The Stimulation of Critical Thinking of Students through Deliberate Practice in Educational Institutions

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Foreword

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Abstract

Today's economy shows a clear gap between the offered skills in education and the demands of the labour market. Within this gap, a new problem is established: current higher education is not convenient for the future labour market. Instead of focussing on traditional skills (e.g. writing and mathematics), educational institutions have to shift their attention to the 21st century skills. The 21st century skills focus on cognitive, intrapersonal, and interpersonal (e.g. collaboration and critical thinking). In order to reduce the lack of 21st century skills in the labour market, educational institutions will have to redesign their curriculum. The present study examines critical thinking as one of the ten described 21st century skills, because of its importance in daily life and complex problem solving. Developing critical thinking, requires engagement in continuous learning (CL). CL in education is important for students to become independent and create a professional attitude when entering the labour market. Although deliberate practice (DP) is often used on the workplace for establishing CL, further research was needed on the implementation of DP in education. This mixed method research examined how the development of students' critical thinking can be stimulated through DP. A pre- and post-test were used for examining the influence of the intervention on the level of critical thinking. However, outcomes of the independent *t*-test showed non-significance, which means that students in the treatment group did not statistically benefit from the blog intervention in comparison to the control group. The intervention consisted of a weekly blog writing through using the principles of DP. In this regard, research found motivation and teacher support to be essential in enhancing critical thinking. Motivation can be enhanced through competition-based aspects in assignments, clear goals, and a safe learning environment. Future research should focus on long term examination for beneficial results of the intervention and a more sophisticated definition of critical thinking.

Key words: Critical thinking, continuous learning, deliberate practice, 21st century skills.

1. Introduction

Today's labour market shows that having an academic credential to secure a job is not enough (Tomlinson, 2008). There are many high educated students with the same academic credential available for the labour market, which makes it hard for a graduate to distinguish themselves from other graduates. Therefore, to be successful and stand out in the current economy and labour market, being experienced and skilled is of great importance (European Commission, 2016a; Livanos & Nunez, 2016). However, the offer of educational institutions is not corresponding with the demands of the labour market. This causes a deep gap between the skills and knowledge that are demanded on the current labour market and the skills and knowledge that are taught within the four years of higher education and universities (hereafter referred as educational institutions) (European Commission, 2016b).

A new problem has been established after examining the gap between the offered skills of the educational institutions and the demands of the labour market (Korka, 2010). Research found that what is currently learned in education is not convenient for the labour market in four years from now (Cedefop, 2015). Because of the ongoing innovations within the labour market, educational programs are not always corresponding with the demands of the labour market (Myagkov, 2016). Students, graduates and young professionals lack or miss several skills. Therefore, it is important that students learn how to develop their own skills and knowledge to create individual independence and cope with tasks demands of their future workplace settings (Jossberger, Brand-Gruwel, Boshuizen & Van de Wiel, 2010). In this regard, 21st century skills are of special importance. The labour markets' demands of the 21st century are asking for different skills than 20 years ago, however, educational programs are not developing in the same speed as the innovations on the labour market (Myagkov, 2016). In order to satisfy all these demands and keep up with the innovations, students need more than just knowledge about core subjects (Sahin, 2009). Not only technical skills and traditional basics (e.g. writing and reading) are needed to complete tasks. Research found that nowadays, behavioural skills and personality traits are becoming more important within the business sector and these skills can be transferred to the 21st century skills (Robles, 2012). The 21st century skills are universal skills which require students to communicate, collaborate, and solve problems with people all over the world (Saavedra & Opfer, 2012). Moreover, 21st century skills are advanced skills which fit into today's dynamic and complex economy.

