in the following way.

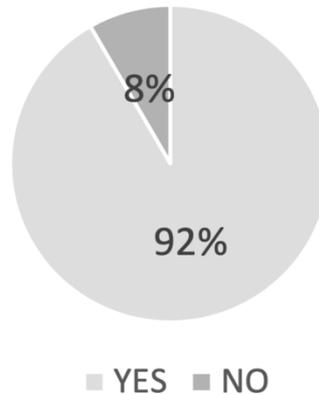
“But yeah, I saw that the other groups are also using those 3D objects for their games earlier we were thinking OK, we could make models. If it doesn't work with the 3D thing but then...yeah, we should do those things as well.” (Nicole)

5.1.5 Part 4 results (Offering guidance and support to other group members)

With the data obtained from the researcher's memo regarding Yes/No type questions, it can be seen that with the exception of John and Flora, who didn't join in the leadership turn, Supporting finding instruction for making the artifact, everyone else in the last section has demonstrated their participation approach by working together to take all the turns(see figure 3). It is evident that Nicole and Tara were the most active participants in the maker project collaboration as they completed practically all of the moves apart from one turn, whereas Alina, John, Katarina and Flora made the least contribution in turn-taking.

Figure 7. *Percentage of Seeking out resources for group collaboration.*

Offering guidance and support to other group members



It appears that respondents had similar opinions about the move based on reading and reviewing interview transcripts for the last leadership move. They responded “Yes” with description all the three questions except for the turn Finding instruction for the artefact designing where only John and Flora said they didn’t adopt this turn. Otherwise, everyone shared their turns to support the group by guiding them in different turns. The following statement of Alina shows how they find instructions for the construction of the artifact.

“Yeah. Yeah. Like I said, every time Jari had given us this design model that we should follow a very generalized one. It was a generalized one. by the way I’ve sent a screenshot of it, so looking at that model how to create the maker project that are certain steps.” (Alina)

Turn 2, Describing something if needed explanation meaning that participants explain further details of any issues asked by the group members. For this turn, everyone was very willing to help others if anyone needed to know or understand something better which reflects that the group collaboration was on the right track as clarification of ambiguity is a part of collaboration. Nevertheless, they tend to explain anything to other members whenever needed. John stated that he explained to other members about the mathematical aspect, financial aspect, and their relationship with the project. “So, I really had to explain to other Members that the mathematical aspect of it, the financial aspect of it, how it really comes in into the into the group, yeah.” In Alina’s comment it is evident that it is a collaborative approach. Her view is as follows.

“So yeah, anytime I didn’t understand someone made me understand, same as for me and others. So well, yeah, the communication was on point.”(Alina)

Based on her opinion it can be said that supporting each other when needed in group collaboration is a flexible approach which can be seen in an ideal team. Such a view would have helped to formed for successful group collaboration.

In the final turn of this move, which is Active support in artefact design shows whether the person who takes different leadership turns but not actively working with others just commanding like as boss. In Alina's answer it is notable that as a team member she also participated doing teamwork not just directing others.

“Yeah, I was also a team member. I was not really like someone who's only directing but yeah, I was the one who's doing the work.”(Alina)

“As I'm uh mathematics teacher to somehow, I'm good at problems problem solving. So yeah, I think so. Yeah. I tried my best to actively support that my group in this way.”(Natalie)

In general, Exploration of new ideas is the most dominated leadership move in maker project group collaboration based on the memos adopted while interviewing. Additionally, coordinating joint work is also a dominant leadership move which may influence a group for positive group outcomes. However, the other two moves of leadership cannot be underestimated as those have huge impact on successful group collaboration. The shared approach is clearly visible in the respondent's point of view regarding various leadership moves as they have taken different turns although other group members also taking the same turns at different times while collaborating in the same group. Therefore, it can be noted that different leadership moves could be emerged and taken by one or multiple group members in the group settings which demonstrated the shared approach of leadership in learning and educational formal context. Although there are few turns when participants didn't take those turns but they have the strong logic behind it. Hence, it's exciting to get to know about participants' perspectives on performing a number of leadership roles.

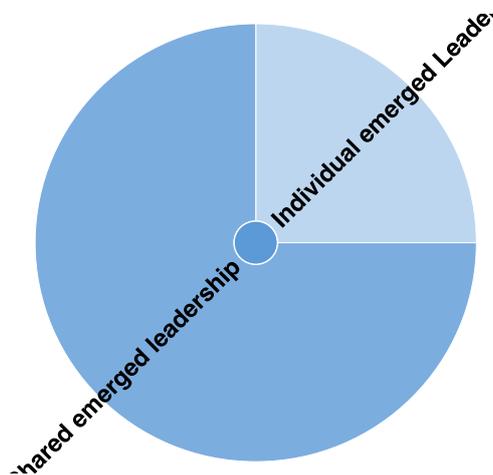
5.2 Which type of leadership emerges in this context?

In order to get the answer to this research question, I have observed the whole data set of all participants answers transcripts. While conducting the interview, participants were perused to navigate their answers at some point how leadership emerged during the group activities and which type of leadership they have detected by their own. I have found a key pattern for this question while reading through the part 1 question which was knowledge stimulation. There I asked them some questions where participants replied in a way close to the RQ2. The first one

is whether there are specific roles assigned within the groups and how it is distributed. The second one is closer to the RQ2. How would they describe leadership in collaborative learning context? Further, I wanted to understand their perception about emerging leadership necessities in maker project collaborative learning settings.

On the visualization (see Figure 7), which depicts how the weights were distributed by using coding references for all three types of leadership which can be seen in maker project collaboration. interviews, it is noticeable that almost the major share of the codes regarding this question I found for either. shared leadership or Individual one. This interview participants were more collaborative and participatory than dominating others. It's interesting to note that most of the members recognized that leadership is crucial for the maker project collaborative learning and said that they had seen most of them were doing collaborative leadership approach while taking different leadership turns. During her study, just one participant's answer might show the dominance type leadership approach in her group. However, I tried to find a pattern for shared and individual leadership as these are evident by the existing literature in the maker-based collaboration context. Nevertheless, I made an effort to define the dominant type, but it wasn't mentioned that much in their responses.

Figure 8. *Distribution of coding references for RQ2 for all the key themes.*



5.2.1 Individual leadership

While analyzing the pattern of types of leadership most of the participants mentioned that their group were lead by different leaders which varies according to different condition e.g., time, expertise etc. However, two participants mentioned the individual leadership in their group

tasks. Alina and Tara were somehow taking the individual approach of leadership role in their group. For example, we can have a look at how Alina defined it in her own statement.

