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Knowledge Construction and Psychological Need Support in Student-Centred Learning Contexts: An Experiment with Estonian 6\textsuperscript{th} Grade Students

Master’s Thesis in Education
FACULTY OF EDUCATION
Learning, Education & Technology
2017
The present study analysed the learning outcomes and psychological need support of Estonian 6th grade students (N = 43) in collaborative, peer-supported and individual learning contexts. The study compared the three learning contexts in terms of knowledge construction and psychological need support as well as analysed the relationship between knowledge construction, work performance and psychological need support across the learning contexts. The study was experimental and was designed as a problem-based history lesson, where students were asked to complete a problem-based worksheet either collaboratively (N = 23), individually (N = 9) or with peer support (N = 10). Students were also asked to fill in a pre-test and post-test questionnaire to measure their knowledge and self-reported psychological need support or thwarting. The findings of this study suggest that students’ psychological needs are most supported in peer learning contexts. It was also found that learning outcomes are connected to psychological need support and good work performance does not necessarily predict high quality knowledge construction. The study found collaborative learning to be the learning context where students create best-quality products and peer learning to result in the highest quality of constructed knowledge. While the empirical findings of this study supported the theory and the posed hypotheses, additional research could confirm and elaborate these results. Implications for teaching practice and future research were discussed.

Keywords: knowledge construction, basic psychological needs, collaborative learning, peer learning, individual learning
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1 Introduction

Following the start of a new millennium, educational policies all over the world have been emphasizing the development of skills and knowledge that are important in the 21st century knowledge society (Vahtivuori-Hänninen et al., 2014; Estonian Lifelong Learning Strategy, 2014; Kuhlthau, Maniotes, & Caspari, 2015; Valiente, 2014; OECD, 2013), competencies like leadership, technology literacy, critical problem-solving, creative thinking, but also skills of regulating one’s own work and collaborating effectively with others. The students of today will have to work together to solve problems that don’t exist yet with the help of technologies that haven’t been invented yet and formal education needs to help them to be ready for that kind of a future. The question, however, lies is what exactly should be happening in the classroom to make way for the future and help students develop the skills and knowledge necessary in the 21st century.

In many innovative strategic documents in the area of education one of the solutions proposed is the flipping of the classroom all around the world (Vahtivuori-Hänninen et al., 2014; Estonian Lifelong Learning Strategy, 2014; OECD, 2013) – giving students the responsibility over their own learning and designing learning around real-life problems. However, the traditional teacher-centred methods of instruction, such as lecturing, reading and filling in factual workbooks, are unable to deliver these learning opportunities (Gash, 2015) and there is, thus, a dire need to design and implement student-centred methods that put the students in charge of their own learning.

The theories of cognitive development that emphasize the uniqueness of learning experiences of every single individual have been around for decades (Wertheimer, 1938; Piaget, 1964; Vygotsky, 1980) and student-centred instructional methods like hands-on learning (Dewey, 1916) inquiry-based learning (Kääs, 1935) or problem-based learning (Barrows & Tamblyn, 1980) have an even longer history. The problem, therefore, does not lie with not knowing what should be done differently or with a lack of strong theoretical reasoning behind why it should be done differently. The main problem is the lack of practical skills and knowledge of teachers in using such methods in ways that are beneficial for the learners. As Kuhlthau et al. (2015) and Gash (2015) point out, teachers need to learn how to implement student-centred methods, before they are able to implement them, because the basics of learning are the same for children and adults – it only happens if an individual is exposed to the new knowledge or the modelling of a behaviour.
Formal education is a political, social and professional system that is affected by teachers’ pre-service and in-service training, national objectives and social expectations that often don’t align with each other. While researchers and policy-makers push for new methods, the lecturers and trainers at universities teach mainly traditional methods, as these are the only things they know, and parents simply want their students to perform well. These differences in expectations cause the education system to be extremely slow in changing and adapting new ways (Gash, 2015). The change is all the more slowed down by the lack of absolute truth in social and educational sciences, as researchers are unable to unanimously agree on what, how and why is best for learners and learning (Gredler, 2012, Kirschner, Sweller, & Clark, 2006).

This has created a way for an intense academic debate over the effectiveness of different student-centred learning methods (Gredler, 2012; Wu, Wang, Spector, & Yang, 2013; Kirschner et al., 2006; Nokes-Malach, Richey, & Gadgil, 2015), whether they are collaborative, individual or peer-supported. But as Hull (1935) pointed out a long time ago, this debate is not caused by a divergence in the empirical findings of research on learning. It is caused by the divergence in theories and definitions that are not consistently used and compared in interpreting these findings. If constructs are defined differently and learning environments are designed differently, but given the same name of “collaborative” or “problem-based” learning, the findings are bound to be different.

One of the most controversial topics in recent research is the effectiveness of collaborative learning methods. Collaborative learning has been used in different academic settings to spark students’ engagement and trigger learning about how to work together in a productive way (Gash, 2015). It is also found to be a very effective way of learning, especially if students complement each other in their perspectives (Deiglmayr, & Spada, 2011; Guthrie et al., 2015). But research also suggests that collaboration is not always successful (Nokes-Malach et al., 2015; Toomela, 2007) that students face many problems when working on collaborative learning tasks (Deiglmayr & Spada, 2011; Gash, 2015; Kirschner et al., 2006) and sometimes even perform worse than if they were working alone (Nokes-Malach et al., 2015; Kirschner et al., 2006).

The skills required in the work life of 21st century are not limited to collaboration skills. People are also required to direct and plan their own work and to seek help from more knowledgeable colleagues and mentors. That’s why student-centred methods should also focus on developing the working and learning skills necessary for coping in such contexts.
Some researchers even argue that learning methods where students are individually in charge of their own work should be preferred to collaborative methods (Kirschner et al., 2006), as learning itself is an individual process and social factors might inhibit it. And while students tend to find the option to learn together fun and attractive (Ryan & Deci, 2000), people often engage in intrinsically motivated behaviours on their own, which means that the social factor is not necessarily important for maintaining engagement in learning activities (Vansteenkiste & Ryan, 2013; Jang et al., 2016). However, more knowledgeable peers can be very useful in helping each other in the development of cognitive skills (Vygotsky, 1980) and that’s why none of the abovementioned approaches should be disregarded.

As learning is the construction of new knowledge within a socio-cultural context (Toomela, 1999; Vygotsky, 1980), there are two things learning approaches need to take into account: how does an individual learner construct knowledge and how is this process facilitated or affected by the learning context (Toomela, 2007; Gash, 2015; Moreno, 2010). The cognitive process of knowledge construction is one that is universal, but the learning contexts can vary considerably. But failing to consider both of these aspects in designing learning situations, can easily lead to unsuccessful learning (Nokes-Malach et al., 2015; Toomela, 2007; Moreno, 2010). It is, therefore, very important to consider how different methods, the social learning context and other environmental factors affect the process of knowledge construction in learning.

Research shows that positive school functioning is promoted in social contexts that nurture learners’ psychological needs of autonomy, competence and relatedness (Jang, Reeve, Ryan & Kim, 2009; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). While there is a big amount of other factors that influence the learners’ experience within the learning environment, the satisfaction of basic psychological needs has been empirically shown to be the most important, as it reflects a student’s general perception of well-being in the classroom (Vansteenkiste et al., 2004). It is therefore essential for the success of any learning method to make sure that learners perceive the tasks to be optimally challenging or interesting, socially engaging and student autonomy supportive. As opposed to that, learning situations that are not supportive of psychological well-being are likely to be detrimental to knowledge construction and performance.

Different student-centred methods are argued to be beneficial greatly due to the support they provide to these psychological needs: students feel more competent and connected to their peers while working together or have a heightened level of autonomy when they are able to take decisions about their own learning (Kuhlthau et al., 2015; Valiente 2014; Nokes-Malach et al.,
2015; Jang et al., 2016). But research has also shown that the main challenges students face in these processes are related to the thwarting of these needs (Deiglmayr & Spada, 2011; Gash, 2015; Kirschner et al., 2006; Nokes-Malach et al., 2015): social conflicts and the inability to have a say in the group work might inhibit the learning experience in groups and high task difficulty might reduce the competence and autonomy level of students when they need to cope with their task on their own.

Even though different student-directed learning methods have their benefits and faults, the need for such methods is clear on scientific, theoretical and policy. And what these mixed empirical results show, is that the question is not in whether social learning is beneficial to knowledge construction, but rather how and when it is (Nokes-Malach et al., 2015).

While there is a wide array of research that argues that either individual, collaborative or any other learning context is the most appropriate or effective for learning, there is a lack of actual comparative studies that empirically prove one to be better than the other (Larsen-Freeman, 2016). This paper aims to fill that gap by addressing the relationship between knowledge construction and perceived psychological need support of students in individual, peer-supported and collaborative learning contexts. The paper would like to argue that while all three contexts have their faults and challenges, they can all be designed to be more supportive of learning and knowledge construction by focusing on supporting the psychological needs of each individual student.
2 Theoretical Framework

The theoretical framework of this research is based on a contemporary social constructivist approach (Vygotsky, 1980; Toomela, 1999; Gash, 2015) that views learning as an individual constructive process that is affected by the environment in which it happens. There is considerable theoretical support to the importance of social factors on the learning process (Vygotsky, 1980; Toomela, 1999; Toomela, 2007; Gash, 2015; de Vries, Perret-Clermont, Sawyer, Pellegrino, & Chevrot, 2016), as well as an extensive body of empirical research that has shown the effect of social context on students’ cognitive processes (Moreno, 2010; Guthrie et al., 2015) academic performance (Blasco-Arcas et al., 2015) and motivation (Deci et al., 1991; Hardre et al., 2003).

In this conceptual approach, the effectiveness of learning environments, contexts and methods should be observed from two perspectives: how well does a learner construct knowledge there and how is the social environment affecting it (Toomela, 2007; Vygotsky, 1980; Gash, 2015; Moreno, 2010). In accordance with this approach, knowledge construction will be observed according to Vygotsky’s (1980) definition and description of the process. In order to fully observe the effectiveness of a learning context, there is also a need for a measure that includes different factors of the social environment and that has shown to be relevant to the learning outcomes. Due to its wide use in educational contexts and strong empirical validation, psychological need support in the framework of Self-Determination Theory (Ryan & Deci, 2000) was chosen to observe the effect of the environment on knowledge construction and performance.

Learning context can mean a variety of things and can be observed on a group, classroom, school or even family level (Rosenthal & Zimmermann, 2014) when talking about learning situations. However, the social learning context that has received most attention in studies in the recent years has been collaboration (Gredler, 2012; Wu, 2013; Kirschner et al., 2006; Nokes-Malach, et al., 2015; Gash, 2015). The discussion on the effectiveness or ineffectiveness of collaborative learning is mainly focused on how the group processes and interaction affect an individual student’s well-being and performance, which means that these findings and their relevance are specific to the context of a single learning activity, rather than any long-term endeavours. Therefore, the definition of learning contexts in the theoretical framework of this study needs to also be specific to one learning activity. Therefore, the learning contexts in this framework are defined and described in accordance with social constructivist theory and derived from the reality of classroom practice (Jang et al., 2016).
2.1 Knowledge Construction

Knowledge is the psychologically organized representation of world and constructing knowledge is a personal act embedded in the social-cultural environment (Toomela, 1999). Construction of knowledge is often referred to as “learning” in academic contexts, but in reality it is simply one type of human learning. Learning refers to different changes in an individual’s psyche (Toomela, 1999; Toomela 2007) that may or may not refer to constructed knowledge. While some learning activities only develop a narrow skill or understanding, education as a whole contributes to the restructuring of a child’s mental functions (Gredler 2012) and the outcome of cognitive development is the acquisition of higher mental skills (Vygotsky, 1998). However, the aimed outcome of learning in most academic situations is the construction of new knowledge (Jang et al., 2016; Deiglmayr & Spada, 2011) and the effectiveness of a learning method or context should therefore be measured by assessing the achievement of the learning goal by measuring the quality of the constructed knowledge.

According to Vygotsky (1980), the highest level of knowledge is displayed when a student is able to define and describe a concept in a way that is correct, clearly differentiates the concept from other related or similar concepts and when a student is able to complete their reasoning using causal clauses. Within social constructivist understanding of learning, the construction of knowledge happens as a learner is exposed to a piece of knowledge. The learner first copies the model and eventually internalizes it (Vygotsky, 1980). Internalized knowledge refers to the knowledge that is already owned by the learner and they are able to elicit at any time when prompted.

However, Vygotsky (1980) also defines the Zone of Proximal Development as a concept for understanding and supporting a learner’s cognitive development. The Zone of Proximal Development refers to an array of things a learner is not able to do alone, but can do with the help of a more knowledgeable other. Gredler (2012) and Vygotsky (1980) argue that to fully support the learning process of each individual student, learning needs to be measured not only in the end, when it is constructed, but rather during the internalization process, in order to assure that the knowledge model the learner will internalize, is the correct one. The role of the more knowledgeable other is, therefore, to fill in the knowledge gaps the student has and assure the construction of correct knowledge (Gredler, 2012).

Vygotsky (1980) referred to a teacher or any other adult as the more knowledgeable other and Gredler (2012) claims that Vygotsky’s theory is misplaced in looking at a student’s peers as
facilitators in the same sense an adult is looked at. However, it can also be argued that in today’s
today’s knowledge society, students of all ages are exposed to different pieces of information that are
very much relevant to the academic curricula (Estonian Lifelong Learning Strategy, 2014).
They get bits and pieces from home, hobby classes, video games, educational and non-educational television, books and the internet, which means that is fair to argue that the students of
today possess pools of knowledge that can vary considerably from each other (Boud, Cohen, &
Sampson, 2014), which means that they are more than capable of facilitating the cognitive de-
velopment of each other in some areas. Additionally, students of the same age are not a homog-
enous group in terms of their cognitive capacity (Moreno, 2010) and there are bound to be gifted
and struggling students in each classroom, which is why there are many situations where student
can act as a more knowledgeable other to each other.