In order to gain these 21st century skills, engagement in continuous, and self-directed learning is essential. After higher education, students (young professionals) are participating in a continuously changing labour market which requires students to continuously develop and improve their 21st century skills (Tynjälä, 2013). Self-directed learning can be described as a process in which a student or employee adapt to external realities and learning goals in regard of achieving permanent transformation. To engage with personal development, individuals are able to choose and implement appropriate learning strategies and evaluate learning outcomes (Knowles, 1975; Siminica & Traistaru, 2013). Secondly, continuous learning can be described as a process in which the need to learn, the motivation,

learning experiences, and applications are presented within an ongoing cycle. There is a continuous drive to learn, and improve knowledge and skills (London & Sessa, 2007). It is important for continuous learning to become self-directed in the future so that students and young professionals are independent when it comes to self-regulated learning and self-development (Jossberger et al., 2010). In this regard, continuous learning can be regulated and facilitated in many different ways. One important example is deliberate practice. Deliberate practice is a way of continuous learning within the workplace, through which skills can be improved and developed (Dochy, Gijbels, Segers & Van den Bossche, 2011). The theory implies an intended and specially designed way of learning for individual development and task mastery (Ericsson, Krampe & Tesch-Römer, 1993). Although deliberate practice is found to be successful in several workplace domains, it is still unknown if this learning method can also be successfully applied to stimulate the development of the 21st century skills in educational institutions (Bronkhorst, Meijer, Koster & Vermunt, 2014).

The 21st century skills are relatively new skills that need to be implemented in curricula, taught, and assessed in educational institutions, so that students can bring these skills into the future labour market (Geisinger, 2016). Because these skills are increasingly important for the future labour market, educational institutions are required to offer and stimulate these skills, so students are well prepared when they enter the labour market (Bronkhorst et al., 2014). Therefore, results of the present study are beneficial for educational institutions because it gives educational institutions the opportunity to concur with the labour market. Additionally, stimulating 21st century skills increases the number of successful completions of students to the labour market (European Commission, 2016a).

Further research is asked on examining how 21st century skills can be taught in education and how teachers can stimulate the development of these skills (Kaufman, 2013). The present research will examine how the development of students' critical thinking can be stimulated through deliberate practice. This way of learning is often used within workplaces, and requires extension for future use which makes the present study experimental. In addition, continuous learning ensures that students become independent in learning after their school career, and are able to regulate their own learning (Jossberger et al., 2010). The present research is using deliberate practice as a way of continuous learning, to stimulate critical thinking, as one of the 21st century skills, of students. Although deliberate practice is already examined many times within domains such as sports and music, deliberate practice is a relatively new topic within education (Eskreis-Winkler et al., 2016). Therefore, the present study will examine if deliberate practice can also be an effective way of improving performance for the stimulation of critical thinking of students in higher education and if it is a way of learning that can be applicable to other 21st century skills. Additionally, the present research contributes to effective learning methods in educational institutions and the transition of 21st century skills to the labour market.

2. Theoretical framework

A literature review is included within the theoretical framework to complement the data collection of the present research. The theoretical framework starts with describing the current level of skills, the missing 21st century skills within current education (and demands of the labour market) according to the literature (2.1). The paragraph describes the content of the 21st century skills with a distinction in four categories. In addition, effective methods that are used in education to teach 21st century skills are described in paragraph 2.2. The third paragraph includes continuous and self-directed learning as a key concept for implementing 21st century skills in education (2.3). Understanding these concepts will contribute to find out how continuous learning is used to stimulate 21st century skills, and examples of this facilitation are presented. One of these examples is the theory of deliberate practice. Therefore, paragraph 2.4 entails a description of the theory and an examination of how this way of workplace learning can stimulate the development of 21st century skills within education. Followed by an elaboration about the demands of the labour market and the transition of 21st century skills to workplace settings (2.5). A summary of the literature is presented in paragraph 2.6. The theoretical framework ends up with an overview of the research question (2.7).