“Because someone needs to take it (leadership role) since nobody's from the other two were that's because I personally am very proactive in my own tasks. I like to get things done way before the deadline so that there is nobody's anxious and nobody's feeling anxiety. And the other two didn't really say anything. So I said, hey, is this OK? This sort of timeline. And they said, yeah, that's fine. It was most mostly for my own mental peace. But the other two were also OK with it.” (Alina)

The above-mentioned example reflects that Alina took the leadership solely as others didn't come forward to take the role. Besides it's also apparent that she had some dominance approach as she was more focused on her own behavior. But it is also notable that she somehow convinced other members in her group to follow her direction. She defined leadership as following way.

“I would define leadership as a skill or a trait that somebody has where they are able to guide the group towards what needs to be done. In the most practical way that you know how much time you have; you know how much effort you should actually be putting in...The leader also knows that what are the motivations and emotions of all the people? Because if in the sense that the person Knows that how much everybody wants. You don't want to pressurize someone who doesn't want to do, and then you force them to do. They're just going to go crazy, so the person knows these strengths and weaknesses of everybody and then plays along that way to just push the group towards getting the task done in in a good way, in a unique way where everybody has contributed. That's what I would Define as leadership a trait or a characteristic that somebody has the ability to do this.” (Alina)

She also mentioned that in maker project leader is required based on the group size. If it has more members, e.g., five or more, then it would need a leader to negotiate with the group members. She mentioned that she had taken the role of decision making many times. Surprisingly, she noted that the fellow group members followed her individual leadership moves thus it can be said that she was successful in her role.

“I know they were comfortable in the sense that they would defend if they felt I was wrong, but most of the time, whatever decision I took that would be the like, the final element in the project for sure. So, in that way I felt.” (Alina)

Additionally, Tara also discussed individual leadership approach almost 8 times. According to her statement there were free riding members in her group which hampers collaborative atmosphere but somehow, she managed to make the group collaboration by her individual attempts.

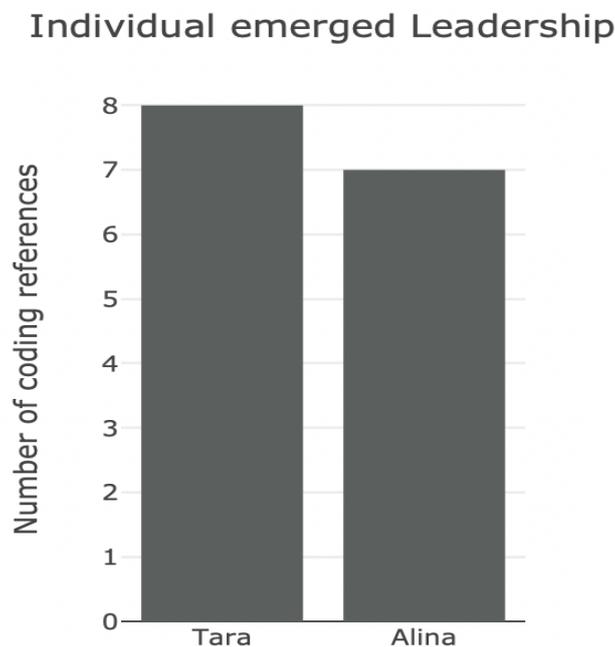
“I don't think they they contributed me a lot, so I would be I would be better off alone... But I don't get any response. I I cannot understand the magic of teams, but. Yeah, somehow, I managed.” (Tara)

Tara had the experience of leading other groups thus inherently she tried to lead the group automatically.

“I was all already leading other groups like I was already in charge leader in other groups. We were dividing the rules like everybody was taking whatever they wanna do. And like according to their strength and capabilities and then. But that that third person she was on relaxing to do anything (Free rider). So, we were the one that giving some work to her”. (Tara)

“for the make a project requires leader... regulating one another. Just reminding them stuff and reminding them to what they need to do. And then when it is the meeting and if something like for example there is something needs to be written and if someone is not giving feedback to that like giving feedback or like or encouraging other people to give feedback or stuff like it's like more like you are. And middle person...making sure that everything is going smoothly.” (Tara)

Figure 9. Distribution of the code individual emerged leadership mentioned by the participants in number.



In general, this research depicts that group members during collaboration in maker-based project activities preferred shared leadership approach which emerged during the collaboration among group members. It was not pre-defined by the instructors but emerged according to the group needs and distributed the role by the means of expertise and time variables. These results

do not indicate that only shared leadership has emerged but there is evidence that individual leadership might also emerge which are not that much widely followed leadership types in maker-based group collaboration. This means that both type of leadership could be emerged but there are more possibilities of emerging shared leaders (see Figure 8), out of 8 participants 6 said their group were mostly depended on the shared leadership approach, although the rest 2 placed their point of view to the individual approach.

5.2.2 Shared Leadership

While answering different questions close to the leadership types which had been emerged during student collaboration and they defined by their own point of view. Shared or distributed leadership is the most stated leadership type found in the interview transcripts. Although participants mentioned leadership types in different questions, I tried to put them in a single theme so that I can get the connection with RQ2 and the themes. From the example below, it can be more visible how students have seen leadership and it works in their group collaboration.

In her group experience, Flora said that they divided their task based on their interest and expertise and therefore they experience shared distribution of tasks and leadership. She also mentioned that in their group there were no roles for leading assigned by their instructor, surprisingly, there was someone who took the leading role in every phase of collaboration.

“The leadership was kind of sometimes it could be from top to bottom, then sometimes it was shared....things you said that then we had, like shared leadership. Yeah. So, we had flexible relationship, yeah.” (Flora)

From Jonna point of view, she mentioned that some of the group members had expertise on different segment for example, using machines, 3D printer and laser cutter. Based on expertise the roles were distributed among the group. In her interview responses she mentioned that leadership is a more democratic approach and there was no dominant leadership found in her group. She mentioned how leadership worked in their group by the following statements.