Therefore, while knowledge can only be created by an individual and it can emerge only in the
brain of that individual (Toomela, 2007; Toomela, 1999; Vygotsky, 1980), human information
processing is a semiotic process mediated by language and is therefore highly social in its na-
ture. According to Vygotsky (1980), a learner’s cognitive development happens through the
internalization of processes that are modelled to the learner. This means that learning begins
with a student being presented with the expected learning outcome and ends with the student
internalizing the factual knowledge, mathematical problem solution or creative collaboration
strategy that was modelled.

2.1.1 Knowledge Co-Construction

Knowledge co-construction is an active process in which a group of learners build upon each
other’s knowledge as they contribute to the group’s shared pool of knowledge through discus-
sion and negotiation (Deiglmayr & Spada, 2011). In other words, collaborating peers can be
seen as one big information processing unit, where learners make use of each other’s knowledge
in meaning making processes.

The concept of knowledge co-construction is also based on a constructivist understanding of
learning and knowledge construction. But in the case of knowledge co-construction, it is argued
that learners don’t necessarily act as more knowledgeable others to each other (Gredler, 2012),
because there might not be a knowledge hierarchy in collaboration and the students might not
be able to facilitate each other’s cognitive development. Nevertheless, the way learners construct
knowledge during collaborative work has been shown to be qualitatively different from that of
a learner constructing knowledge on his own or with the help of more knowledgeable peers (Chen et al., 2015; Deiglmayr et al., 2011), which is why it needs to be considered separately.

While negotiating understanding will happen inherently in collaboration, effective and individually beneficial knowledge co-construction requires facilitation (Gash, 2015). This claim was also made by Vygotsky (1980), whose argument’s bottom line was that children are not capable of facilitating their own and each other’s cognitive development as they are not able to model the “ideal” learning outcome. However, more knowledgeable peers are able to facilitate the learning of their classmates, especially in learning situations where the competencies of learners complement each other (Deiglmayr & Spada, 2011; Guthrie et al., 2015) and this understanding has been the bottom line of arguing for the effectiveness of different learning methods where students construct knowledge in interaction with each other. However, collaborative knowledge construction is not a direct facilitation of each other’s cognitive development (Gredler, 2012), as the aim of collaboration for the students is to complete a task as a group, not to teach each other, which is why there is a body of research that has shown knowledge co-construction to not be the best way for an individual to learn (Gredler, 2012; Guthrie et al., 2015)

The effectiveness of collaborative learning contexts and methods in constructing knowledge has not been conclusively proven (Gash, 2015; Deiglmayr & Spada, 2011, Moreno 2010, Nokes-Malach et al., 2015), as learning environments are affected by variables other than the number of learners interacting with resources and each other. But research does suggest that constructing knowledge in interaction with peers can be beneficial to the learner (Deiglmays & Spada, 2011; Gash, 2015). Explaining concepts to each other helps students to identify and fill the gaps in their understanding, discussing contradictory claims allows learners to correct their own and others’ misconceptions and building upon each other’s ideas can result in a shared pool of knowledge that no individual learner could have achieved on their own (Deiglmayr & Spada, 2011; Moreno, 2010). While it is very likely that the pool of knowledge the students create together will not be acquired by all the students who are co-constructing knowledge (Gredler, 2012), it is highly probable that the knowledge is correct and therefore it serves as the first step for the students in internalizing a new knowledge model.

2.1.2 Knowledge Construction and Performance

As described by Vygotsky (1980), the knowledge a learner has already constructed can be freely elicited by the student at all times, but in educational practice it is important to also measure
the knowledge that is still emerging and the student has not internalized yet, in order to assure that they are developing correct cognitive models. The assessment practices in classrooms are generally based on the same understanding.

Student performance is assessed according to learning objectives, which can range from remembering and understanding information to using it in evaluation and creation processes (Kratwohl, 2002; Bloom, Kratwohl, & Masia, 1984). In educational research, the achievement of different learning goals is generally labelled as performance.


All these methods are measures of student performance, but they measure skills and abilities (Bloom et al., 1984). The necessary precondition of developing and successfully demonstrating these skills is the construction of relevant factual, conceptual, procedural and metacognitive knowledge (Kratwohl, 2002). Therefore, students are not able to create a good-quality homework assignment without having knowledge about what a good-quality homework assignment is like and how to create one. However, when students receive external help without internalizing it, they are combining their own knowledge with that of someone else and thus creating a good-quality product, without actually having acquired the knowledge necessary for that (Vygotsky, 1980). This is what happens when a student copies the answers from a classmate or free-rides in collaborative work. Constructed knowledge can be one measure of student performance (Kratwohl, 2002), but performance measures might not display any information about constructed knowledge (Vygotsky, 1980). This is important to understand in designing assessment practices, but also important to know in designing learning activities, since emerging knowledge is an indicator of what kind of knowledge a learner will be constructing (Vygotsky, 1980), but only in a situation where that process is not affected by external factors, such as peers, alternative information or distractions.
2.2 Basic Psychological Needs

According to the social constructivist theory, learning and knowledge construction are maximized when the learning environment of a student is supportive of his well-being (Toomela, 1999). Student well-being in the educational context has been measured in different ways, but most reliable measures and theories focus on a student’s general satisfaction with their health, relationships and safety (Soutter, O’Steen, & Gilmore, 2014; Anderson & Graham, 2016; Anderson, 2005) and the proposed models are not applicable in making sense of situation-specific well-being. Positive school functioning, nevertheless, is shown to be affected by students’ well-being (Ryan & Deci, 2000; Anderson, 2005; Soutter et al., 2014) and Self-Determination Theory (Ryan & Deci, 2000) offers a framework to observe the well-being within situational contexts.

The support of students’ basic psychological needs is an indicator of how well an environment supports the student’s well-being and readiness to learn. The theoretical framework for measuring the psychological need support in this study is Self-Determination Theory, due to it being in accordance with the social constructivist approach to knowledge construction and learning in general, as well as due to its strong and wide empirical relevance in academic settings (Chen et al., 2015; Deci et al., 1991; Hardre & Reeve, 2003; Jang et al., 2016; Jang et al., 2009; Reeve, 2012).

Self-Determination Theory is a meta-theory of human motivation and personality that emphasizes the role of social context on cognitive and social development (Deci & Ryan, 2012). The theory begins with the assumption that humans are active organisms with tendencies toward growing and mastering challenges. These natural developmental tendencies require ongoing social support, meaning that the social context can either hinder or support the psychological development of an individual (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000; Deci & Ryan, 2012). The theory argues that psychological well-being and optimal functioning are predicated by the fulfilment of three psychological needs: autonomy, relatedness and competence. The conditions and contexts that support the individual’s experience of autonomy, relatedness and competence are shown to foster the most high quality form of motivation, engagement, performance, persistence and creativity (Ryan & Deci, 2000; Jang et al., 2016; Deci & Ryan, 2012).

In Self-Determination Theory, needs are innate psychological nutriments that are essential for ongoing psychological growth, integrity and well-being (Ryan & Deci, 2000). There are three fundamental needs: autonomy, competence and relatedness. All three needs are essential and
if any is thwarted versus supported, it will have a distinct functional impact on a person’s well-being and performance (Deci & Ryan, 2012).

In the classroom, the psychological needs of a student are affected by the perceived support the learner receives from the learning environment, the teacher and his peers (Jang et al., 2016; Deci et al., 1991). If a student perceives the classroom activities to be supportive of his needs, intrinsic motivation, good performance and student well-being follow (Deci & Ryan, 2012). Therefore, the theory proposes that the level to which the three basic psychological needs of autonomy, relatedness and competence are thwarted or supported has a significant impact on the engagement and motivation and, consequently, wellbeing and performance of the individual in that setting.

2.2.1 Autonomy

Autonomy refers to the experience of volition and self-endorsement of one’s activity (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000). In an academic context, the need for autonomy refers to the need to perceive that the decisions regarding learning behaviour are taken by the learner himself (Deci & Ryan, 2012). Student autonomy can be supported in a variety of ways, as anything the teacher says or does can either control students toward a behavioural goal or focus on giving students a choice and initiative in their own learning (Oga-Baldwin, Nakata, Parker, & Ryan, 2017). Autonomy-supportive teaching methods include the use of interesting activities, offering choices and opportunity for self-direction in learning, allowing students to work at their own pace or framing the lesson within a context of intrinsic goal pursuit (Reeve, 2012; Jang et al., 2016). Autonomy support has been shown to correlate positively with student engagement and motivation situationally (Jang et al., 2016) and longitudinally (Jang et al., 2012; Hardre & Reeve, 2003).

2.2.2 Relatedness

Relatedness refers to the experience of love and care by others in a social context (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000). The need for relatedness in the classroom is expressed through the need to be part of a group and have good relationships with peers and teachers (Deci & Ryan, 2012). The ways to support a learner’s need for relatedness can vary depending on their personality (Ryan & Deci, 2000), age (Deci et al., 1991) and culture (Oga-Baldwin et al., 2017), but some universal relatedness-supportive methods of instruction include learning in
groups or pairs, reinforcing the use of positive peer feedback and creating a supportive classroom environment.

2.2.3 Competence

Competence refers to the experience of a sense of effectiveness in interacting with one’s environment (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000). The need for competence in a learning situation refers to the need to perceive a learning task to be optimally challenging and useful (Deci & Ryan, 2012). Defining the optimal challenge level can be tricky, as research has shown this to be dependent on individual differences in perfectionism (Thuy-vy & Deci, 2016), perceived task difficulty (Moreno, 2010) and relevant internal scripts (Fischer et al., 2013). However, competence as a psychological need does not only refer a learner’s perception of competence in relation to the task in hand. It also encompasses the perceived usefulness of the learner’s actions (Reeve, 2012). Therefore, competence-supportive ways of instruction include creative problem-solving, learning through real-life phenomena and individualized teaching.

2.2.4 Psychological Need Support and Performance

The importance of psychological need support in learning lies with positive school functioning on a general level. On one hand, psychological need support guarantees the students’ well-being (Ryan & Deci, 2000), but on the other hand it also creates affordances for higher levels of motivation (Jang et al., 2012; Deci et al., 1991). In the framework of Self-Determination Theory, motivation is the key to high quality learning and academic performance (Deci & Ryan, 2012). Therefore, in order to understand the relationship between psychological need support and knowledge construction or performance, it is important to understand the role of motivation in the process.

Within the framework of Self-Determination Theory, motivation is defined as a phenomenon that drives an individual to act. The theory defines extrinsic and intrinsic sources of motivation and describes their roles on an individual’s development (Deci & Ryan, 2012). Intrinsic motivation is an innate tendency to inquire, learn and explore. It is expressed through engagement in activities that an individual undertakes for interest, enjoyment or curiosity without a need of external motivators. Extrinsic motivation is expressed through engagement in activities because they are believed to deliver a desired outcome (Deci & Ryan, 2012).
While students might show great interest in some topics or enjoy the group learning process in some instances, the majority of learning goals are extrinsic motivators (Mega, Ronconi, & De Beni, 2013; Deci, Vallerand, Pelliottier, & Ryan, 1991) and high levels of extrinsic motivation have shown to negatively affect the perceived stress and academic performance of students (Hardre & Reeve, 2003; Jang et al., 2016).

This is why the role of teachers is to help students in assimilating the classroom values and regulations, as well as learning goals, so that the students are able to be self-determined while learning and achieving mastery (Deci et al., 1991). That assimilation happens through the internalization of extrinsic motivators – an active and natural process through which individuals transfer socially sanctioned requests into their own values and regulations (Ryan & Deci, 2000). When the internalization process is successful, people will identify with the importance of these social regulations and fully accept them as their own. In a classroom setting, the students reason for learning changes from „I need to get a good grade because my parents expect the best from me“ into „I need to do this well, because I think it is important for myself“.

The internalization of extrinsic motivators depends on how well the basic psychological needs are supported in situations where people are acting upon these motivators. (Ryan & Deci, 2000; Deci & Ryan, 2012). Therefore, students are only able to internalize the learning goal for understanding English grammar rules if the learning situation in which they are expected to do that, supports all three basic psychological needs: autonomy, relatedness and competence needs.

As the theory posits, when students’ psychological needs are supported, their behaviour is self-determined (Deci & Ryan, 2012). Self-determined behaviour in academic settings refers to the student perceiving that they are in charge of their own learning and their own learning environment. Therefore, it is only reasonable to observe the satisfaction of psychological needs and its effect on knowledge construction in learning contexts where students are allowed and able to be self-determined.

2.3 Student-Centred Learning Contexts

The roots of contemporary student-centred learning methods lie in Lev Vygotsky’s theory of social constructivism that emphasizes the role of social interaction in knowledge construction (Vygotsky, 1980). Constructivism and educational policies all around the world, therefore, put
strong emphasis on the need to learn collaboratively and construct new knowledge in interaction with peers and teachers (Vahtivuori-Hänninen et al., 2014; Estonian Lifelong Learning Strategy, 2014; Kuhlthau, Maniotes, & Caspari, 2015; Valiente, 2014; OECD, 2013; Gash, 2015).

While learning situations can differ from each other in a variety of aspects, the issue of social interaction in knowledge construction is one of intense debate in current educational research (Gredler, 2012; Wu et al., 2013; Kirschner et al, 2006; Nokes-Malach et al., 2015). There are two things that need to be taken into account in designing learning situations: how does an individual learner construct knowledge and how is this process facilitated or affected by the learning context (Gash, 2015; Moreno, 2010). Based on the autonomy-supportive teaching methods listed by Jang et al. (2016), it is possible to differentiate between three qualitatively different social learning contexts: (1) collaborative learning, where students work and negotiate together to achieve a common goal; (2) peer learning, where students consult with each other during their work; (3) individual learning, where students work on their own and consult the teacher when faced with a problem.

2.3.1 Collaborative Learning

Collaborative learning is the construction of socially shared knowledge in a specific group setting (Deiglmayr & Spada, 2011). The knowledge-society of tomorrow requires from young people the skills to creatively solve complex problems in collaboration with different experts. This is why educational policies all around the world emphasize the importance of using collaborative learning methods in schools (Vahtivuori-Hänninen et al., 2014; Estonian Lifelong Learning Strategy, 2014; Kuhlthau, Maniotes, & Caspari, 2015; Valiente, 2014; OECD, 2013; Gash, 2015). However, researchers are yet to agree on how these methods should be implemented (Gash, 2015).