2.1 Current level of 21st century skills in education

Skills can be described as the ability and quality a student has to execute tasks or to accomplish certain goals (Cimatti, 2016). Whereas traditional skills, e.g. reading, writing and mathematics, are still an important basis within education, an increase of the importance of the 21st century skills is present when it comes to practise in the modern world (Geisinger, 2016). The 21st century skills focus on cognitive, intrapersonal, interpersonal, and technical skills (Geisinger, 2016), and can be described as skills that effect behavioural traits. These days, companies and organisations indicate that the 21st century skills have taken a dominant role when hiring new staff, for complex problem solving, innovative ideas, and a participative ambiance (Cimatti, 2016; Robles, 2012) and are essential for students to successfully participate in the current labour market (Rotherham & Willingham, 2010). It was found that the traditional skills are well taught in education, in contrast to the 21st century skills, which still require more emphasis in academic programs (Wellington, 2005). The changing knowledge and skills within the economic world ensures that our systems and educations have to be reorganised. To successfully function in our interconnected world economy and political networks, skills have to become universal (Rotherham & Willingham, 2010). The 21st century skills are a large component of skills that students require to communicate, collaborate, and solve problems with people all over the world (Saavedra & Opfer, 2012). This section clarifies the 21st century skills and discusses the importance of stimulating these skills in education. The 21st century skills are distinguished in four categories (Binkley et al., 2012): ways of thinking, ways of working, tools for working and living the world.

2.1.1. Ways of thinking. The first category of 21st century skills contains three skills that refer to the way of thinking of the student. The first skill includes creativity and innovation, which are both important for the labour market, because these skills helpful with improve, advance and implement new products and come up with new ideas for the labour market (Binkley et al., 2012). This means that students need to think 'out of the box' and be open to new ideas in order to come up with radical or incremental changes within an organisation. This can be stimulated through (virtual) simulations where students are presented with a problem (Kaufman, 2013). Students need to take risks within the development of new and innovative ideas to make sure these ideas are effective, have an impact and can be adopted (Binkley et al,. 2012). Additionally, risk taking is essential to innovate on the labour market and think out of the box to have new ideas. Secondly, metacognition is about learning to learn, knowing and understanding the strengths and weaknesses of one's skills and abilities. In addition, this skill requires effective self-management and the ability to manage learning, autonomy and discipline in order to improve learning. This skill is important for monitoring the progress of one's own learning and for the awareness of developing skills and knowledge. Self-reflection and evaluations are examples of how this monitoring can take place (Binkley et al., 2012).

At last, the most important skill within this category is critical thinking, problem solving, and decision making. Moreover, critical thinking and problem solving became an increasingly important feature within the labour market and is therefore the most important skill that a student must possess (Binkley et al., 2012). It helps students understand systems and strategies, identify gaps and solving problems, and it helps to critically reflect on activities and behaviour which leads to (better) decision making. The skill includes six cognitive thinking skills, such as interpretation, analysis, evaluation, and explanation. Critical thinking, problem solving, and decision making is accessible on a large-scale assessment and can be used in many settings, tasks, and workplaces.

2.1.2. Ways of working. The second category contains ways of working. Thereby, communication and collaboration are two essential skills. Collaboration is becoming more important while organisations make more use of teams than in the past (Knapp, 2010). Collaboration and team work includes effective interaction with others, strengthen others to accomplish (shared) goals, respond open-mindedly, and furthermore, be responsible to others (Binkley et al., 2012). Within collaboration, it is important for a student to be able to work in diverse teams (e.g. intercultural teams, small teams, or even virtual teams) and to adapt within a team. However, not every employee or graduate is able to work in teams. In consistency with collaboration and teamwork, students need to be able to effectively communicate. Communication is not only important within a team or an organisation, communication is becoming a worldwide phenomenon that is crucial for the current interconnected world economy (Rotherham & Willingham, 2010). Therefore, communication skills are found to be one of the most crucial skills that are required within the current business sector. These communication skills include e.g., written and

oral communication, understand texts and make others understand, adapting strategies, and convincing peers to take full account of other perspectives (Binkley et al., 2012).

2.1.3. Tools for working. The third category includes tools for working, which refers to information and ICT literacy. Our current and future labour market is asking more for ICT literacy, since ICT became indispensable in our environment. Our phone, computer, and laptop are no longer to be considered because of the digitalisation of our daily and working life. The high demands in the labour market ensure that people have to stay updated on current innovations and continuously develop new theories and business models (De Weert, 2011; Vélez & Giner, 2015). Students require new information to continuously develop these new theories. Information literacy contains the understanding of using reliable and valid information, searching and collecting relevant information, and using graphs, presentations and maps in an appropriate way (Binkley et al., 2012). Therefore, information literacy requires the ability to apply digital technologies and communication/network tools. Accordingly, students need to know how to work with these resources and ICT possibilities, and furthermore, they need to understand and interpret media messages, and how they can apply technology effectively (Binkley et al., 2012). These features result in the skill ICT literacy, where it is important for the student to analyse media, use the information and create (new) media products. Capture, edit, and compose a video or audio project is an example of how this ICT literacy can be stimulated (Kaufman, 2013).