“I don't know how to say it, but to us it was more of a democratic. Kind of leadership where divide and everybody has their own tasks...In our case, maybe because each one of us has different skills and could just handle their own tasks individually regarding them to their skills level. I think that's why I would say there was no dominant leader. But it was more of a group effort...I think, I would say it depends on the skills level...That is how, I would say, I would argue the case of leadership, so it should be a shared leadership.”(Jonna)

John also noted that leadership can be distributed or emerged based on expertise. “I would someone will take their leadership role in case where their area of expertise was needed”. This suggests that John has the view of leadership requirement basis. He also mentioned that leadership is a rotational approach among the group members. Rather than having leadership fixed to a single person it would be distributed rotationally according to the requirement of expertise. John mentioned like this “leadership I would say was rotationally (circulated among the group members).” Besides, Katarina explained that they had different roles within the group which they had assigned by themselves. They took the whole responsibility of collaboration into different time segmentation e.g., she mentioned like that “we said OK, I will go this day and I will complete this task like that we did it.” In her further explanations about leadership distribution and which type emerged in their group, it surprisingly stated that almost everyone acted as leader when they did their group task.

“Yeah, actually, I think we all act like leader when we are doing the group work because we had our different task when it comes to my thing, I must act like a leader and ask them to do this and that...One of our group members always try to book the place and everything and ask us to come at this time and let's do like this like. Another group member, she got the initiated like let's do like that, like motivating enough. (Identifying different roles of leadership which emerged). In our maker project we all acted like we got our chances to act out like leader... I think we all have to be that leader and some of group members already like they want to do this super-fast and finish this, I will like that also because it motivates other also. Then at that time they are taking the leadership and they are telling let's meet this day. Let's talk about this. Let's end this here like that.” (Katarina)

In line with Katarina’s statement, Natalie also described the leadership distribution in the same process. Interestingly she also mentioned like the previous respondents that leadership is decided based on expertise. Whoever is expert in which part take that turn and it changed time to time. According to her statement the roles varied from step to step and in every step the roles changed. Katarina exemplifies this step-to-step process in a pragmatic way and how it worked. In has been described in this way.

“when we start a step out making our project that I was expert in, in this, you know step I was a leader, and the other members was (had) just followed me. But when we went through other steps, our roles changed, and it was because every member had different strengths and weaknesses and different expertise. So, in this in every step, our roles changed.” (Katarina)

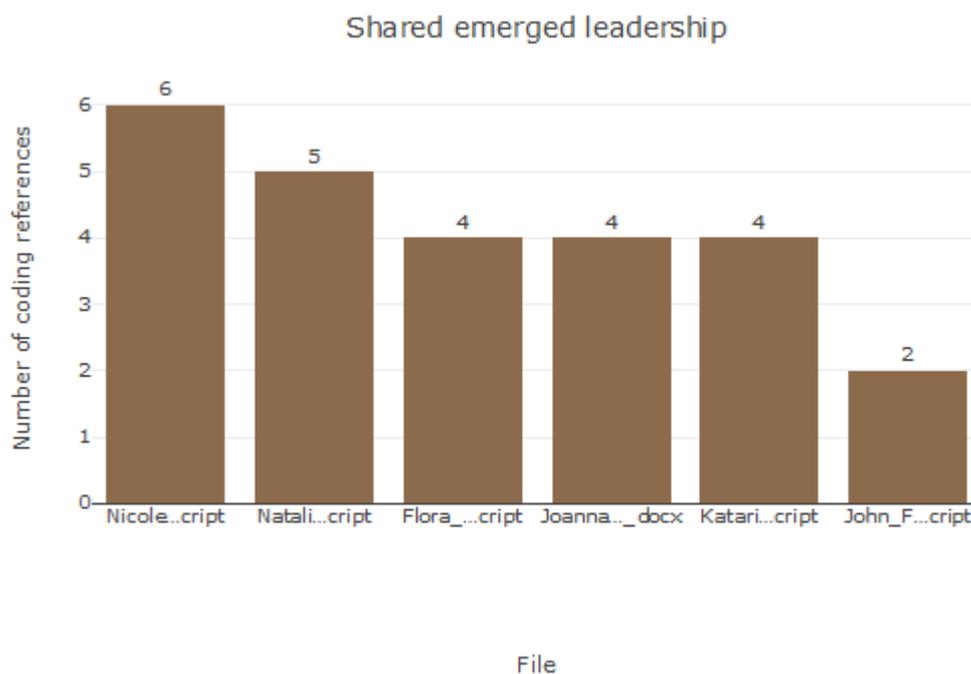
“In the maker project you know, through our collaborative activity, all of us was emerging leaders. there wasn't a fixed leader and it changed. It changed from time to time, and it was automatically, but just, you know,

someone was expert in some aspect of making that project and then she just took the leadership in that step and start to lead others.” (Natalie)

However, in Nicole’s transcript it is more apparent that the collaborative leadership approach was taken in their group.

“I think it was more of a collaborative leadership because since each of us was good with some aspect, that aspect was led by that person...Everybody was giving their contribution. But when it came to, we realized our strength and whatever was needed that we gave that person that much space to lead in that aspect. So, it was a collaborative leadership, I would say, not a single person was charge of the entire project. It was depending on what was required the roles changed in terms of leadership. But as I said, there was no single person evolving as a leader of the entire project...it emerged at different leaders but not in a single person. Like all of us.” (Nicole)

Figure 9. Distribution of the code Shared emerged leadership mentioned by the participants in number.



5.3 How is students’ emerging leadership related to their effective group success?

Leadership emergence can significantly influence the student’s collaboration by taking different leadership role while collaborating. There are different leadership roles for leading which could be taken by only one assigned member or by multiple group members who are taking roles according to the group demand. Whenever leadership emerges in collaborative learning

settings, this can benefit the groups by effective group collaboration and positively impact on group outcomes. In the third research question it was designed to identify how different leadership moves which emerge in maker project collaborative learning, impact in group success. In order to find answer to this question first I defined two groups by the types of leadership then I highlighted six key themes and compared those themes between two groups to get the scenario of the group collaboration, performance and environment according to the group nature. The themes are the following: legitimating leaders' role by accepting their actions, improvement of overall project, influential coordination, effective at finding out resources and supportive to outcome, effective support and guidance for the final outcomes and smooth group atmosphere and collaboration. By addressing these themes, it was tried to find out relationship of leadership turns taking by group members at different stages with two key types of leadership emerged during their collaboration and how those turns and types impacted. In below participants' responses are mentioned and explained for each theme and type.