While some researchers have identified significant motivational and cognitive benefits of collaborative interaction in learning (Volet, Summers, & Thurman, 2007), others have shown collaboration to hinder performance (Toomela, 2007) and decrease student well-being (Deiglmayr & Spada, 2011; Gash, 2015; Kirschner et al., 2006).

Learning in collaboration has been found to be an effective way of learning when students complement each other in their perspectives (Deiglmayr & Spada, 2011; Guthrie et al., 2015), as there is an increased chance for their prior knowledge to be challenged and for cognitive
change to occur (Gash, 2015). In cases where a collaborative group acts as a single information processing unit, the cognitive load is distributed among the participants (Moreno, 2010), as learners are able to create a pool of knowledge that no single participant possesses (Gash, 2015) and therefore approach the learning task with increased perceived competency. Group learning is also an empirically proven way of increasing learners’ relatedness support (Deci & Ryan, 2012).

However, collaboration is not always successful (Nokes-Malach et al., 2015; Toomela, 2007), as students may ignore each other’s opinions, rely on dominant voices in making decisions, free-ride, give in to conformity pressure and dismiss contradictory information (Toomela, 2007). In such cases, the students’ perceived relatedness and competence support are detrimentally thwarted and may lead to unsuccessful learning.

2.3.2 Peer Learning

Peer learning is not a single educational strategy. It is an abstract term that broadly refers to any learning method where students reciprocally consult with their peers to achieve their individual learning goals (Boud et al., 2014). While research on organic peer learning in formal education is understudied (Boud et al., 2014), researchers have recently been studying the benefits of instrumental peer learning strategies like peer-assisted learning (Supple, Best, & Pearce, 2016), peer tutoring (Jones et al., 2017) and peer teaching (Boud et al., 2014).

The importance of peer learning also stems from the requirements of a future knowledge society, where people interact with problems, resources and each other to learn and construct knowledge (Gash, 2015; OECD, 2013). It follows the basic constructivist assumption of Vygotsky (1980) that a learner’s cognitive skills can only develop in interaction with a more knowledgeable other who is able to model the expected learning outcome for the learner. Students engaging in peer learning are expected to act as more knowledgeable others to each other in different areas.

Peer learning benefits from similar knowledge construction support that collaborative learning does. Namely, learners are able to increase their pool of knowledge by asking help from more knowledgeable peers and increasing their perceived competence-support in the process (Gash, 2015). The smarter peers, on the other hand, benefit from rehearsing existing knowledge and monitoring their own gaps of knowledge as they present their ideas or convey information to
others (Webb, 2013). As the initiative of asking for help is left to the learners, the method puts into a disadvantage the learners who don’t have high cognitive, social or self-regulatory skills (Gash, 2015) or those who face learning challenges (Jones et al., 2017). However, students tend to find the option to learn together fun and attractive (Ryan & Deci, 2000), which diminishes the threat of zero interaction. Peer learning is also very autonomy-supportive, as learners are able to choose their own preferred learning strategy and ask for feedback (Deci & Ryan, 2012; Jang et al., 2016).

2.3.3 Individual Learning

Individual learning, just as peer learning is not a universally defined instructional strategy, but rather a term that is used to describe learning methods where students work independently on achieving their learning goals and consult with their teacher when faced with a problem (Jang et al., 2016).

Individual learning is the student-centred learning method mostly advertised by constructivist theorists and researchers (Toomela, 2007, Vygotsky, 1980), as it is built upon the idea that every student constructs knowledge on a unique combination of pre-existing beliefs, facts and habits. Students interpret new information according to their individual cognitive organization and not according to the carefully constructed instructional message (Gash, 2015), which requires individual attention and facilitation from the teacher to every student. The only way to create a maximally competence-supportive classroom is for the teacher to provide every student with in-time support whenever they need it.

Research on psychological need support in educational settings has shown that there are many learning situations in which relatedness is less central to intrinsic motivation than autonomy and competence (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013). People often engage in intrinsically motivated behaviours on their own, which means that relatedness is not necessarily a detrimental factor for maintaining autonomous motivation and engagement (Vansteenkiste & Ryan, 2013; Jang et al., 2016).

Despite relatedness being less important than autonomy or competence, students and their performance still benefit from relatedness support (Deci & Ryan, 2012). Also, when individual learning situations are not designed to support psychological needs, students may experience
lack of competence when the task difficulty is too high and lack of autonomy when the task is not interesting or important for the student (Jang et al., 2016; Deci & Ryan, 2012).

2.4 Problem-Based Learning

Problem Based Learning begins with an assumption that learning is an active, integrated and constructive process influenced by social and contextual factors (Barrows, 1996; Gijselaers, 1996). It is characterized by a student-centred approach and the role of teachers is as facilitators rather than sources of knowledge. Problems in this approach are open-ended (ill-structured) and serve as the initial stimulus and framework for learning. (Hmelo-Silver, 2004).

Problem-based learning can be conducted in collaborative teams, in tutor groups or individually. While researchers have found that problem-based learning is not always successful (Tawfik & Kolodner, 2016), it has been shown to be more beneficial for knowledge acquisition than lecturing (Wijnen, Loyens, & Schaap, 2016). The method is used to increase student engagement and motivation by putting learners in an active role and foster their interest by revolving around real-life problems (Hmelo-Silver, 2004; Tawfik & Kolodner, 2016). It is also a method that is endorsed by curricula and educators around the world (Vahtivuori-Hänninen et al., 2014; Estonian Lifelong Learning Strategy, 2014; Kuhlthau, et al., 2015; Valiente, 2014; OECD, 2013).

In problem-based learning, students learn by solving problems and then reflecting on their experiences. It helps them to become active learners because it situates learning in real-world problems. Most importantly, it has a dual emphasis on helping learners develop strategies and construct knowledge at the same time (Hmelo-Silver, 2004).

The problem-based learning cycle begins as the students are presented with the problem scenario. They analyse the problem by identifying the relevant facts from this scenario. As students understand the problem better, they develop a hypothesis about the possible solution to this problem. A vital step in this process is identifying knowledge deficiencies relative to the problem. These deficiencies become what can be said as learning issues that students research about during their self-directed learning. Then they apply their new knowledge and gauge their hypothesis. At the end of each cycle, students reflect on their abstract knowledge gained. As it is already mentioned that teachers act as facilitators; they help students to learn cognitive skills required for collaboration and problem solving (Hmelo-Silver, 2004).
Problem-based learning is a popular (Estonian Lifelong Learning Strategy, 2014; Kuhlthau, et al., 2015; Valiente, 2014; OECD, 2013) and effective instructional method (Hmelo-Silver, 2004) that places learning into a real-life context and fosters student motivation and engagement (Wijnen et al., 2016). It requires students to develop factual and conceptual knowledge (Bloom et al., 1984), as well implement that knowledge by developing solutions (Kratwohl, 2002). Problem-based learning can be carried out individually, collaboratively and co-operatively, which is why it’s important to understand the differences of social learning contexts on student performance and well-being, as it would help educators design even better and more effective learning environments.
3 Methods

The current study was conducted in the form of an experiment in an authentic classroom learning environment of Estonian 6th grade students. The data was collected before, during and after a problem-based learning task. The aim of the research was to analyse the learning outcomes and psychological need support of students in collaborative, peer-supported and individual learning contexts, in order to get an insight into how these contexts differ from each other naturally. For that, the classical model of problem-based learning (Hmelo-Silver, 2004) was used and no additional guidance was provided for the students, as only this would have a practical value for teachers and educators alike to know what kind of additional need support students need in order to function and perform well in the classroom.

This chapter describes the aim and objectives of the study, formulates the research questions and arguments the posing of 5 hypotheses. The aims and objectives are followed by a description and argumentation for the choice of research design and participants. Consequently, the data collection process is described and data analysis methods explained and accounted for.

3.1 Aim and Objectives

This research aims to analyse the learning outcomes and psychological need support of students in collaborative, peer-supported and individual learning contexts. Under this general aim, two research objectives were specified.

Previous research shows that there are two things that need to be taken into account in designing learning situations: how does an individual learner construct knowledge and how is this process facilitated or affected by the learning context (Gash, 2015; Moreno, 2010). Failing to consider both of these aspects in designing and assessing learning situations, can easily lead to unsuccessful learning (Nokes-Malach et al., 2015; Toomela, 2007; Moreno, 2010). The first objective of this research is to compare collaborative, peer-supported and individual learning contexts in terms of knowledge construction, work performance and perceived psychological need support.

The level to which three basic psychological needs of autonomy, relatedness and competence are thwarted or supported plays a detrimental impact on the engagement and motivation and, consequently, wellbeing and performance of a learner in any educational setting (Deci & Ryan,
The second objective of this research, therefore, is to analyse the relationship between knowledge construction, work performance and perceived psychological need support across different learning contexts.

In accordance with the aim and objectives of the study, the following research questions were formulated:

1. How is the perceived psychological support of students different in collaborative, peer and individual learning contexts?
2. How is the quality of constructed knowledge different in collaborative, peer and individual learning contexts?
3. How is the quality of performance different in collaborative, peer and individual learning contexts?
4. How is the quality of work performance and knowledge related to the students perceived psychological need support?
5. How is the quality of work performance related to the quality of constructed knowledge?

3.2 Hypotheses

Research has shown that positive school functioning is promoted in social contexts that nurture learners’ psychological needs of autonomy, competence and relatedness (Jang et al., 2009; Vansteenkiste et al., 2004). While there are clear benefits of collaborative learning in perceived competence (Moreno, 2010; Gash, 2015) and relatedness (Ryan & Deci, 2000), students also tend to face challenges of free-riding, and conformity (Toomela, 2007) that can significantly thwart all three psychological needs. Individual learning approaches give control of the learning environment over to the learner and thus support their autonomy and competence (Jang et al., 2016). Peer learning benefits from similar competence and relatedness support as collaborative learning by allowing students to interact with each other and complement each other’s knowledge (Gash, 2015). Additionally, peer learning adds a layer of autonomy support as learners are more independent in choosing their own preferred learning strategies (Jang et al., 2016). Therefore, it is presumed that the psychological needs of students are best supported in peer learning context (1).

The aimed outcome of learning in most academic situations is the construction of new knowledge (Jang et al., 2016; Deiglmayr & Spada, 2011) and the effectiveness of a learning
method should therefore be measured by assessing the achievement of the learning goal by measuring the quality of the constructed knowledge. Research suggests that constructing knowledge in interaction with peers can be beneficial to the learner and has some clear privileges compared to individual knowledge construction (Deiglmayr & Spada, 2011; Gash, 2015). But the process of knowledge co-construction can easily be hindered by suppressed participation, conflict avoidance and negative social interactions (Toomela, 2007). It is expected that students in peer learning context achieve better quality of constructed knowledge than students in collaborative or individual learning contexts (2).

In educational practice, learning performance is often measured according to the quality of the product created during the learning activity. Collaborating peers can be seen as one big information processing unit, where learners make use of each other’s knowledge in meaning making processes (Gash, 2015). This way, learners are able to create a pool of knowledge that no single participant possesses (Deiglmayr & Spada, 2011). While the effectiveness of different social learning methods in individual knowledge construction has not been conclusively proven (Gash, 2015; Deiglmayr & Spada, 2011, Moreno 2010, Nokes-Malach et al., 2015), knowledge co-construction is an active process that allows learners to share the cognitive load among the group members (Moreno, 2010) and approach the task with a complementary approach. Therefore, it is expected that the students in collaborative learning context achieve best quality of work performance (3).

While peer learning appears to be the best way to construct knowledge and support student wellbeing, all three learning contexts – collaborative, peer-supported and individual – have their own benefits for student development. Collaboration skills that are required in today’s knowledge society can only be developed through collaborative practices (Estonian Lifelong Learning Strategy, 2014; Kuhlthau, Maniotes, & Caspari, 2015; Valiente, 2014; OECD, 2013; Gash, 2015) and individualized learning is the only way for the teacher to maximize the efficient achievement of learning goals, as each student constructs knowledge upon a unique set of facts and values (Vygotsky, 1980). This shows that the question is not in whether social learning is beneficial to learning, but rather how and when it is (Nokes-Malach et al., 2015). Self-Determination Theory suggest that these contexts have the potential to be equally effective for student performance and wellbeing if the instructional design supports the three psychological needs of autonomy, relatedness and competence (Ryan & Deci, 2000; Jang et al., 2016). Therefore, it is presumed that the quality of student work performance and knowledge is related to their perceived psychological need support (4).
The necessary precondition of developing and successfully demonstrating skills and abilities is the construction of relevant factual, conceptual, procedural and metacognitive knowledge (Kratwohl, 2002). When students receive external help during learning activities, they are combining their own knowledge with that of someone else and thus creating a good-quality product, without actually having acquired the knowledge necessary for that (Vygotsky, 1980). Therefore, it can be assumed that the quality of work performance is not directly related to quality of constructed knowledge (5).

3.3 Research Design

As this research aims to compare the learning outcomes and psychological need support in collaborative, peer-supported and individual learning contexts, its farther purpose is providing educators and researchers alike with practical and conceptual insights into how these context differ from each other, what they are beneficial for and how they can be enhanced within actual learning environments. It is therefore important for the research context to be as similar to an authentic classroom learning environment as possible.

According to Larsen-Freeman (2016), classroom-oriented research needs to consider learning environments to be complex systems, which makes it very difficult to measure individual variables, but has the value of reflecting the learning process in the way that it takes place in the settings the students learn. Similarly, Kratwohl (1993) claimed that laboratory-based research on learning processes might give some information about the cognitive processes underlying learning and knowledge construction, but it fails to consider the social and environmental factors learners are affected by on an everyday basis in the school environment.