Noticeable, many studies focus only on this part of the 21st century skills, namely, ICT and information literacy (e.g. Aslan, 2015; Franklin, 2015; Izzo, Yurick, Nagaraja & Novak, 2010). It seems that educational institutions take measures to implement 21st century skills in their curriculum by implementing technology features in the classroom, however, it usually stops with the digitalisation of study materials (Izzo et al,. 2010). Digitalisation in education triggers students to work with online learning methods and the use of internet for research, review and evaluate (relevant) information, which is a part of developing ICT literacy. It also triggers students to use technology to accomplish (individual) learning goals. Additionally, technology makes students independent from the classroom environment (e.g. with MOOC's or virtual learning environments) and offers students to work on personalised assignments. Technology and digitalisation makes students also independent of working on their (individual) learning goals wherever they want, and whenever they want (Franklin, 2015). Therefore, the role of the teacher changes within the development of ICT and information literacy. Teachers develop a supporting role instead of a teaching role. Moreover, many teachers feel uncomfortable within teaching digitalisation, because they (often) lack these technology skills themselves.

2.1.4. Living in the world. Finally, the fourth category consists of skills that are essential for 'living in the world'. The category includes citizenship, life and career, and personal and social responsibility. Skills are based on leadership, ethics, adaptability, personal productivity and self-direction (Kaufman, 2013). It became more important that people understand the world and all the aspects of citizenship,

because of an increase of individual movement to compete against others, connect, and collaborate (Binkley et al, 2012). This means that people should be able to understand the roles and responsibilities of institutions, the government, from the social environment, and its own responsibilities. In addition, with citizenship it is important that people participate in a community as well as in decision making and voting in elections. Understanding and developing knowledge about civil rights can be enhanced through the recognition of the importance by teachers in education (Binkley et al., 2012). Additionally, the accessibility of world news and social media, ensures engagement and participation in civilisation. Within the second skill, life and career, the basis consists of the awareness of our changing world. This skill is about managing one's own life and career path, in terms of goals, work, cultural differences, and integrating in an environment (Binkley et al., 2012). A personal portfolio is an example of how this managing can be mapped through reflection and evaluation on current goals and future achievements. The last skill of this category is personal and social responsibility. The skill includes knowledge about maintaining good health, intercultural dimensions and the ability to communicate in different social situations. As with life and career, responsibility can be monitored through portfolios of work and assessment (Kaufman, 2013). Table 1 represents an overview of the ten mentioned 21st century skills, within the four categories, according to Binkley (et al., 2012).

Table 1

Overview of the '21 Century Skills' (Binkley et al., 2012).

Ways of thinking	• Creativity and innovation • Critical thinking, problem solving, decision making • Learning to learn, metacognition
Ways of working	• Communication • Collaboration, team work
Tools for working	• Information literacy • ICT literacy
Living in the world	• Citizen ship – local and global • Life and career • Personal and social responsibility (including cultural awareness and competence)

2.2 Effective learning methods

In order to get an overview of how the 21st century skills from previous paragraph are learned in current educational institutions, next section discusses three effective teaching methods, Web 2.0 technology, project-based learning, and problem-based learning. Additionally, the role of the teacher and requirements of students to effectively participate in these methods is discussed.