5.3.1 Legitimizing leaders' role by accepting their actions.

Individual leaders' leadership moves effectiveness

When a leader or different leaders taking different leadership moves by performing several turns in group collaboration it is not sufficient to measure that those moves make the group successful without identifying how the group members react to those turns and moves. It would be successful if the members are following the leaders' actions. So, it is a crucial aspect to judge the leadership success by assessing how the other members react to the leaders' activities. Therefore, in the very first point, I tried to assess how group members legitimate different emerged leaders' tasks and moves. There were two types of leadership that emerged in the maker project collaboration which are individual and shared leadership. A majority of this current study participants mentioned that they did share leadership approach while only two participants stated that they did individual leadership approaches in their group.

In the following it can be seen how individual leaders get legitimated by their fellow group-mates while taking different leadership moves. When Alina was responding to the first question, she said like members accepted her turns sometimes but not always because sometimes members opposed her opinion or directions and she needed to reconsider her turns and directed in new ways.

“Let's assume I suggested that let's change this...and people accepted me because they would if I took a decision, they wouldn't just listen to it and their tone their body language and the way they would respond to it was I know there was no negative way. It was. It was in a playful way it was very normal. I didn't get the vibe of like ohh this person is offended and is now is. But again, not always. Sometimes they would say no, actually this is not this is not really appropriate...Ohh, I didn't think of that way. OK, great. My idea is bad. Let's drop this down. I didn't think that way. Let's not consider it.”(Alina)

In Tara's response it was evident that there was also an interruption situation among them while Tara was taking leadership moves because there were some coalition and rejection by the group members.

“OK, so actually the thing is with that the other group member. Remember the third one? She was she was an interrupting on anything because she was just she was just gonna go with the flow. So she was there. And then they say when there's something, sometimes, interrupting...we were like colliding and we were just like interrupting or rejecting the ideas, but sometimes.”(Tara)

Shared leaders' leadership moves effectiveness.

On the other hand, when analyzing the 2nd group's (Shared emerging leadership) data about how the group members legitimating the leaders' leadership moves I found that there were more positive environment and attitude towards the emerged leaders moves. Flora mentioned in her response that there was no conflict in their project collaboration. Besides Joanna reflected their group situation by stating like “So those that accepted is they had good reason behind it”. That means if there is valid reason behind any leadership turns those were accepted. In terms of legitimating leadership moves by group members John described their perspective from a different dimension which was more democratic as whenever there is a move by any members it was kind of reaching a consensus among the group members which reflects the best scenario of the shared leadership collaborative atmosphere. The following statement shows how their group members legitimated each other's leadership moves.

“I would say in our case it was sort of an open leadership like I indicated earlier discussions on, for example, would come after some sharing our different opinions and then reaching a consensus without necessarily make the voting. But you know bringing giving in suggestions and thrashing through those. At the end of the whole thing, you come up to say, oh, well, this could be the best foot forward to say most of the suggestions that I was bringing from my perspective would actually work as much as maybe would first discuss them, try to thrash them out and come up with the best position.”(John)

In her answer, Katarina mentioned that they didn't have interruptions of turns when taken by any emerged leader. The following example from Katarina's group can describe how their group decides any turns of leadership moves. "I don't think we have interruptions because even when we are proposing the name of the group project, we had like 10 names... we didn't pick one name there. We just merged two or three together like that. Yeah, that's how we even came with the name." In the same tone as Katarina, Natalie also mentions that a leader is more responsible for the decisions but those were more collaborative way. She said that "it was by all members, but not alone. So, there's no direct rejection. And the last response was from Nicole who referred that most of the time the leadership moves taken by leaders were accepted, maybe with some suggestions and modifications but not rejected.

"I would say most of the time (Leadership moves was legitimated). It was accepting. It was less of an interruption, more of an acceptance and giving suggestions. But There was no as such outright rejection, I would say, but yeah, modification. Suggestions, acceptance." (Nicole)

By reviewing the above-mentioned results from group 2 it can be said that there were more democratic, shared approach of leadership turn taking and acceptance, and least rejection or interruption for the legitimizing leaders role. In contrast, in group 1, when individual leaders were doing their leadership moves there were more coalitions and rejections compared to group 2. So, for the legitimating emerged leader's leadership moves, shared leadership type has more acceptance than individual leadership type.

5.3.2 Improvement of overall project

For assessing improvement of the group overall project, both groups were asked the question how emerged leader improved the project concept, design, and final artifact of the project? To answer this question, group 1 participants responses were more generalized although Tara responded like saying emerged leadership was the key factor for their group project, but Alina mentioned more specified answer that when she proposed and changed some of the project design and concept the overall outcome was satisfactory to them.

"Now technically in the start I wanted all three of us to just do a board game and because in escape room, I thought that would be just nice... I was like, hey, yeah, a rescue room can have a board game in it....then changed the concept. Our final project was supposed to be created on the website. These people didn't know that, and I created the website. Umm yeah, I knew

a platform where it would be just easy to create. So those people I suggested in that way that we could create everything on a website which is wix.com...So but we all three of us happy (with the overall project).” (Alina)

However, group 2 responded to this question by answering with positive vibe that emerged leadership helped to improve their project concepts, designs, and final artifacts somehow at some points. Joanna pointed out that their emerging leader was exploring and bringing new ideas into table to make the better adjustment the board game concept and design. Which helped them with their overall project. She addresses the issue in the following way “she (The one who takes the role of exploring new ideas and concepts for the design) brought in more new information about how the board is. So yes, we could say that (she was) exploring our ideas and the new information (that) really helped.” (Joanna). Interestingly John said that while exploring the materials he started discussion with his groupmates by asking different questions which led them to the improvement of the project concept. Moreover, Natalie mentioned that collaborative learning approaches constantly develop new ideas and sometimes might change the whole project concept and design. Therefore, they were more careful when a new idea emerged, they thought about it from different angles of that idea and then they decided to take it or not, which led them to progress.

“Yeah, I think leadership (move) is a key role in progress and achieving goal(s) in all group activities. So, our group are not exception and yeah, leadership was really important in our group (project) activity.” (Natalie)

Nicole also mentioned that the leader’s exploration of new ideas helped them to finalize their project at a satisfying pace.