In order to take the complexity of authentic learning environments into consideration, Cohen, Manion & Morrison (2015) suggest that experimental approach is to be taken. They argue furthermore, that the authenticity of such experiments can be further enhanced by assuring the mode of delivery is familiar to the students and the content is as close to their current learning topics as possible. This is why experimental approach was chosen for this study and the topic of the experiment was created in line with the subject area content the students were currently learning about.

Experimental research is a research method where one (Cohen et al., 2015) or more variables are manipulated to see if this produces a change in on or more other variables. In the current
research, 6th grade students were subject to a treatment of problem-based learning method. The manipulated variable was the social learning context: students were solving the problem-based learning task either collaboratively, individually or with the help of their peers. It was then observed how these contexts affected students’ knowledge construction, work performance and psychological need support.

In the theoretical framework of the current research, collaborative, peer and individual learning contexts are defined and described as student-centred contexts, which is why the research had to be designed around a student-centred instructional method that would allow the comparison of the three contexts. Problem-based learning was chosen, as it is, by definition, characterized by a student-centred approach (Hmelo-Silver, 2004) and can be used in all three contexts.

Taking all that into consideration, this research was designed to be an experiment and was planned to be a problem-based history lesson where students were tasked with finding a way that could have saved Socrates from death penalty during his trial. The data collection was planned to take place during a history lesson and the students were currently learning about Ancient Greek culture.

The content of the lesson was created according to the learning outcomes written in the 6th grade history curriculum: “The student knows the characteristics of the culture and life of Ancient Greece”, “The student is able to see and understand the life of people in the past through their eyes”, “The student knows the culturally important people of Ancient Greece”. The content of the lesson was also aligned with students’ prior knowledge, as they already had some general knowledge of life in Ancient Greece, but had not learnt about Ancient Greek philosophers yet. This way, the content of the lesson was new to the students, but was designed to build upon their pre-existing knowledge.

The problem-based learning task was designed according to the model proposed by Hmelo-Silver (2004), where students are presented with a problem scenario and then asked to identify facts, generate hypothesis, identify knowledge gaps and finally apply new knowledge to the problem. The model was used to create a worksheet (Appendix 1) that guided students through the problem-solving process with instructions to the following tasks:

1. Read the scenario
2. Write down what you know about the trial based on the scenario (identify facts)
3. Write down what you think was the problem in the trial of Socrates (generate hypothesis)
4. Write down what you need to find out in order to solve that problem (identify knowledge gaps)
5. Search for answers
6. Brainstorm possible solutions to the problem
7. Propose a final solution to the problem and explain how it solves the problem (apply knowledge to the problem)

The problem-based learning cycle is usually a long-term process where students spend considerable time on doing individual research and finding answers to their research questions (Hmelo-Silver, 2004). The duration of the data collection process was 90 minutes, so the model-based process of problem-based learning was altered a little. Instead of students conducting research on their own by finding relevant resources and looking for information from them, the students in this research were provided with a reading material that they could use to find answers to their questions. The reading material (Appendix 2) was created to cover information relevant to the court trial of Socrates, his life and the context of his life, as per the content and learning objectives of the 6th grade history curriculum. The reading material was developed with keywords to access prior knowledge about the topic and to promote connection between the problem-solving case and general knowledge of Ancient Greek history.

In the theoretical framework of this study, knowledge construction is defined as the personal act of psychological organization of the world that is embedded in the social-cultural environment (Toomela, 1999). Knowledge construction can therefore only be measured by elicitation of the acquired knowledge. A questionnaire (Appendix 3) was created to make the factual and conceptual knowledge (Kratwohl, 2002) of students visible. The questionnaire consisted of one free elicitation question to trigger students’ knowledge about the topic and three open-answer definition questions about the core concepts of the trial of Socrates. Students were expected to fill in the questionnaire before and after the problem-based learning lesson. According to Vygotsky (1980), learning has happened when a student has completely internalized the knowledge of skill and therefore can truly only be measured through free and guided elicitation, which is why such method was chosen to gather data about the constructed knowledge.

The psychological need satisfaction of an individual is subjective and situation-specific (Ryan & Deci, 2000; Ryan & Deci 2012) and the subjective experience of all needs being satisfied is
not one of euphoria or happiness, but rather one of being “okay” (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000; Ryan & Deci 2012). This means that the most exact measure of how much the psychological needs of students are supported or thwarted is the students’ spontaneous expression about their situational affect that is reported either in the present or in retrospective. It is important to note that the psychological need support is situation and context specific, which means that it can vary considerably between contexts and between situations, as even the smallest alteration in the environment can trigger a big difference in the expression of positive or negative affect. Therefore, when asked questions like “How are you?” or “What did you think about this situation”, the responses about negative or positive experiences are the things the students remember the most and therefore the issues that bothered or helped them the most. Ryan & Deci (2002) found that this is especially true when asking from students, as they are less likely to reflect on motivational and emotional issues that were not relevant or especially distinguished.

This is why the pre-test questionnaire (Appendix 3) included a question about whether students normally prefer to work alone or together with their peers and why. The post-test questionnaire (Appendix 3) asked whether students enjoyed working alone or with others during the problem-solving case and why. These questions serve best as the free elicitation of students’ positive and negative affect during the learning experience in retrospective (why they usually like it) and in the present (why they liked it/didn’t like it now).

As Kratwohl (1993) and Larsen-Freeman (2016) recommended, the experiment setting was designed to be as similar to an authentic everyday learning environment as possible to make sure that the setting where data is collected can be recreated in the classroom by a teacher and therefore has practical value for their practice. This was done by planning the data collection to happen in the students’ home classroom together with the classmates they learn with every day. The physical environment would, therefore, be void of any distractions that might affect students’ work and the distractions that are there during their other lessons, would be present during the experiment as well. The design also accounted for reducing the emergence of social factors that might emerge when students are asked to work with strangers or expected to perform in a foreign social environment.
3.4 Participants

The participants were chosen through purposive sampling to make sure that the research results can be used in classroom practice. The data was collected from two classes of an Estonian basic school’s 6th grade students \( N = 43 \) in the form of an experiment. All students agreed to participate in the research and the experiment was carried out with the written consent of parents. The experiment design and implementation were supervised by the history subject teacher to be as similar to an authentic everyday learning environment as possible.

47% \( N = 20 \) of the participants were male and 53% \( N = 23 \) female. The students in the first class \( N = 24 \) were divided into groups of four and worked on the problem-solving case collaboratively. The students in the second class \( N = 19 \) each filled in a personal worksheet and worked either individually \( N = 9 \) or in interaction with their peers \( N = 10 \).

3.5 Data Collection

The data was collected in two classrooms and the process took 90 minutes in total. The students were first asked to answer a pre-test questionnaire (Appendix 3) that was created to measure their prior knowledge about the topic and to assure that the knowledge construction measured in the end of the learning process happened during the experiment and not prior to that.

The students were then presented with a problem-based learning task in the form of a worksheet (Appendix 1) that they were expected to complete in 60 minutes. They also received a reading material to use for information seeking (Appendix 2). Students in the first classroom were divided into groups of four students and asked to work collaboratively on filling one worksheet per team. All students in the second classroom received an individual worksheet and were allowed to choose whether they want to work alone or together with their peers.

All instructions and guiding questions related to the task were written on the worksheet. The students were informed that their work will not affect their grades, but that it will be assessed for research purposes. The students were not instructed to memorize or remember the content and they were not told that their knowledge will be assessed in the end of the lesson. When students had completed the worksheet, they were asked to put all materials away and answer a post-test questionnaire (Appendix 3). Both, the pre-test and post-test questionnaire was filled in individually by all the students.
The researcher was in the role of the teacher and the subject teacher of the students was in the role of the observer. Due to the research aims and design, the role of the researcher in the process was, therefore, very passive. The researcher gave all the above-mentioned instructions, shared the worksheets and questionnaires with the students and answered the additional questions students had during the learning activity.

3.6 Analysis

The data was coded and analysed to assess the quality of constructed knowledge, the work performance and the psychological need support of the students. Theory-based content analysis was used to code the students’ open answers into categories of psychological need support and thwarting. The quality of constructed knowledge and worksheet content were coded into grades according to the assessment criteria of the school’s and the teacher’s everyday practice and the coding system was developed in accordance with the theoretical background of the study.

3.6.1 Coding the Data

The coding categories used to assess the quality of constructed knowledge and the quality of work were adopted from the teacher’s regular assessment and grading practice where “1” refers to “weak”, “2” refers to “unsatisfactory”, “3” refers to “satisfactory”, “4” refers to “good” and “5” refers to “very good”. The first two assessment levels are negative and three latter ones positive. The definitions of the coding categories were created in accordance with Vygotsky’s (1980) theory of knowledge construction and conceptual thinking. According to Vygotsky (1980), the highest level of knowledge is displayed when a student is able to define and describe a concept in a way that is correct, clearly differentiates the concept from other related or similar concepts and when a student is able to complete their reasoning using causal clauses. The two variables, work performance and constructed knowledge, were both used to measure knowledge: the first one measuring the knowledge a student displays with the help of resources and the latter one measuring the knowledge a student has individual constructed. Therefore, Vygotsky’s approach was used in developing the definitions of the coding categories for the coding of both of the phenomena.
The quality of constructed knowledge was assessed according to the relevance, correctness and comprehensiveness of the factual and conceptual knowledge displayed by the learner in pre-test and post-test questionnaires. In accordance with Vygotsky’s (1980) theory, the lowest level of constructed knowledge is displayed when a student’s response is lacking or false and the highest level is displayed when a student’s response is correct and elaborate (Table 1). A student received an individual grade for their answer to each of the four questions in the questionnaires: “What do you know about the trial of Socrates?”, “Who was Socrates?”, “What did Socrates teach?” and “Why was Socrates under trial”.

Table 1. Coding system for quality of constructed knowledge.

<table>
<thead>
<tr>
<th>Coding category</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak</td>
<td>The student did not display any correct knowledge about the trial of Socrates</td>
<td>„I know nothing“ „I have no idea“</td>
</tr>
<tr>
<td></td>
<td>The student did not display any correct knowledge about who Socrates was.</td>
<td>„He was a bad person“ „Socrates was probably a person“</td>
</tr>
<tr>
<td></td>
<td>The student did not display any correct knowledge about what Socrates’s teachings were.</td>
<td>„I don’t know“ „He taught religion“</td>
</tr>
<tr>
<td></td>
<td>The student did not display any correct knowledge about the reasons for which Socrates was under trial.</td>
<td>„I have no idea“ „Because he was evil“</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>The student displayed some knowledge about the trial of Socrates, but it was mostly factually not correct or irrelevant to the content of the lesson.</td>
<td>„This is where Socrates’ fate was decided“ „He was accused“</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>The student</td>
<td>displayed some knowledge about who Socrates was, but it was mainly false or irrelevant to the content of the lesson.</td>
<td>„He was a human being“ „He was a teacher“</td>
</tr>
<tr>
<td></td>
<td>The student displayed some knowledge about what Socrates taught, but it was mainly false, a guess or irrelevant to the content of the lesson.</td>
<td>„He taught philosophy (?)“ „He taught impiety“</td>
</tr>
<tr>
<td></td>
<td>The student displayed some knowledge about the reasons for which Socrates was under trial, but the factual information was mainly incorrect or the provided reason was not the reason for him being under trial.</td>
<td>„He was under trial because taught wrong things“ „He was accused harassing of the youth“</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>The student knew some basic things about the trial of Socrates, but made some factually incorrect claims.</td>
<td>„Socrates was cocky and that’s what got him killed“ „There were no facts against him, but 281 people still voted against him“</td>
</tr>
<tr>
<td></td>
<td>The student displayed some basic knowledge about who Socrates was, but reported some minor incorrect facts or failed to give a factually complete answer.</td>
<td>„He was a philosopher“ „He was a teacher and a philosopher“</td>
</tr>
<tr>
<td>Level</td>
<td>Description</td>
<td>Example</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>Good</td>
<td>The student reported only correct facts about the trial of Socrates, but did not give a comprehensive overview of the trial context, reasons and outcomes.</td>
<td>„Socrates was accused based on rumours and he was sentenced to death“ „281 men voted against him and 220 men voted in favour of him. He was sentenced to death“</td>
</tr>
<tr>
<td>Good</td>
<td>The student displayed factually correct knowledge about who Socrates was, but failed to clearly differentiate him from other philosophers or men of the era.</td>
<td>„He was a philosopher in Ancient Greece“ „He was an Ancient Greek philosopher from Athens“</td>
</tr>
<tr>
<td>Good</td>
<td>The student’s response about the teachings of Socrates was factually correct, but failed to clearly differentiate his teachings from those of other philosophers.</td>
<td>„He taught philosophy and gave advice about how to life your life“ „He taught that you need to understand that you are not wise“</td>
</tr>
<tr>
<td>Average</td>
<td>The student displayed some basic knowledge of what Socrates’ teachings were, but made some minor factual mistakes or failed to give a factually complete answer.</td>
<td>„He taught philosophy on the streets of Ancient Greece“ „He taught philosophy to kids“</td>
</tr>
<tr>
<td>Average</td>
<td>The student knew the basic reasons for Socrates being under trial, but made some incorrect claims or failed to give a factually complete answer.</td>
<td>„He was under trial, because he was not fearful of god“ „People thought he taught with false information“</td>
</tr>
<tr>
<td>Average</td>
<td>The student displayed some basic knowledge of what Socrates’ teachings were, but made some minor factual mistakes or failed to give a factually complete answer.</td>
<td>„He taught philosophy on the streets of Ancient Greece“ „He taught philosophy to kids“</td>
</tr>
</tbody>
</table>
The student’s claims were factually correct and complete, but did not list all the main reasons for Socrates being under trial.

<table>
<thead>
<tr>
<th>Very good</th>
<th>The student displayed correct and comprehensive knowledge about the trial of Socrates. The response included the description of different aspects of the trial.</th>
</tr>
</thead>
</table>
|           | „He was accused of impiety and of influencing the young“  
People believed he guided the youth to the wrong path“  
„Socrates was accused of acting against god’s teachings and of ruining the youth of Athens. He was found guilty and sentenced to death“  
„Socrates was accused based on rumours and 501 citizens comprised the jury who decided over his accusations. Socrates did not have witnesses and was sentenced to death“  
„Socrates was a Greek scholar who lived in the 5.-6. century“  
„He was an Ancient Greek philosopher who shared his knowledge for free on the streets of Athens“  
„Unlike other philosophers, Socrates did not talk about the creation of the world. He showed people that they don’t really know all the things they think they know“ |
<table>
<thead>
<tr>
<th></th>
<th>„Socrates taught that if you are wise, you know that you are not really wise and that if you know what is right, you won’t do anything wrong“</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student displayed factually correct and complete knowledge about the reasons for Socrates being under trial and all the main reasons were reported.</td>
<td>„Socrates was under trial because the circulating rumours claimed that he was different and did not follow the rules“ „Socrates was under trial, because the rumours accused him of impiety and of corrupting the youth of Athens“</td>
</tr>
</tbody>
</table>

For assuring the quality of the data, two reliability coders in addition to the researcher coded the quality of the constructed knowledge according to the abovementioned categories. The percent agreement for the answers to the first questions of “What do you know about the trial of Socrates” was 86%, the percent agreement for the second question of “Who was Socrates” was 93%, the agreement for the third question of “What did Socrates teach?” was 95% and the agreement of the coding of the answers for the fourth question of “Why was Socrates under trial?” was 91%.

The work performance of students was also assessed according to the relevance, correctness and comprehensiveness of the answers on the worksheet, as well as whether students completed all tasks. In accordance with Vygotsky’s (1980) theory, the lowest level of conceptual knowledge is displayed in the worksheet when a student’s response is lacking or false and the highest level is displayed when a student’s response is correct and elaborate (Table 2). Additionally, since one of the tasks in the worksheet required students to give reasons for their answer, the relevance of the causal clauses was considered. The students whose causal clauses were not relevant or did not fully explain the reasons, were coded to perform lower than students who used strong and relevant causal clauses.
Each worksheet was graded according to the criteria described in Table 2 and each individual student received a work performance grade according to the worksheet that they filled. All students in collaborative groups received the work performance grade of the worksheet that their group filled in.

Table 2. Coding system for quality of work performance

<table>
<thead>
<tr>
<th>Coding category</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weak</td>
<td>All tasks are not completed. Most of the factual information in the answers is incorrect. The formulated problem is not relevant to Socrates’ trial. The offered solution would not solve the problem and is not argued.</td>
<td>„I don’t know anything. Socrates was a person. Socrates was a drunkard“ „I don’t know what the problem was“ „The solution would be a bribe“</td>
</tr>
<tr>
<td>Unsatisfactory</td>
<td>All tasks are completed, but most of them not according to instructions. There are significant factual mistakes in the answers to the worksheet. The formulated problem is not completely relevant to the trial. The offered solution does not completely solve the problem and is not argued.</td>
<td>„I don’t know anything. Socrates was a philosopher“ „The problem was that Karl wasn’t there“ „The solution would be to create a time machine, because that’s the only idea I have“</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>The tasks are completed, but some of them are not completed according to instructions. The factual information written in the worksheet is mostly correct.</td>
<td>„The accuser of Socrates was spreading rumours of Socrates to get sentenced to death“ „The problem was that the people who saw him should have convinced the judges“</td>
</tr>
<tr>
<td>Level</td>
<td>Description</td>
<td>Example</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Formulated problem is generally relevant to the trial. The offered solution has potential to solve the problem, but is poorly argued.</td>
<td>„The solution would be to create a time machine and to go there with many people and save Socrates“</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>The tasks are completed according to instructions, but the answers are not elaborate. The factual information written in the worksheet is correct. The formulated problem is relevant to the trial. The offered solution has potential to solve the problem, but is not well argued.</td>
<td>„His accuser was Meletus. Socrates was accused of impiety and of corrupting the youth of Athens“ „The problem was that Socrates was sentenced to death, even though he proved with facts that he is not guilty“ „Socrates could have been saved if he had proposed a more harsh sentence for himself, because that’s what the jury wanted“</td>
</tr>
</tbody>
</table>
| Very good | The tasks are completed according to instructions and the answers are elaborate. All the factual information in the worksheet is correct and complete. The problem is well formulated and relevant to the trial. The solution has potential to solve the problem and is very well argued. | „Socrates was found guilty unfairly. There were no facts to prove his guilt. He was sentenced to death“ „The problem was that Socrates was sentenced to death solely based on rumours“ „The problem could have been solved by popularizing Socrates among the people, so that they would understand him and know that the rumours weren’t true. Because if more people had voted in his favour, he
would not have been sentenced to death“

Two reliability coders were also used to uphold the reliability of the coding of worksheet answers. The percent agreement of the coders in grading the worksheets was 88%.

Theory-driven content analysis was also used to interpret the data from the students’ open answers to the questions “Why do you usually like to work alone/with others” and “Why did you/didn’t you like working collaboratively/with peers/alone?”. The coding categories and their definitions were developed according to the theoretical framework of basic psychological needs (Ryan & Deci, 2000) within Self-Determination Theory (Deci & Ryan, 2012). The answers were coded according to the basic psychological needs of autonomy, competence and relatedness. The answers were assigned to one of 6 categories: autonomy support, lack of autonomy, relatedness support, lack of relatedness, competence support and lack of competence, as described in Table 3.

Table 3. Coding system for perceived psychological need support.

<table>
<thead>
<tr>
<th>Coding category</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy support</td>
<td>The student reports taking decisions over his own learning by choosing preferred ways, displaying initiative or having other type of options.</td>
<td>„I got to do this my own way“ „It was nice to discuss and come up with different ideas and solutions“</td>
</tr>
<tr>
<td>Lack of autonomy</td>
<td>The student reports pressure, external demands and inability to take decisions over his own learning.</td>
<td>„The task was pointless“ „I couldn’t even read the instructions“</td>
</tr>
<tr>
<td>Relatedness support</td>
<td>The student reports personal care and support,</td>
<td>„Our team was really cool“ „I was able to chat with my friends“</td>
</tr>
<tr>
<td>Lack of relatedness</td>
<td>The student reports bullying or bad relationships, social insecurity and indifference of peers.</td>
<td>„We had a bad team“ „The team members kept blaming me“</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Competence support</td>
<td>The student reports good coping with the task, being useful or overcoming challenges.</td>
<td>„If I didn’t understand something, I could ask for help“ „We complemented each other’s knowledge“</td>
</tr>
<tr>
<td>Lack of competence</td>
<td>The student reports task difficulty, uselessness or struggle.</td>
<td>„It would have been easier and quicker if I did it together with others“ „Some team members didn’t work at all“</td>
</tr>
</tbody>
</table>

Reliability coding was also done for coding the open answers into perceived psychological need support or thwarting. Two reliability coders coded the data in addition to the researcher and the percent agreement of the coders was 84%. Additionally, the answers referring to negative affect were grouped together and coded as “need thwarting” and the answers referring to positive affect were grouped together and coded as “need support”.

3.6.2 Statistical Analysis

The data was then analysed with IBM SPSS Statistics 24. Descriptive statistics were displayed with the help of frequency tables, percentages, means and standard deviations. ANOVA, Chi-Square Test, Fischer’s Exact Test and Pearson Correlation were used to measure the statistical significance of the findings. The statistical significance level for all the tests was $\alpha = .05$.

One-Way Analysis of Variance (ANOVA) was used to compare the average grades of the three learning contexts. However, ANOVA’s accuracy depends on the population normality
and normal distribution of the data, which was impossible to provide with the small sample size of this research. Therefore, the non-parametric Chi-Square Test was also used to compare the distribution of grades across the learning contexts. ANOVA was also used to compare the average grades of students reporting psychological need support and thwarting, but Chi-Square Test was used additionally for the abovementioned issue. Chi-Square Test was also used to compare the counts of psychological need support between the three learning contexts. However, the prerequisite of the Chi-Square Test is that the observed and expected cell numbers are bigger than 5 in more than 80% of the cases, which wasn’t the case when comparing all 6 categories of psychological need support across learning contexts. This is why Fischer’s Exact Test was used to evaluate the statistical significance of the difference there. Pearson’s Correlation Coefficient was used to measure the linear correlation of work performance and quality of constructed knowledge.
4 Results

The data was gathered from $N = 43$ 6th grade students from one Estonian basic school. The data was collected in two classes. In the first class the students worked as groups of 4 in a collaborative learning context ($N = 24$). In the second class, the students worked individually in a peer learning context ($N = 10$) or an individual learning context ($N = 9$).

Prior to the learning task, the students in all learning contexts were asked whether they usually prefer to study alone or in groups and why. 74% ($N = 32$) of the students stated that they usually prefer working together with others, as opposed to the 26% ($N = 11$) who prefer individual learning activities. The reported preference was similar in both classrooms: 71% ($N = 17$) of students in the first class and 79% ($N = 15$) of students in the second class prefer to work together with other students. The difference was statistically significant ($\chi^2(1, N = 41) = 10.26, p < .05$). Students who claim to usually prefer individual learning activities, do so due to perceived autonomy support and the students who prefer group learning claim the reasons to be mostly related to relatedness and competence support.

64% ($N = 7$) of the students who prefer working alone claim that to be due to heightened autonomy (“No one disturbs me”, “I can focus on my own work”, “There is no one else to blame”). 27% ($N = 3$) of students who prefer individual learning, seem to prefer it due to its support on their perceived relatedness, as it makes them feel socially more secure (“No conflicts”, “It’s not easy to work with some people”). Only one student reported individual learning to be competence supportive (“It’s a lot faster to learn alone”).

Out of the students who claim to usually prefer group learning, 46% ($N = 12$) reason it to be due to relatedness support (“It’s fun”, “I like working with others”, “Then I have at least some motivation”) and 50% ($N = 13$) claim the reason to be competence support (“It’s easier together”, “It’s okay if I don’t know everything”, “We can think together”). Only one student claimed to like group learning due to autonomy support (“I can express my opinion and we complement each other’s thoughts”).

After the learning task was completed, the students were inquired about whether they liked working individually, collaboratively or with peers. The results showed that 61% ($N = 26$) of the students enjoyed the learning activity and 39% ($N = 17$) did not. 61% ($N = 26$) of students reported psychological need support and 35% ($N = 15$) of them reported psychological need thwarting as the reason for liking and not liking the problem-based learning task within their
learning context (collaborative, peer or individual learning). Competence support and thwarting was reported the most (Table 4).

Table 4. Reported psychological need support and thwarting.

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy support</td>
<td>7</td>
<td>16,3</td>
<td>17,1</td>
</tr>
<tr>
<td>Lack of autonomy</td>
<td>4</td>
<td>9,3</td>
<td>9,8</td>
</tr>
<tr>
<td>Relatedness support</td>
<td>8</td>
<td>18,6</td>
<td>19,5</td>
</tr>
<tr>
<td>Lack of relatedness</td>
<td>2</td>
<td>4,7</td>
<td>4,9</td>
</tr>
<tr>
<td>Competence support</td>
<td>11</td>
<td>25,6</td>
<td>26,8</td>
</tr>
<tr>
<td>Lack of competence</td>
<td>9</td>
<td>20,9</td>
<td>22,0</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>95,3</td>
<td>100,0</td>
</tr>
<tr>
<td>Missing System</td>
<td>2</td>
<td>4,7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>100,0</td>
<td></td>
</tr>
</tbody>
</table>

4.1 Psychological Need Support in Different Contexts

The first research question of this study was the following: How is the perceived psychological support of students different in collaborative, peer and individual learning contexts? The posed hypothesis was that the psychological needs of students are best supported in peer learning context (1). The empirical data supported this hypothesis. All students ($N = 10$) in peer learning context reported psychological need support and none of them reported psychological need thwarting. In collaborative learning, psychological need support was reported by 50% ($N = 12$) of students and only 33% ($N = 3$) of students reported need support in individual learning context. The difference of the three learning contexts in psychological need support was statistically significant ($\chi^2(4, N = 41) = 10.54, p < .05; V = .35, p < .05$). The difference of the three contexts was also statistically significant ($p = .02$) when viewed separately according to the support and thwarting of each of the three needs of autonomy, relatedness and competence (Table 5).
Table 5. Student reported autonomy, relatedness and competence support and thwarting across learning contexts.

<table>
<thead>
<tr>
<th></th>
<th>Collaborative learning</th>
<th>Peer learning</th>
<th>Individual learning</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>4,2%</td>
<td>30,0%</td>
<td>22,2%</td>
</tr>
<tr>
<td>Autonomy support</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of autonomy</td>
<td>Count</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>8,3%</td>
<td>0,0%</td>
<td>33,3%</td>
</tr>
<tr>
<td>Relatedness support</td>
<td>Count</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>16,7%</td>
<td>40,0%</td>
<td>0,0%</td>
</tr>
<tr>
<td>Lack of relatedness</td>
<td>Count</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>4,2%</td>
<td>0,0%</td>
<td>11,1%</td>
</tr>
<tr>
<td>Competence support</td>
<td>Count</td>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>29,2%</td>
<td>30,0%</td>
<td>11,1%</td>
</tr>
<tr>
<td>Lack of competence</td>
<td>Count</td>
<td>8</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>33,3%</td>
<td>0,0%</td>
<td>11,1%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>23</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

In peer learning, students claimed to benefit similarly from autonomy (30%), relatedness (40%) and competence (30%) support. Reported autonomy support in peer learning was mostly related to the option to discuss with others ("It’s nice to be able to discuss with others", "I was able to talk to other students"), relatedness support in peer learning was expressed by positive social affect ("It was fun", "It was nice to work together") and competence support appeared in being able to build on each other’s ideas ("We complemented each other’s knowledge", "If I didn’t know the answer, someone else did").

In collaborative learning, only 17% of the students reported relatedness support and others were divided on competence support (29%) and competence thwarting (33%). Students found collaborative learning to be supportive of their competence as they found the learning task to be easier when done together ("It was easier together", "I didn’t have to do everything alone") but at the same time, students also reported a lack of competence in collaboration as they were frustrated with the usefulness of the team members ("Two team members did nothing", "Some students didn’t work at all"). Only 4 students reported relatedness support by claiming they enjoyed working together ("We had fun together", "The company was good").
In individual learning, students mostly reported autonomy support (22%) and autonomy thwarting (33%). Students found individual learning to be autonomy supportive mainly due to being able to do things their own way ("I got to work in silence", "I was able to work at my own tempo") and autonomy need thwarting was reported mostly due to being forced to work ("I don’t like worksheets", "I didn't have motivation to work").