“Yes, I think because that helped this whole project progress at a satisfying pace because they’re their guided us for something.... Yes. In the sense that when you are taking up that role (exploration of ideas), you become more proactive, more involved, and more engaged with the project. So, you try to find out whatever is best for the entire project.” (Nicole)

5.3.3 Influential coordination

In this influential coordination theme to measure the effectiveness of leadership moves, I asked the respondents from both individual and shared leadership group that how influential was the emerging leaders’ coordination, what is the respondent’s perception and why do they think so? When I tried to identify how the respondents from group 1(individual emerged leaders) answered this question I noticed that their opinion differs from the group 2 participants. Alina was saying “emerging leaders are coordinating with the group. Well, I was the one who is doing

everything. So... there was no other leader as such that...If (I) wouldn't have coordinated, it would have been a mess.” Which means that although she was the only one to coordinate with other members if she didn't take the role of coordinating it would impact negatively on the group performance. Therefore, she influenced her groupmates by motivating them. She said like “we know what every time when we meet and every time with as time passes, we all three should be on the same page so that when we present it doesn't look like you did your thing.”

But in Tara's group it was really mess though she addressed that the coordination is very important. According to her statement, I noticed that Tara was trying to coordinate in the meetings, but then one of them anyway supportive to the group and she was escaping the group collaboration. Tara mentioned how she tried to coordinate and manage their group challenging situations by the following way.

“actually, we had some problems with action cards so. They were (saying) like oh we don't have time, (then) I was like OK I'll just print (actively coordinating) don't worry.” (Tara)

Even though Tara was trying to make the situation by her coordination, as it wasn't the shared leadership environment other members were trying to escape the activities by releasing all the pressure to the individual leader. Which reflects that the individual leader's coordination wasn't successful for the overall group project.

In the other side, Group 2, there is also a considerable difference with the responses from group 1 participants. For almost all participants, mentioned that their and other emerged leaders within their group coordination was positively impacted their group collaboration and final product. For example, Katarina mentioned in her interview that there was one group member who took different leadership moves which motivated the whole group by her coordination as well as other members also did so. Flora's statement makes it clear how leadership and coordination help them to reach their final goal. She said that “Yeah, leadership actually improves group activities and collaboration. It was really effective. The leadership was effective in collaboration, and it actually made us reach the final goal, because from the beginning we listened to each other (each other) and coordinating”. It was clear to us that leaders' leadership move of coordination positively impact to reach to the group goal if it is done in shared manner. In contrast, the participants answers show that it's difficult to coordinate with the group members if there is only one leader who is coordinator, and the other members are free riders.

5.3.4 Effective at finding out resources and supportive to final outcome.

In this research interview, the participants were also asked to answer the question how much effective was leadership moves when leaders helped the group by finding out various resources from many platforms and how much supportive those resources to their final product? To identify the patterns, I found in group 1 individual emerged leaders responding positively that they did the research to find out different resources to make the final product efficiently.

“Yeah, because emerged leaders are more like they are analyzing people's motivation how much time and effort they will give and how much they want to invest in the in that project. And they are also thinking what kind of things that they will gain from that project...they are trying to do like come up with best ideas or like find a reasonable logical solutions all the time... Yeah this happened for example I said like there was something wrong with the design so they came to me and they said all do you know what, how to do this and how can I make it more clear and more quality? And I tried some platforms to make it with better quality and then I did it. I give it. Because I think this is for the resources.”(Tara)

However, for the 2nd group, I also noticed the same kind of responses from the participants. As for the finding out resources it was seen in result section of leadership moves all the shared emerged leaders sharing the leadership moves turns for the finding out resources (see figure 3??? Leadership moves). Interestingly, the participants also answer this question by the same types of positive responses. Flora was mentioned in the following was how her group emerged leader helped them by finding out resources.

“(One emerged leader) brought this idea of websites by finding out different resources that we should design a web that websites and put the activities they the pictures and everything they presentation we have to present how are we going to present. So it made everything smooth and effective.”(Flora)

“So, I think it overall it's good for the project because it (leadership move of find out resources by different emerged leaders) would come out very different from what you would imagine it initially if you keep doing those exploring resources and if the leader whoever is at that point of time takes proactive role of knowing about resources. So yeah, there it helps in the sense that the product would ultimately be better than you had thought initially.” (Nicole)

The above-mentioned examples show how the leaders make the situation smooth and effective for other members. More specifically if we look closer at Nicole's statement, it is visible that the necessity of leadership in finding resources is very important and supportive.

5.3.5 Part Effective support and guidance for the final outcomes

Another very crucial aspect of measuring emerging leadership effectiveness is assessing how much emerged individual or shared leaders effectively involved to support and guide to construct the final outcomes of the maker project? Interestingly while reviewing the responses of this question from both group 1 and 2, it was almost all the participants pronounce and explain that they found almost whether it was individual or shared leaders, everyone tried to support the group and guide to the right track. One participant described how the leader's role of supporting helped her during the project. She stated that when she required support others supported her and which was really important for her to go ahead and continue her tasks. She also mentioned that that support and guidance gave her spirit and motivation to move forward and brainstorm various new ideas also. John gave his group an example of how a group worked during the time shortage and how one person who wanted to lead individually but they all shared the leadership move to support and guide bring them a very supportive collaborative success.

“We had challenges like time was really running out on on on our part. So one of our members lead to sort of volunteer to say maybe instead of us I'll take initiative to to make this one work. So we said no, it's fine. You take that one out, but we're going to support you, for example, by sharing the material that the each tell me tell that she needed to to do that. So say for the project to be to be a success, we as members of the group were really supportive of each other and it it worked out well.”(John)

“Yeah. I think. There was not just one situation, but there was situation at times where you needed that kind of support and for the project to move on so the leader or the different people who were different of leaders at different times. So, they keep giving that support from time to time. When they become proactive, the others also take interest and start doing it. If they are stuck or if they are not being that active. So, in a way it gives the push to the project at every step. To the fun one is doing it proactively. Then others also kind of reminded of the fact, OK, we have to also face up. So yeah, in that sense, it does.... Yeah, most of the time is like If someone is taking the lead, then others do follow. So, it gives push to the project. I would say it moves on yeah.” (Nicole)

5.3.6 Smooth group atmosphere and collaboration

Effectiveness of leadership is critically dependent on how smoothly the group is moving forward and how smooth the group collaborative environment is for the group members to collaborate. To find the relationship between maker project collaboration and pre-service teacher students emerging leadership I asked the question to the participants at the end how was their

group atmosphere when the emerged individual and shared leaders has taken different leadership moves turns? For answering this question, participants from group 1 and group 2, were responding very positively and almost everyone responded that they had a very warm, smooth and supportive atmosphere for collaboration. Tara from group 1, was answering the question in the following way.