### 4.2 Quality of Constructed Knowledge

The second research question of this study was the following: How is the quality of constructed knowledge different in collaborative, peer and individual learning contexts? The posed hypothesis was that **students in peer learning context achieve better quality of constructed knowledge than students in collaborative or individual learning contexts** (2). The data supported this hypothesis. The average grade for knowledge in peer learning context ($M = 3.70$; $SD = .82$) was higher than in collaborative ($M = 3.41$, $SD = .65$) or individual ($M = 3.22$, $SD = 1.09$) learning context. Also, it is noteworthy that 70% of students in peer learning context received a grade of “good” or “very good”, as opposed to 42% of students in collaborative context and 44% of students in individual learning context (Table 6). This difference is important, because grades “good” and “very good” refer to the highest levels of knowledge as students are able to define and describe concepts correctly and thoroughly. Grade “good” was received for replies like “Socrates was under trial because he was accused of impiety and of giving bad advice to the young” or “Socrates taught philosophy to the youth and gave advice about how to live your life” that are factually correct, but lack strong causal relations or specific context, unlike the answers that received the grade “very good”: “Socrates was under trial, because the rumours accused him of impiety and of corrupting the youth of Athens” or “Socrates taught to people that they think they are wise and know a lot, but showed that they don't actually know it all when he asked them some simple questions”.

The students working in individual learning context performed the worst in terms of constructed knowledge, as 33% of them received a grade of “unsatisfactory”, as opposed to 4% of students in collaborative learning and 10% of students in peer learning. The grade “unsatisfactory” refers to one of the lowest levels of knowledge, where students are not able to display factually correct nor elaborate explanations of concepts: “Socrates was un trial probably because he taught with wrong information” or “Socrates taught people to not be fearful of god”. It’s also significant that 54% ($N = 13$) students in collaborative learning context received a “satisfactory” grade, as
the grade is the lowest positive grade and also refers to a lack of through and completely correct understanding with answers like “Socrates was under trial, because he was not fearful of god” or “Socrates mostly taught philosophy”.

Table 6. Distribution of conceptual knowledge grades among learning contexts.

<table>
<thead>
<tr>
<th>Learning context</th>
<th>Collaborative learning</th>
<th>Peer learning</th>
<th>Individual learning</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsatisfactory</td>
<td>Count</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>4,2%</td>
<td>10,0%</td>
<td>33,3%</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>Count</td>
<td>13</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>54,2%</td>
<td>20,0%</td>
<td>22,2%</td>
</tr>
<tr>
<td>Good</td>
<td>Count</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>37,5%</td>
<td>60,0%</td>
<td>33,3%</td>
</tr>
<tr>
<td>Very good</td>
<td>Count</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>4,2%</td>
<td>10,0%</td>
<td>11,1%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>24</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

The differences in grade means across the three learning contexts were not statistically significant \( (F(2,40) = .88, p > .05) \) and the difference of knowledge grade distribution between learning contexts was not statistically significant either \( (p = .25) \). However, the lack of generalizable results is greatly due to the very small sample size and lack of normal data distribution. The differences in quality of knowledge construction were visible through descriptive statistics and that data suggests that in the case of a larger sample, the results might also be generalizable.

4.3 Quality of Work Performance

The third research question of this study was the following: How is the quality of performance different in collaborative, peer and individual learning contexts? The posed hypothesis was that the students in collaborative learning context achieve the best quality of work performance (3). The data supported this hypothesis. The average grade for worksheet in collaborative learning context \( (M = 4.70; SD = .51) \) was higher than in peer \( (M = 4.20, SD = 1.23) \) or individual \( (M = 3.89, SD = 1.17) \) learning context. The average grade difference between the
three contexts was not statistically significant ($F(2,40) = 1.69, p > .05$), which was, again, most likely due to a lack of normal distribution and large enough sample.

However, all (100%) students in collaborative learning context received a grade of “good” or “very good” for the worksheet (Table 7). In peer learning, the grades of “good” or “very good” were awarded to 80% of and in individual learning, only 56% of the students. The grade “good” was awarded to a worksheet that was filled in correctly and displayed the learner’s ability to write relevant answers and causal clauses such as “The problem with Socrates’ trial was that the people trusted the rumours and not the facts” or “Socrates could have been saved from death by having witnesses, because the jury might have believed them”. The grade “very good” was the highest possible grade and was awarded to worksheets that were thoroughly correct and displayed an ability to write strong causal clauses like “The problem with Socrates’ trial was that the jury did not care about the lack of factual evidence” or “If Socrates had changed his behaviour and attitude in the court, he would have had a chance to be saved from death, because people and the jury would have liked that”.

Table 7. Distribution of worksheet grades among learning contexts.

<table>
<thead>
<tr>
<th>Learning context</th>
<th>Collaborative learning</th>
<th>Peer learning</th>
<th>Individual learning</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsatisfactory</td>
<td>Count: 0</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>%: 0,0%</td>
<td>20,0%</td>
<td>11,1%</td>
<td>7,0%</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>Count: 0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>%: 0,0%</td>
<td>0,0%</td>
<td>33,3%</td>
<td>7,0%</td>
</tr>
<tr>
<td>Good</td>
<td>Count: 12</td>
<td>2</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>%: 50,0%</td>
<td>20,0%</td>
<td>11,1%</td>
<td>34,9%</td>
</tr>
<tr>
<td>Very good</td>
<td>Count: 12</td>
<td>6</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>%: 50,0%</td>
<td>60,0%</td>
<td>44,4%</td>
<td>51,2%</td>
</tr>
<tr>
<td>Total</td>
<td>Count: 24</td>
<td>10</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>%: 100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

No student received a negative grade in collaborative learning context, as opposed to 20% of students in peer learning and 11% of students in individual learning whose work was rated as “unsatisfactory”, due to the irrelevance and factual incorrectness of the worksheet answers like “The problem with Socrates’ trial was Karl wasn’t there” or “The solution would be to build a time machine”. Students in individual learning context were also the only ones to receive a
grade of “satisfactory” that refers to a lack of factual correctness and reasoning in the worksheet answers like: “The problem with Socrates’ case was that the people who saw Socrates should have convinced the jury” or “Socrates could have been saved from death if he had asked for a harsher punishment”.

The distribution of worksheet grades among the learning contexts was statistically significant ($p = .05$). Students in peer learning context appeared to perform the worst, as 20% of them received a grade of “unsatisfactory”, as opposed to 11% of students in individual learning and none of the students in collaborative learning.

4.4 Performance, Knowledge and Need Support

The fourth research question of this study was the following: How is the quality of work performance and knowledge related to the students perceived psychological need support? The posed hypothesis was that the quality of student work performance and knowledge construction is related to their perceived psychological need support (4). The empirical data supported this hypothesis. The average grade of knowledge ($M = 3.54$, $SD = 0.81$) and worksheet ($M = 4.46$, $SD = .99$) of students who reported psychological need support was higher than the average grade of knowledge ($M = 3.40$, $SD = .74$) and worksheet ($M = 4.13$, $SD = .64$) of students who reported psychological need thwarting. While parametric statistical relevance tests again failed to produce positive results ($F(1,39) = .30$, $p > .05$; $F(1,39) = 1.32$, $p > .05$), the non-parametric tests, that are more suitable for the sample of this research, showed different results.

The relationship between psychological need support and conceptual knowledge grades was statistically significant ($\chi^2(3, N = 41) = 12.09$, $p < .05$; $V = .27$, $p < .05$). The relationship between psychological need support and worksheet grade was also statistically significant ($\chi^2(3, N = 41) = 13.04$, $p < .05$; $V = .57$, $p < .05$).

Psychological need support was reported by 72% of students who received a grade of “4” and by 67% of students who received a grade of “5” for conceptual knowledge (Table 8). 82% of students who received a grade of “5” for the worksheet, reported psychological need support (Table 9).
Table 8. Conceptual knowledge grades according to reported psychological need support.

<table>
<thead>
<tr>
<th>Student reported need support or thwarting</th>
<th>Need support</th>
<th>Need thwarting</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsatisfactory</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>%</td>
<td>75,0%</td>
<td>25,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>%</td>
<td>50,0%</td>
<td>50,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Good</td>
<td>13</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>%</td>
<td>72,2%</td>
<td>27,8%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Very good</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>%</td>
<td>66,7%</td>
<td>33,3%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>15</td>
<td>41</td>
</tr>
<tr>
<td>%</td>
<td>63,4%</td>
<td>36,6%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

Table 9. Worksheet grades according to reported psychological need support.

<table>
<thead>
<tr>
<th>Student reported need support or thwarting</th>
<th>Need support</th>
<th>Need thwarting</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsatisfactory</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>%</td>
<td>100,0%</td>
<td>0,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>%</td>
<td>0,0%</td>
<td>100,0%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Good</td>
<td>5</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>%</td>
<td>35,7%</td>
<td>64,3%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Very good</td>
<td>18</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>%</td>
<td>81,8%</td>
<td>18,2%</td>
<td>100,0%</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>15</td>
<td>41</td>
</tr>
<tr>
<td>%</td>
<td>63,4%</td>
<td>36,6%</td>
<td>100,0%</td>
</tr>
</tbody>
</table>

4.5 Work Performance and Knowledge Construction

The fifth research question of this study was the following: How is the quality of work performance related to the quality of constructed knowledge? The posed hypothesis was that the
quality of work performance is not directly related to the quality of constructed knowledge (5). The data supported this hypothesis. Students received overall higher grades for conceptual knowledge after lesson than they did before the lesson and received the highest grades for worksheets (Table 10). There was a weak statistically significant positive correlation ($r = .31, p < .05$) between the grade given for conceptual knowledge and the grade given for the completion of the worksheet. Since the correlation was weak, the relationship was also tested for three learning contexts separately. However, the correlation was not statistically relevant when viewed separately for collaborative learning ($r = .39, p > .05$), peer learning ($r = .50, p > .05$) and individual learning ($r = .50, p > .05$), in which case there is no basis to claim that a good grade for work performance predicts a good grade for knowledge construction. The biggest average grade difference between knowledge grade ($M = 3.42, SD = .65$) and worksheet grade ($M = 4.5, SD = .51$) appeared in collaborative learning context.

Table 10. Average grades for knowledge and worksheet across learning contexts.

<table>
<thead>
<tr>
<th>Learning context</th>
<th>Conceptual knowledge grade before lesson</th>
<th>Conceptual knowledge grade after lesson</th>
<th>Grade for worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative learning</td>
<td>Mean</td>
<td>1.13</td>
<td>3.42</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.338</td>
<td>.654</td>
</tr>
<tr>
<td>Peer learning</td>
<td>Mean</td>
<td>1.30</td>
<td>3.70</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.675</td>
<td>.823</td>
</tr>
<tr>
<td>Individual learning</td>
<td>Mean</td>
<td>1.33</td>
<td>3.22</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.000</td>
<td>1.093</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>1.21</td>
<td>3.44</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.600</td>
<td>.796</td>
</tr>
</tbody>
</table>

4.6 Summary of the Results

The results clearly show that the psychological needs of students are most supported in peer learning, as all students in that context reported psychological need support. The support of the three needs of autonomy, relatedness and competence were reported almost equally by
students in the peer learning context. The students in the collaborative learning context mostly reported either competence support or competence thwarting. In individual learning context, the majority of students reported either autonomy support or autonomy thwarting during the lesson.

The results also show that the highest quality of knowledge was constructed in peer learning context, as the majority of students received an either “good” or “very good” grade for the knowledge they displayed. The lowest quality of knowledge was displayed in individual learning context. It was also noteworthy that half of the students in collaborative learning context received merely a grade of “satisfactory”.

The best work performance was found to be by students in collaborative learning context, as all of them received a grade of “good” or “very good” for the worksheets. Students in peer learning context performed almost equally well, but had also a conflicting result of the most “unsatisfactory” worksheets. However, the average grade of worksheets was the lowest in individual learning context.

The results clearly show that the perceived psychological need support is related to better academic outcomes in both, knowledge construction and work performance. But it is also evident from the results that good work performance does not predict high quality knowledge construction.

In some cases, the sample turned out to be too small to make generalizations about the results when analysed with parametric tests that assume normal distribution of the data. However, the descriptive statistics and non-parametric statistical significance tests supported all of the hypotheses and suggest that the results can also be generalized to the wider public.
5 Discussion

There is an ongoing debate among researchers over whether collaborative and other student-centred learning methods are actually beneficial for learning, despite the methods being around and used for decades. Recent policies (OECD, 2013; Estonian Lifelong Learning Strategy, 2014) and national curricula (Vahtivuori-Hänninen et al., 2014; Kuhlthau et al., 2015) all around the world are putting more and more emphasis on learning to solve problems together, planning and guiding one's own work and developing co-operation skills, as the students of today will need all that to cope with their future careers and lives in the 21st century.

The world of tomorrow expects young people to have the skills to collaborate creatively and these skills can only be acquired through collaborative practice in school, as this is where students spend a very big part of their time on a daily basis. On the other hand, individual learning methods are necessary to truly assure the cognitive development of students (Vygotsky, 1980) since the way each individual student to reaches an understanding or a new level of skill is different (Gredler, 2012; Vygotsky, 1980). Peer learning, however, is a way to make use of students’ different prior knowledge in formal learning environments and also assure that they get necessary need in their cognitive development whenever needed (Gredler, 2012). All these methods are perfect representations of professional interdisciplinary co-operation in working environments and therefore necessary in the classroom, since that’s exactly what formal education should prepare the students for.

Therefore, there is no question about whether collaborative, peer and individual learning contexts have or should have a place in the classroom. The questions lies with how to maximise the learning experience in all three of them. This paper argues that while all three contexts have their faults and challenges, they can all be designed to be more supportive of learning and knowledge construction by focusing on supporting the psychological needs of students.