“I think when there's an emerging leader it always improves their group atmosphere and also I think sometimes it saves time, energy and effort because like a emerging leaders kind of know the people's strengthening weaknesses and or maybe like because they are, they need to be leading those people and that's why they need to know them, they need to be observed, they need to observe them.”(Tara)

Besides, the remarkable demonstration of how smooth the group atmosphere and collaboration were by the support of shared leadership is in the example below from group 2, which stated by Nicole.

“Hmm, well, it was the atmosphere was really good because as I said our collaboration went pretty smooth. There were no hard feelings or any kind of put pressure or something like that. There were no negative vibes attached to our way of working and the leaders. They were leaders in true sense I would say because they did not try to dominate, pressurize or kind of push be being too pushy. So I would say that most there was really good and it went pretty smooth and yeah, it was a leadership interview sense, like really motivating each other to do their best.”(Nicole)

In general, this research depicts that participant in both groups 1&2, preferred to mention their statement about how different emerged leadership moves developed within the group members and how those leadership moves and types of variation helped to reach the successful group collaboration in their maker project. These results from the data analysis of the current study do not present the whole scenario of what else could also impact on their group success. However, it is apparent that participants mentioned that shared emerged leadership approaches help to improve the atmosphere and collaborative environment by the help of some other aspects during maker based collaborative learning. parents mentioned them, including in the context also that they do not use specific strategies. Participants from both groups also replied to almost the same answers for the last 3 questions of the 3rd RQ of this study. In contrary, group 1 differs from the group 2 in RQ3s first 3 questions which are very much significant to measure the group collaboration and result.

Discussion

The aim of this study was to explore pre-service teacher students emerging leadership moves and how the emerged leadership is related to successful collaboration. For this, 8 pre-service teacher education students were interviewed where they described their leadership moves turn taking during their maker projects, and how successful those moves were for their final artifact and collaboration. In this part, analyzed and obtained research findings have been compared with previous study findings aligning with the studied questions.

6.1 What leadership moves emerge in future teacher students' group collaboration?

In answer to the first question, it has been found that the pre-service teacher student' group collaboration in the maker project came up with four the leadership moves: coordinating joint work, exploring new ideas, seeking out resources, and offering guidance and support to other group members. These findings contribute to the existing body of literature on student collaboration and leadership in a new educational context of pre-service teacher education. Our findings indicate that Exploration of new ideas and coordination of joint work were the 2 most frequent leadership moves which students taken turns. Of which exploration of new ideas was the highest turn taking moves by the future teacher students although in previous research indicated that the coordination of joint work was the most common move (Leskinen et al., 2021) which was consistent to another previous research. Leskinen et al., (2021) has identified coordination as a pivotal part of collaboration (Li et al. 2007; Hennessy and Murphy 1999; Howe and Zachariou 2019; Sun et al. 2017).

Even in this current study, exploration of new ideas was the most taken move, still coordination of joint work was with 2nd highest move taken by students that means coordination of joint work is a very important part of group collaboration. The collaboration wherein the learners managed and regulated the usage of resources and instruments and subsequently followed the overall procedure of their design and maker activities were examples of Coordination of joint work (see Table 2, rows 1–5). It made a big contribution to how the students engaged in groups by providing settings including a range of tools and resources with the team. Emergent leadership was significantly predicted by peer nomination of "having good ideas". A person is more likely to be acknowledged and adopted by others if they can provide good ideas by exploration (Li et al., 2007).

According to the current research, exploring and developing different alternative options for the conceptualization and making of the final group products was a requirement for the exploration of new ideas leadership move. This was particularly evident as the way the participants collaborated in groups, which involved experimenting with how they could adjust the artifacts' constructions or ideas and design in order to fulfill the specific requirements of the group members (Table 2, rows 6–10). According to previous studies on collaboration, participants involvement to new ideas is essential for the procedure of knowledge co-construction as well as contributing to the creation of innovative viewpoints and means of thought (Miell and Littleton 2004; Rojas-Drummond et al. 2008, 2014). Leskinen et al., (2021), found that, their results contribute to this knowledge of by showing how, in a makerspace setting, school pupil's application of hands-on resources while experimenting with new ideas can be particularly important for providing opportunities for the development of STEM-related understanding and knowledge in addition to creative engagement in the maker project (see also Kumpulainen et al. 2019; Dougherty 2016; Martin & Dixon 2016; Pepler et al. 2016).

Furthermore, leadership's importance in fostering interactional spaces for imagining how things may be (Shin et al. 2004) has been highlighted in the research. Since makerspaces are open-ended and creative environments, leadership move that explore new ideas can serve an essential role there (Certo 2011; Lee et al. 2005; Mawson 2011). There, in our investigation for the exploration of new ideas as a leadership move during the pre-service teacher student's collaboration is also depicting that it has huge impact on their group final artifact design for their maker project.

These leadership moves are consistent with earlier leadership research, which showed that leadership can take the form of awareness of what others are doing, recognizing their demand, and assisting other people in participating in collaborative activities (Lee et al. 2005; Shin et al. 2004; McMahon and Goatley 1995). Moreover, supporting group members' work through dialog and action have previously been identified as important for collaboration (Hennessy and Murphy 1999; Howe and Zachariou 2019) and advancing equity and inclusivity of makerspaces (Giusti and Bombieri 2020). Overall, these findings resonate with the educational objectives of makerspaces (Dougherty 2013) in which relative expertise, enacted through supporting others by giving guidance and sharing knowledge, plays a crucial role (Marsh et al. 2019; Martin 2015; Wohlwend et al. 2017). The results of our study also demonstrate how the students' leadership moves and their negotiation in group interactions were associated with qualitatively different forms of collaboration.

6.2 Which type of leadership emerges in this context

This research demonstrated the interactivity of the dominant leadership style. In group collaboration individual emerged leadership was in minimum in compared to the shared leadership while it was not supportive to the maker project and group collaboration. Prior research showed dominant leadership can result in conflicts and dissatisfaction among peers (Lee et al. 2005). Leskinen et al., (2021) also noticed that in this type of leadership they had little opportunity to take part in generating new ideas within their group. Similarly, the current research finding shows that it has conflicting situation and free-riding situation from the group members when the group was led solely by individual leader. Overall, the individual leadership activities in the group led to arguments and an unwillingness to embrace other students' points of view since individual leaders need to do most of the group tasks by themselves. By demonstrating how these individuals' trajectories for collaboration as well as directing shared effort provided inconsistent chances of engaging in shared design and creating work, our results add to the above body of prior research. The co-construction of STEM-related knowledge, such as how to control the speed of the marble, during collaboration was subsequently hindered (see Miell and Littleton 2004; Rojas-Drummond et al. 2008), as well as collaboration on the artifact's original design (see also Eteläpelto and Lahti 2008).