The aim of this research was to analyse the learning outcomes and psychological need support of students in collaborative, peer-supported and individual learning contexts. The results of the current research shed light onto how students perceive all of these learning contexts to support or thwart their basic psychological needs and how that influences their academic performance. The results are therefore an indicator of how the learning contexts themselves are beneficial to the students and what could teachers do to support the students’ their well-being and, consequently, effective knowledge construction in different learning contexts. Therefore,
the findings can guide teachers in designing effective collaborative, peer and individual learning contexts.

The first important finding of this study was that psychological need support does matter and that the students whose needs are supported, construct higher quality knowledge and create higher quality products. This finding confirms theory, since according to Self-Determination Theory (Ryan & Deci, 2000), positive school functioning is determined by the psychological need support students receive. This claim has also found empirical validation, as researchers have found higher levels of autonomy, relatedness and competence support to predict good learning outcomes (Jang et al., 2009; Vansteenkiste et al., 2004).

The perceived psychological need support refers to an individual’s evaluation of how well his environment allows him to function well – to what extent can he affect his own behaviour in the environment, to what extent he received social support and care and to what extent he is capable of meaningfully engaging with the environment. While the theory posits that the satisfaction of all three needs is essential for well-being, the most researched (Jang et al., 2016) need in academic environments, is the student’s need for autonomy. The reason for that being the novelty of giving students a choice in the classroom setting. The focus of competence support in the classroom is in creating tasks that are challenging enough for students to not be bored and simple enough for them to be able to solve them. This is what curriculum design and teachers’ tasks are based on and that is also what the social constructivist theory claims (Vygotsky, 1980). There is no novelty in or discussion about the topic. Same goes for relatedness support – teachers, researchers and parents alike would agree that a good social classroom environment, where students support and care for each other, is essential for the well-being of a child in the learning environment. Autonomy support, on the other hand, refers to a student perceiving that they are able to take their own decisions about their learning behaviour. But that is a very difficult endeavour for teachers in both, traditional and student-centred learning situations.

According to Jang et al. (2016), autonomy support starts with giving the students a chance to learn the way they would like to. Most students in current research claimed to usually enjoy working with others more than working alone, which suggests that group learning methods should be preferred against individual learning methods, in order to support student autonomy. However, almost a quarter of students claimed that they prefer to work individually and if a group method is forced on students who dislike it, their autonomy need is thwarted. The same
happens when there is a need for students to work on their own, but they would rather prefer to work together.

While it is important to consider the needs of all student, the entirety of learning content and methods can’t be designed to be exactly what the students want. But what the teacher can do, is to create a learning environment that allows students to understand why that content or method is important, what makes it relevant to the students’ lives or how it can be fun and interesting. This can be done in several ways: by discussing the goals with the students or setting the goals together with them; by allowing students to decide the order in which they solve the math problems; by allowing a grammatically correct essay to be written about a topic of their interest.

As the question is not whether to use one learning context over the other, but how to use them in a way that supports positive school functioning (Jang et al, 2016; Nokes-Malach et al., 2015), it is important to understand how the different learning contexts support students’ psychological needs and what kind of support they are lacking.

The second important finding of this study was that collaborative, peer and individual learning contexts do differ from each other in the support and thwarting of students’ psychological needs, which means that the type of support, guidance and intervention students need from the teacher is different in the three contexts.

Collaborative learning is generally regarded as an effective way of learning (Deiglmayr & Spada, 2011; Guthrie et al., 2015), as students act together as a single information processing unit to distribute the cognitive load (Moreno 2010) of the task and build a pool of group knowledge that no single learner possesses (Gash, 2015). When students are able to discuss with each other, their perceived task difficulty decreases (Gash, 2015) and perceived competence increases (Deci et al., 1991). Collaborating peers are often also faced with a variety of challenges (Nokes-Malach et al., 2015) as students free-ride, ignore each other’s opinions or rely only on dominant voices in taking decisions (Deiglmayr & Spada, 2011; Gash, 2015; Kirschner et al., 2006). If a student feels that their participation is not making a contribution to the team work, they feel a lack of competence (Deci & Ryan, 2012). The results of this research shed light on this exact issue: collaboration can easily either support or thwart a learner’s need for competence. As competence need refers to the need to feel that one’s actions are useful in the learning environment, it is usually granted by assuring that the tasks are optimally challenging for the students. However, in collaboration, the perceived competence is highly affected by
the presence of others, as many students in the current study reported that they were not able to work well because of their team members. On the other hand, collaborating students also reported competence support, as the presence of other students made the task seem easier. It is, therefore, up to the teacher to shape collaborative learning methods in a way that promotes equal contribution and to be attentive during the collaboration process and to intervene before the thwarting of competence need results in stress and negative learning outcomes. This is especially necessary in cases where students don’t like working with others, but nevertheless are required to develop collaboration skills.

Individual learning is perhaps the learning context with the biggest potential to be autonomy-supportive, as students are able to take all decisions alone (Deci & Ryan, 2012). But autonomy does not only refer to the independence of the learner in choosing the best method, it also refers to the student’s perception of the locus of control over the learning environment in general (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000). So, when the student is only given a choice over which pen to use or at which table to sit, it is autonomy supportive, but it is simply a small part of the student’s learning behaviour within the learning environment and when student choice and interest is disregarded in the content and method of the learning, the situation is more autonomy thwarting than autonomy supportive. In the current study, the students in individual learning contexts reported almost equally autonomy support and autonomy thwarting and this serves as an indicator that the amount of student choice should be considered relatively to the entirety of decisions taken within the learning environment and when most decisions are taken by the teacher, the environment will not be perceived as autonomy supportive (Reeve, 2012). However, that doesn’t mean that students should be able to decide what to learn and what not to learn. It means that they should be included in the decision-making process.

Peer learning seems to benefit from the positive aspects of both, individual and collaborative learning, as students are able to take their own decisions and are able to ask others for help whenever they need to. In this study, the students in peer learning context reported support to all the three psychological needs and none of them reported any need thwarting. However, nothing is perfect and the downside of peer learning is that it lacks the social pressure that makes the outcome of collaborative work thorough and creative.

The third important finding of this study was that the quality of students’ work is not necessarily an indicator of the quality of the knowledge they have constructed. This was especially evident in collaborative learning context, as these students created the best and most creative solutions,
but the constructed knowledge they displayed in the end of the lesson, was of a much lower quality. This indicates two things: collaborative learning has its clear benefits and work performance is not an indicator of constructed knowledge.

The achievement of learning outcomes can be measured by different indicators of student performance (Bloom et al., 1984; Kratwohl, 2002). In many cases, the performance is measured by both, the quality of the created product and the quality of constructed knowledge, because they both are often relevant to the learning goals. But learning refers to different changes in an individual’s psyche (Toomela, 1999; Toomela 2007) and in academic contexts, the focus is mostly on measuring the constructed knowledge: what does a student know by the end of the lesson, week or year. Knowledge can only be created by an individual (Toomela, 2007; Toomela 1999; Vygotsky, 1980) and can therefore only be measured individually, which means that the acquired knowledge of a student can only be measured by individual elicitation.

This study supports the claims made by other researchers (Kratwohl, 2002; Nokes-Malach et al., 2015; Mega et al., 2013), that the quality of a product does not determine the quality of acquired knowledge. The reasons for that vary: copying text from the book, not participating in group work, getting help from other students. This is very well demonstrated by the results of this research, where the biggest difference between grades received for the worksheet and conceptual knowledge appeared in collaborative learning. This is not to say that products shouldn’t be measured. On the contrary, learning products need to be held to a certain quality for learners to know what is expected from them in the learning context (Jang et al., 2016). However, assessment of learning also needs to measure what exactly learners know and are able to do and that is often not visible in the created products.

However, the big difference in the quality of product and quality of constructed knowledge in collaborative learning is also an indicator of what the biggest benefit of collaborative learning is. Namely, the students in collaborative groups came up with the most creative solutions to the problems and displayed the most comprehensive critical thinking in the worksheet. This shouldn’t be a surprising finding for any researcher in the field of collaboration, as there is considerable empirical support for this claim (Gash, 2015; Blasco-Arcas et al., 2013; Deiglmayr & Spada, 2011; de Vries et al., 2016). Collaboration has been argued by many to be beneficial due to the enhancement of one’s pool of knowledge by processing information as a group, rather than as an individual. And this is also why groups are able to be more critical and more creative,
especially in situations that are challenging or situations where the group members’ knowledge complements that of each other’s.

But due to the many challenges of collaboration, researchers are still divided over whether collaborative learning should be used in schools or not. However, considering the findings of this study and observing the learning contexts from the perspective of psychological need support and the perspective of academic performance, it can be concluded that collaborative, peer and individual learning contexts each have their own benefits and faults, but they all have a purpose in the classroom and they can all be designed to be more effective by understanding what kind of support students need.

Prior to this study, there was lack of research that compared different social learning contexts in the same methodological framework and compared the impact of the social environment on student performance. While this research was conducted on a relatively small sample, it did confirm theory and demonstrated that each context is beneficial in its own way. Altogether, the findings of this study serve as practical advice for teachers, confirmation of the findings of previous studies and suggestions and grounding for future research.
6 Evaluation

In this chapter, the critical evaluation of this study is presented. The reliability, validity and ethicality of the study are discussed from different aspects and limitations of the research are considered. Additionally, ideas and suggestions for future research and development of the research method are offered.

6.1 Reliability and Validity

To analyse the reliability and validity of the current study, the concepts of internal validity, construct validity, external validity and reliability are discussed. Internal validity is the approximate truth about a causal relationship (Trochim & Donnelly, 2001). In the context of the current study, internal validity refers to the evidence of the three social contexts (collaborative, peer and individual) being the reasons for differences in grades and psychological need support and thwarting. According to Trochim & Donnelly (2001), there are three criteria that a research must meet before its internal validity can be assured. The first one is temporal precedence. In this research, it is clear that the assigning into social contexts came before the psychological needs were affected and knowledge was constructed and that the latter two are dependent on the social learning context, rather than the other way around. The covariation of the cause and effect were assured with the statistical significance tests that concluded that the differences between the groups were statistically relevant. The third criteria is a lack of no plausible alternative explanations. Due to the large scope of what a social learning context entails in this research, is can be argued that the differences in the outcomes are due to the learning context, rather than any other variable. At the same time, is true that learning environments are affected by many other factors (Kratwohl, 1993). In the current study, the learning outcomes, for example, might have been affected by students’ lack of motivation to work hard, since they were not given a grade for their work and therefore their learning outcome would not have mattered to them.

Construct validity refers to the degree to which the operationalisations of the study allow to make conclusions about the construct (Trochim & Donnelly, 2001). The construct validity of this research was assured by using data-driven content analysis in making sense of the data, as well as by designing the data collection methods in accordance with the theoretical background of the study. The fact that the findings did not contradict any other relevant empirical results
and also aligned with the assumptions made based on theories, also serves as an indicator of construct validity.

External validity is an estimate of whether the results can be generalized from the study sample to the population (Trochim & Donnelly, 2001). The external validity of this research was, to a certain extent, assured with statistical reliability tests. Due to the lack of normal distribution of the data and a small sample number, not all statistical significance tests that would have been appropriate for the variables, could be carried out. However, non-parametric tests proved that the compared groups are statistically significantly different from each other and that there is a potential to generalize the results to the wider public.

Reliability refers to the consistency of the findings and can be estimated through inter-rater, test-retest, parallel-forms and internal consistency reliability (Trochim & Donnelly, 2001). In this study, inter-rater reliability was used, as two reliability coders were used to code all of the data. The agreement percentage was over 70% in all of the cases, which indicates the reliability of the results. However, in order to truly assure the reliability and validity of the results of this study, future research should also consider other estimates of reliability.

6.2 Ethical Issues

Ethicality in contemporary social research refers to voluntary participation, informed consent, risk of harm, confidentiality, anonymity, and right to service (Trochim & Donnelly, 2001). All the listed ethical issues were considered during the research design, data collection and presentation of the results.

In order to find the research subjects, the school head teacher was contacted. The head teacher found a volunteer teacher who was willing to co-create and oversee the research process. The volunteer teacher also found other subject teachers who were willing to let students participate in the research during their lesson time. Before the data collection date, consent forms were sent to the parents of all the students and by the day of the data collection, all signed consent forms were gathered by the researcher. The parents of all of the students agreed to let their children participate in the research. Before the data collection process, the researcher confirmed with all the students whether they are willing to participate in the research and for those, who would not have liked to participate, regular subject lesson activities were planned.
by the teacher. All students agreed to take part in the research. The students were also informed about the aim and objectives of the research, as well as how the data would be analysed and used. Students were not at a risk of harm at any point during the research.

Confidentiality and anonymity were assured by not making the names of the students public at any point during the research. The students were identified by numbers in order to connect the worksheets with pre-test and post-test questionnaires, but the persons remained anonymous throughout the data analysis and presentation process.

6.3 Limitations of the Study

Due to the experimental nature of the study, there were two main limitations that affect the generalizability of the study: a relatively small sample and a narrow scope of the research.

The participants of the study were same-age students of one school. The sample size of 43 students was also a very small sample for data analysis, as many statistical tests could not be carried out or would not give correct results, because of a lack of normal distribution of the data among the three compared contexts. This means that the sample was not representative of the population it aimed to generalize about and the results might not be generalizable to that population, even though non-parametric tests showed statistical significance of the findings.

The scope of the research was also relatively narrow, as only one type of learning method – problem-based learning – was used. There is a considerable amount of research on how problem-based learning affects students’ academic performance (Hmelo-Silver, 2004) and, therefore, some of the findings of this study might not be due to the learning contexts, but rather due to the use of problem-based learning. However, the results are relevant nevertheless and this is simply a limitation that needs to be considered in designing future research.