In the other hand, where this study's attention concentrated, the students' collaboration helped to create a shared leadership style. Participants in this group deliberated over one another's suggestions (see, for instance,). Collectively, each of them generated ideas (third extract, rounds 213-218), and throughout their teamwork, they switched throughout being both leaders and followers (second excerpt). For instance, the interaction between the learners as they placed the prism (third excerpt) demonstrate the way they support, and guidance encouraged a shared mode of leadership that encouraged the other students to take the responsibility and assume leadership roles in the group project. As a result, the students were able to creatively apply their knowledge to the collaborative design of the laser maze and jointly create their understanding of the goals of the design challenge.

6.3 How is students' emerging leadership related to their effective group collaboration?

All the participants in this research followed leadership moves at some point which demonstrated that they have taken either individual leadership roles or shared leadership roles. It is apparent by the results of this study that leaders emerged positively impact on group success

especially in the maker project context. Empirical research reveals that group effectiveness depends on leadership, making leadership one of the key components of the group process (Hare & O'Neill, 2000; Yamaguchi, 2001). Previous research about emergent leadership showed that emerging leaders have more impact for the successful group collaboration as they can heavily contribute to the group project by frequently initiate more ideas, raise more opinions, and raise more questions to the communication going among their groups (Bass, 1990). Although there are slight differences between individual and shared leadership effectiveness in group collaboration. This study found that emerged individual leadership is dominant leadership approach which makes the group collaboration less efficient and more complex.

In their research findings, Sun et al. (2017) found that dominant type of individual leadership might not help a group accomplish its objectives (Sun et al. 2017). In this type of leadership environment students are not willing to collaborate rather they have mentality of free riding. However, compared to the actions of individual dominant leaders, the actions of non-leaders were less frequently imitated by others (Li et al., 2007). According to earlier studies, learners can choose different paths toward collaboration, some of which are more individual self-focused, but those personal paths do not result in fruitful collaborative efforts (Barron 2003).

By aligning to the prior mentioned research, in the current study findings it was found that individual, self-focused, less active group members were more chaotic toward the group which ultimately make the group environment, and collaboration process problematic. The individual approach of the emerged leadership was not completely successful from different points of view. Legitimizing leaders role, Influential group coordination and Improvement of overall group project in this 3 perspective of leadership success, group 1 leaders mentioned that they were not successful as their group members did not legitimated their all the leadership moves turns, then there were lacking coordination from the emerged leaders and for the chaotic condition emerged individual leaders were not able to make the collaborative atmosphere smoother although they succeeded to finalize the group project artefact.

However, individual leaders at some points were successful. They supported the group by finding resources for their group, so that they could move forward and finalize the group project. As there were free-riding group members who interacted less with the individual leaders, it was sole responsibility to find out different alternative resources for the group to finish the make project artefact. Moreover, in their group collaboration, individual leaders took the emerging leadership move offering guidance and support to their peers very effectively. They guide and

support in terms of any complexities regarding understanding any concepts, ideas or making processes. Therefore, in this point it can be said that by aligning with previous research, emerging individual dominant leadership is not successful enough for the group collaboration although it helped the group at certain level to be successful.

On the other hand, for the 2nd group, shared leadership was the most efficient type of leadership which turns the groups to effective maker project collaboration for pre-service teacher students' group. It has been discovered that more generalized, distributed leadership behaviors are more likely to predict team success compared to conventional, pre-defined individual leadership styles (House and Aditya 1997). In this study, it has been noticed that shared leadership approach is better at maker-based problem solving which leads to supportive collaboration. Three systematic reviews of shared leadership, which has been defined as emergent phenomenon wherein leadership is undertaken jointly by several members of the same team, were published in 2014, and the results all of those demonstrated that the greater the amount of shared leadership there is, the more beneficial it is for the group's success and other the final results (D'Innocenzo et al., 2016; Nicolaides et al., 2014; Wang et al., 2014).

In previous behavioral research indicated that shared leadership is linked to better problem-solving abilities, and more beneficial collaboration styles (Pearce, Yoo, and Alavi 2004; Balthazard, Howell, and Atwater 2004). In their study of shared leadership, Klein et al. (2006) discovered that this approach promoted greater skill development, better activity coordination, and higher task dependability. Shared leadership was linked to greater levels of collaboration among educators in K-12 settings (Khourey-Bowers, Dinko, and Hart 2005). The strongest correlation between shared leadership and improved team performance or greater effectiveness is maybe the most significant (Kezar & Holcombe, 2017). Almost in every theme which has been selected to define the success of emerged leadership, shared leadership participant group indicated that they were successful in every phase.

They were legitimated and supported each other while any of the emerging leaders within the group taken any leadership moves turns. As they had shared responsibilities of taking leadership turns, they collaboratively improved the maker project overall which indicated that their group atmosphere was quite smooth for collaboration. Besides, all the members offered and guided each other when needed that means they had collective responsibility to co-construct the knowledge ground and understanding of issues. Which explicitly shows how smooth the group atmosphere was in emerged shared leadership groups. According to Rojas-Drummond et al.

(2008) and others (2014), the shared form of leadership encouraged equal engagement and co-construction of common knowledge, both of which are important for effective and productive collaboration (see also Authors 2019a; Dougherty 2016; Martin and Dixon 2016; Pepler et al. 2016).

Conclusions

This thesis includes several limitations. First of all, the participant sampling failed to be random or representative. Only 1 university context although the participants are international students who are doing their master's degree in teacher education and the participants could be biased to the researcher as they are previously known with the researcher. Secondly, the number of participants was small (N=08), therefore qualitative approach has been taken in this research, thus, results could not be extrapolated and generalized. Thirdly, for the analysis of researcher's memo (Note taking) regarding Yes/No type questions could be small enough to analyze in a quantitative format, but the data were backed up by the interview data of Yes/No descriptive questions. On top of that, due to lack of time it wasn't possible to capture and analyze video data, thus only post project semi-structured interview method applied and analyzed.