6.4 Future Research

While the empirical findings of this study supported the theory and the posed hypotheses, additional research could confirm and elaborate these results on a larger scale and a more representative sample, as the current study focused only on the students in one age group, one school and working on one task at one point in time. Also, test-retest and parallel-forms reliability measures should be considered in the future.
Future research could also include a more detailed and qualitative content analysis to find out exactly how the knowledge and performance of students differ in these learning contexts. There is a considerable body of research on knowledge construction in different settings (Gash, 2015), but the findings fail to conclude what exactly makes for a knowledge construction supportive learning environment, which is why a thorough content analysis could shed some more light on the issue.

The psychological need support of learners in academic settings is also a topic that has been widely researched (Vansteenkiste & Ryan, 2013; Ryan & Deci, 2000; Deci et al., 1991) and Chen et al. (2015) have created and validated a self-report instrument that measures the satisfaction of these needs. While the instrument measures need satisfaction and frustration in a wider life setting, the instrument could easily be adapted to a timed learning environment. This would give a more thorough understanding of how students’ psychological needs are supported or thwarted in different learning contexts and what are factors that need special attention in designing learning tasks and environments.

Additionally, prior research shows that students achieve better results and higher motivation when acting upon internalized learning goals (Vansteenkiste & Ryan, 2013; Deci et al., 1991). Future research could also compare students’ performance and wellbeing in different learning situations where students are aware of the learning goals and have accepted them as their own, since theory suggests that when learner’s behaviour is self-determined, the role of social and other factors is minimal (Deci & Ryan, 2012).
The aim of this research was to analyse the learning outcomes and psychological need support of students in collaborative, peer-supported and individual learning contexts. The overall findings of this study suggest that collaborative, peer and individual learning contexts each have their own benefits and faults, but they are all necessary to prepare students for their future lives in the 21st century knowledge society.

As Self-Determination Theory claims (Deci & Ryan, 2012) and prior research suggests (Reeve, 2012; Ryan & Deci, 2000), this study also found that psychological need support is important in every learning context and the students whose needs are supported, construct higher quality knowledge and create higher quality products. The study also found that collaborative, peer and individual learning contexts differ from each other in the support and thwarting of students’ psychological needs, which means that the type of support, guidance and intervention students need from the teacher is different in the three contexts. It also means that all three contexts – collaborative, peer and individual learning – can be designed to be more effective by providing extra support for the needs that are naturally not supported in these contexts.

Students in collaborative learning either feel their peers to be supporting or thwarting their competence need by either helping them cope with complicated tasks or inhibiting the group work by not participating. As these challenges of collaboration are well known by teachers and researchers (Nokes-Malach et al., 2013; Toomela, 2007), understanding them together as threat to competence will help teachers focus collaborative learning situations to be more competence-supportive by making sure students are held equally responsible and feel competent in their work. Similarly, the students in individual learning either feel that their autonomy is supported or thwarted within the learning context, as they either feel good about being able to do things their own way or feel like they are not given enough choices in the classroom. Recent research has focused quite heavily on autonomy support (Oga-Baldwin et al., 2017; Jang et al., 2016; Mega et al., 2013; Vansteenkiste et al., 2004; Hardre & Reeve, 2013) and there are many ways for teachers to be autonomy-supportive in the classroom (Jang et al., 2016; Vansteenkiste et al., 2004). One such way is to give the students an option to work and interact with others, since, in peer learning context, students are rather self-determined in their behaviour.

The study also found that the quality of students’ work is not necessarily an indicator of the quality of the knowledge they have constructed. This means that while a collaborative group
may perform exceptionally well in coming up with a creative solution to a problem, the knowledge they end up constructing in the process, might not be of high quality, as they are able to learn on each other’s knowledge in solving the problem. This issue has also been brought up by researchers who are not convinced that collaborative learning is the best for knowledge construction (Kirschner et al., 2006; Tawfik, 2016; Toomela, 2007). Nevertheless, collaborative groups in this study created the best and most critically argued solutions to the problem, which means that with its many faults, collaboration does also have its benefits. As all three learning contexts covered in this study seem to have their own benefits, future research on the topic would be greatly needed.

Prior to this study, there was a lack of research comparing different social learning contexts within the same framework (Larsen-Freeman, 2016). While the current study filled that gap, the scope of this research was rather narrow and validation of its results on a wider sample is necessary. For a deeper understanding of the results of this study, future research could also take an experimental approach and focus on what exactly makes for a knowledge construction supportive learning environment in different social settings.
References


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Appendix 1

Worksheet

THE TRIAL OF SOCRATES

Name of student(s):

It is year 399 BC and philosopher Socrates from Athens is under trial. He is accused of impiety and corruption of the youth. His accuser, Meletus bases his formal accusation speech solely on rumors and does not present a single fact that would show Socrates to be guilty of the charges. Socrates holds a defence speech where he argues to be innocent, refers to many people who could prove his innocence and emphasizes that Meletus had no proof to back up his accusation. Despite that, Socrates is found to be guilty and sentenced to death. The judges of his trial are 501 men of Athens, out of whom 281 vote for his death sentence and 220 against it. Your task is to figure out what went wrong in the court cased and how Socrates could have been saved from the death sentence.

What could have been done to not find Socrates guilty?
1. I know that...
Think/discuss about the trial of Socrates. What do you know about it? Write down all the facts!

2. The problem with the trial of Socrates was that...
Think/discuss about what seems wrong to you about the trial of Socrates. Write it down with one sentence.

3. I need to know...
What do you need to know to find a solution to the problem you wrote down and to save Socrates from death? Write it all down as questions.
4. Find answers
Find answers to your questions from the reading material “Socrates”. If the reading material does not answer your questions, ask the teacher for help.

5. Brainstorm
Take 5 minutes to come up with as many different solutions as possible to help you solve the problem you wrote down and save Socrates from death. Write all the solutions down.

6. The solution is...
Think/discuss about all the ideas you wrote down and decide whether they would really help Socrates. Write down what you think could save Socrates from death and why you think that way.
Appendix 2

Reading Material “Socrates”

SOCRATES

Who was Socrates?

Socrates (469-399 BC) was a classical Greek philosopher who searched for wisdom and spent his days teaching philosophy on the streets of Athens. Socrates himself didn’t write any books. His thoughts are known to us today through the works of his disciples Plato and Xenophon.

Socrates lived during a time where it was common for young aristocrats to pay considerable amounts of money to Sophists in order to learn rhetoric, the art of persuasive speech, from them.

The people of Athens mistakenly believed Socrates to be a Sophist as well, because they all were known as divertive thinkers and opponents to many traditions of the city-state. Unlike Sophists, Socrates never received money from his disciples and audience, which is why he lived in great poverty. Teaching on the streets consumed all of his time and therefore he was not able to have a paid job. He never spoke to masses, but talked to people one on one. His audience consisted mostly of people who came to listen to his dialogues. Throughout the conversation, Socrates asked questions about seemingly simple issues to make people realize how little they really know about things.

The majority of his audience consisted of young aristocrats, since they were the only people who had enough time to learn philosophy on the streets of Athens. This meant that the working people, who made up the majority of the citizens of Athens, never had contact with him and only learnt about his teachings through rumours. Socrates was sentenced to death for having found guilty of impiety and corruption of youth.

What did Socrates talk about?

Unlike earlier philosophers, Socrates did not focus on the creation of the world, but rather on how an individual should live his life. He claimed that only a wise person can be right and fair in his actions. A person can only be brave if he knows what bravery is and fair only when he
knows what fairness is. Socrates also claimed that once a person knows what is right, acting in a wrong way is unacceptable for him.

Socrates also found that people often think they know things they really don’t know. His goal was to show to people how limited their knowledge really is. For that, he asked seemingly simple questions that people were, to their surprise, not able to answer. Socrates thought that to achieve true wisdom, one needs to understand how little they actually know. The Oracle of Delphi (who was believed to be the spokesperson of god Apollo) allegedly said that Socrates is the wisest man alive. Socrates himself thought that his wisdom is that “he knows that he knows nothing”. Other people don’t even know that, although they think they know a lot. Like Socrates said, “Know yourself” or in other words: know the limit of your knowledge!

Why was Socrates under trial?

Socrates was accused of impiety (not believing in gods of state) and of corrupting the youth with his teachings. His accusation sounded like this: "Socrates is an evil-doer, and a curious person, who searches into things under the earth and in heaven, and he makes the worse appear the better cause; and he teaches the aforesaid doctrines to others.". His accusers never brought up evidence or examples to prove their claims to be true. However, Socrates was known well as a dissenter, whose behaviour and views were disapproved by many for several reasons.

1. Socrates was subject to many defamatory rumours likening him to Sophist who were known by many to be greedy and hypocritical.

But far more dangerous are the others, who began when you were children, and took possession of your minds with their falsehoods, telling of one Socrates, a wise man, who speculated about the heaven above, and searched into the earth beneath, and made the worse appear the better cause.

As little foundation is there for the report that I am a teacher, and take money; this accusation has no more truth in it than the other. Although, if a man were really able to instruct mankind, to receive money for giving instruction would, in my opinion, be an honour to him.

For I do nothing but go about persuading you all, old and young alike, not to take thought for your persons or your properties, but first and chiefly to care about the greatest improvement of the soul. I tell you that virtue is not given by money, but that from virtue comes money and every other good of man, public as well as private. This is my teaching, and if this is the doctrine which corrupts the youth, I am a mischievous person. But if any one says that this is not my teaching, he is speaking an untruth.
2. Many people, who considered themselves to be wise, didn’t like that Socrates confused them with his questions and made their wisdom seem questionable. That’s why Socrates had many enemies among statesmen, artisans and poets.

At last I went to the artisans; I was conscious that I knew nothing at all, as I may say, and I was sure that they knew many fine things; and here I was not mistaken, for they did know many things of which I was ignorant, and in this they certainly were wiser than I was. But I observed that even the good artisans fell into the same error as the poets, because they were good workmen they thought that they also knew all sorts of high matters, and this defect in them overshadowed their wisdom.

This inquisition has led to my having many enemies of the worst and most dangerous kind, and has given occasion also to many calumnies. And I am called wise, for my hearers always imagine that I myself possess the wisdom which I find wanting in others.

But I know only too well how many are the enmities which I have incurred, and this is what will be my destruction if I am destroyed; not Meletus nor yet Anytus, but the envy and detraction of the world, which has been the death of many good men, and will probably be the death of many more; there is no danger of my being the last of them.

3. Socrates did not hold in esteem the democratic polity of Athens. The believed that the state should be governed by wise and competent people, not commoners as was custom in Athens. He respected professionals who were competent for their occupation and did not like that the city-state was governed by people who know nothing about governing.

4. The infamous Critias and Alcibiades, who each organized an anti-democratic coup and ruled Athens as tyrants, were disciples of Socrates. Socrates was also rather closely involved with both of them throughout his life.

Why was Socrates sentenced to death?

The highest governing body of Athens was the assembly. The court process was similar to that of the assembly - the jury consisted of 501 citizens who were chosen through lottery.

The prejudices of people were detrimental to Socrates in the accusation process, as well as in the inviction process. Important roles were also held by the speeches of the accuser and Socrates, as well as by the way they were performed.

1. The accusation was vague and presented in a beautiful and persuasive manner. This is why people believed the accusation even though Socrates thoroughly debunked most of the claims in his own speech.

How you, O Athenians, have been affected by my accusers, I cannot tell; but I know that they almost made me forget who I was, so persuasively did they speak; and yet they have hardly uttered a word of truth.
2. Socrates acted condescendingly and was unyielding in front of the jury.

And now, Athenians, I am not going to argue for my own sake, as you may think, but for that you may not sin against the God by condemning me, who am his gift to you. For if you kill me you will not easily find a successor to me, who, if I may use such a ludicrous figure of speech, am a sort of gadfly, given to the state by God; and the state is a great and noble steed who is tardy in his motions owing to his very size, and requires to be stirred into life. I am that gadfly which God has attached to the state, and all day long and in all places am always fastening upon you, arousing and persuading and reproaching you.

3. Socrates did not apologize and believed until the very end that he does not deserve a punishment at all. His accuser asked for death penalty. Socrates has the option to suggest a punishment he thinks he deserves and the jury was to choose between the two options. Socrates said with satire that a fair punishment would be if the citizens paid for his feasts and finally suggested a minor amount of fine as his punishment. The votes were cast 281:220. This gives reason to speculate that if he had proposed a more serious punishment for himself, he wouldn’t have been sentenced to death.

And, as I am convinced that I never wronged another, I will assuredly not wrong myself. I will not say of myself that I deserve any evil, or propose any penalty.

4. Socrates did not show fear of death and never begged for mercy.

Someone will say: And are you not ashamed, Socrates, of a course of life which is likely to bring you to an untimely end? To him I may fairly answer: There you are mistaken: a man who is good for anything ought not to calculate the chance of living or dying; he ought only to consider whether in doing anything he is doing right or wrong, acting the part of a good man or of a bad.

For the fear of death is indeed the pretence of wisdom, and not real wisdom, being a pretence of knowing the unknown; and no one knows whether death, which men in their fear apprehend to be the greatest evil, may not be the greatest good. Is not this ignorance of a disgraceful sort, the ignorance which is the conceit that a man knows what he does not know?

Socrates did not have enough time to debunk rumours that had been circulating for decades. His adjudicators were 501 Athenians who were mainly working people. However, working people never had a chance to come into contact with Socrates directly, which is why their opinions and beliefs about Socrates were based only on rumours.

Perhaps you may think that I am braving you in saying this, as in what I said before about the tears and prayers. But that is not the case. I speak rather because I am convinced that I never intentionally wronged anyone, although I cannot convince you of that - for we have had a short conversation only. But if there were a law at Athens, such as there is in other cities, that a capital cause should not be decided in one day, then I believe that I should have convinced you; but now the time is too short. I cannot in a moment refute great slanders.
Appendix 3

Pre-test and post-test questionnaires

**QUESTIONNAIRE 1**

What do you know about the trial of Socrates?

Who was Socrates?

What did Socrates teach?

Why was Socrates under trial?

Do you usually prefer to learn alone or together with classmates?

**QUESTIONNAIRE 2**

What do you know about the trial of Socrates?

Who was Socrates?

What did Socrates teach?

Why was Socrates under trial?

Did you enjoy working alone/together with classmates?