So, there are higher possibilities of getting biased information by the participants which favor them. So, in future research several sessions could be analyzed through video data from real time collaboration during maker activities in fablab and classroom. Besides, the duration of the maker project was really a bigger concern as it is only a part of a 10credit course, so it might not be fully focused by the teacher and or students which might not serves the full attention of collaboration. Furthermore, there might be female dominance during the collaboration means that only one male student was in the class so there might be some issues regarding gender which could be traced in next research. Considering the reliability of the interviews was evaluated, just one individual prepared the interview transcript. As a result, in future research, it is feasible to collaborate with two or more researchers, increase the sample at random, examine bigger and wider participants from different university future teacher student's group, by performing quantitative as well as qualitative analysis, and apply video data analysis and focused group observation method.

Despite the various limitations, the research sheds focus on pre-service teachers' leadership perspective as it is a huge field of research to identify how leadership emerged in teachers learning contexts which they could use in their future professional context. Shared leadership approach sheds also light to the benefits of collaborative approach of leadership turn taking rather than doing individual leadership in educational context. The gathered insights might be supportive to the teachers of future teacher students who could design the maker project course more pragmatically by analyzing this research suggestions. It would also be beneficial to the future teacher students who will be doing teaching profession might apply the techniques of

leadership development to their students in various learning context. The librarian and educationist could also get some insights about maker project collaborative aspects for their future research and practical maker-based projects. Future studies may examine the relationship and correlation between the different leadership types and formal and informal education settings in a wider context. Besides it could be explored in future research, how pre-service teacher students' technological expertise supports successful maker project collaboration. Because there are teachers who are doing teachers training program may lack technological competencies. Perhaps this will be considered in the next study.

This study emphasized to identify the emergence of leadership among future teacher students during their maker based collaborative learning project. Adopting a qualitative analysis approach to examine what leadership moves emerged during the maker project collaborative learning and how those moves impact on successful group collaboration. A deductive and inductive thematic analysis applied to generate and adopt common codes from the interviews of the eight participants. This thesis started by identifying which leadership moves with various turns taken mostly by the group members and how it occurred while collaborating. Second, it has examined which emerging leadership types emerged. And finally, it identified if the leadership moves influence positively in group collaborative outcomes. Overall, it was proven that a considerable proportion of participants acknowledge leadership approach were emerged during their group activities which impacts positively to their maker project collaboration. Therefore, it is evident that the leadership emerged among future teacher student's maker project group collaboration, and their emerging leadership attitudes changed the group atmosphere and collaboration that reflects emerging leadership is a success factor for maker-based group project collaboration. In contrast, there were a small number of participants who considered their groups emerged individual leaders were less fruitful in terms of group collaborative atmosphere and success than the shared leadership groups.

This study explicitly interpret different leadership moves and the interpretation of participants' leadership moves turns taking are quite consistent with the previous studies and it is suggested that seeking out resources are the dominant type of leadership moves in the current research. Besides Coordination of joint work also contributed a lion share leadership moves. Moreover, results showed that the different leadership moves influenced the group outcomes positively. It also found that leadership moves related to the types of leadership specifically with the shared one. Because in a shared leadership approach students can take different turns at different times. On the other hand, individual leaders took all the turns by themselves and not giving the chances

to other members. In conclusion, this study's results highlight the importance of leadership emergence and its potential to support effective collaboration in pre-service teacher education maker project.

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Appendix 1

The interview script

1st section

Please let me know about what kind of leadership moves were there in your group collaboration during the maker project (What leadership moves emerge in future teacher students' group interactions in the makerspace?)

Let's talk about your maker project and final artefact.

1. Can you briefly describe the maker project you took part in (product name, purpose, target users)?
2. In what ways working in a maker project was different from other non-making collaborative projects?
3. Were specific roles assigned within the group? If yes, what were they and which role did you undertake?

Let's discuss about leadership in your group activities

4. How would you describe "Leadership" in collaborative learning? (Individual or Shared leadership)
5. Do you think a maker project requires leader/s to lead the group? Why yes or why not?
6. How do you see an emerging leader in a collaborative learning setting? Did you recognize your own leadership during collaboration in the maker project?

2nd section

Now I am going to specify more in details about the leadership attitude during group collaboration: - Please give your honest opinion about how actively you have performed your tasks while answering the following questions.

Part 1: Questions about Coordinating joint work.

- | |
|---|
| <ul style="list-style-type: none">● Did you take over the group activities by organizing the working process? |
| <ul style="list-style-type: none">● Did you manage different group activities and the conduct of activities? |
| <ul style="list-style-type: none">● Have you assigned the tasks within the group members such as who will do what task? |

- Have you taken the role of promoting everyone's participation in group work?
- Did you set the agenda of work for others?

Part 2: Questions about Exploring new ideas.

- Have you made any critical reflections on the maker project concepts?
- Have you taken initiatives for changing the materials used in the making activity?
- Did you have any suggestions for changing the design of the artefact?
- Did you do any explorations to adjust the materials to better fit?
- Have you proposed new options or alternatives for the design of the artefact?

Part 3: Questions about Seeking out resources.

- Did you try to find resources from different platforms?
- Have you observed and discussed with peers working on the same challenge?
- Did you use your observations to guide your group's design and making activity?

Part 4: Questions about Offering guidance and support to other group members.

- Did you support finding instructions in construction of the artefact?
- Did you describe something if group members haven't understood or needed more explanation?
- Have you actively supported problem-solving of the artefact?

3rd section

Please let me know how different leadership moves help to make your group collaboration successful (How are Leadership moves and types related to group's effective collaboration?)

- 1) In your group, how members legitimate emergent leader's role when they started taking decisive action? Did they accept, interrupt, or reject the leaders' proposed action? Why did they do such a thing?
- 2) In terms of group success, how influential was emerging leaders' coordination? Do you think their coordination was the key factor in that process? Why?
- 3) Do you think while exploring new ideas emerged leader/s improved the project concept, design, and final artifact? How?

- 4) In your group, how much supportive the leader/s was to find out resources when needed? How effectively it supported your group final outcomes?
- 5) Think about a situation when as a group you needed some guidance and support, how much supportive the emerged leader/s was and how effective those supports for your final outcomes?
- 6) While collaborating, how emerging leader improved the group atmosphere and artefact? How smooth was the group atmosphere and collaboration while the leader took an active role?

Appendix 2

A final artifact of a group



A photograph of final artifact of a group during their Maker project group collaboration which is named as "Stars' Road".