2.2.1. Web 2.0 Technology. ICT literacy can be seen as a crucial required (technical) 21st century skill that graduates and young professionals need to apply within workplace settings and can be taught through 'Web 2.0 Technology' (Tucker, 2014). This technological method offers, among other things, online platforms where students make use of discussion forums and is a technological enriched learning environment which enables students to manage their own learning and requires students to cope with these ICT proceedings and technological gadgets. Although ICT literacy is becoming more and more important within the 21st century labour market, schools are just starting with implementing this skill. Musa, Mufti, Latiff and Amin (2012) state that personal attributes and behavioural traits are also needed to be employable for a graduate, besides the traditional skills. Examples of these personal attributes and behavioural traits can be translated to 21st century skills, namely, critical thinking, communication, responsibility, problem solving, creativity and innovation. Using Web 2.0 Technology is not only stimulating ICT literacy and informational technology skills, this method is also encouraging other 21st century skills, in particular problem solving, collaboration, communication, and social responsibility (Tucker, 2014). Moreover, the method stimulates students to become self-directed in their own learning, and expects teachers to take a more supportive role.

Traditional education assumes that face-to-face contact is the only way to learn and develop these 21st century skills, however, students nowadays, mostly learn outside the classroom in an external setting (e.g. online or with social activities such as sports) (European Commission, 2016b). Moreover, research found that technology-supported learning should be used after students are fully engaged with face-to-face learning without technology, to optimize the development of students' learning processes (Lee, Tsai, Chai & Koh, 2014). The online platforms used in Web 2.0 Technology can stimulate students with learning to be collective by encouraging, helping, and supporting work from peer students. This helps students to be responsible for their own learning (Tucker, 2014). Blogs, discussion platforms, chats and forums made it possible for students to react on each other's work and to develop these collaboration and (verbal) communication skills. In addition, these online platforms allow open sharing for solutions and can be used by an individual or team (Franklin, 2015). Providing students the opportunity for elaborating on their reasoning and decision making is the responsibility of the teacher (Franklin, 2015). Therefore, the role of the teacher within this method can be characterized by providing ICT resources and to secure the software is usable for every student (Tucker, 2014).

2.2.2. Project-based learning. A different method that was found to be successful in developing 21st century skills is called 'project-based learning' (Musa et al., 2012). Within this learning, students are exposed to a meaningful learning process (often real-life cases) and are engaged with completing their project. Project-based learning implements activities that are integrating classroom lessons with the real world (Lawrence-Fowler, Grabowski & Reilly, 2015). Research found that individuals are driven to perform well as part of a team and are likely to develop their communication skills within a project group, which makes this learning method very successful for developing 21st century skills. Moreover, research showed that project-based learning offers great opportunities for the development of communication skills of the students. Whereas face-to-face contact is of importance for the collaboration, communication skills can be enhanced by writing e-mails, executive summaries and reports, which are by forehand all digital skills (Musa et al., 2012).

Within project-based learning, the teacher should provide a learning environment which support students to develop 21st century skills and to become proficient with critical thinking, problem solving, communication and collaboration (Musa et al., 2012). In addition, the teacher has an important role in supervising the project group, and evaluating the progression of solving the case (Garcia & Gracias, 2012). One important suggestion of the research is that these 21st century skills can be developed over time. Therefore, these project groups have to last an entire academic year for students to develop these personal attributes and behavioural traits (Ongardwanich, Kanjanawassee & Tuipae, 2015). It is essential for a teacher to follow these students within their learning process through evaluating and reflecting on their skills and behaviour in class or through an online learning environment. Furthermore, research found that the development of 21st century skills has to start during high school, because during this preparation, students are highly adaptable and behavioural changes can be made in time (Ongardwanich et al., 2015).

In contrast to Musa and colleagues (2012), research suggested that project-based learning as a teaching method has some disadvantages, which includes a lack of motivation and self-esteem of students (Issa, Hussain & Al-Bahadili, 2014). Therefore, Issa (et al., 2014) added a competition-based aspect to this learning method, the so called 'competition-based learning method'. Where project-based learning is characterised by working in teams and solving real-life problems, competition-based learning adds more value to work in, and compete with other teams when increasing the intrinsic (through e.g. fanaticism) and external motivation and learning outcomes of the students (Issa et al., 2014).

In sum, the method entails two key criteria; (1) the group selects a topic of interest, which stimulates (intrinsic) motivation, and (2) the project group decides their own direction of learning, which enables students to work in a way that they prefer (Musa et al., 2012). This relates to the theory of deliberate practice since specially designed activities (e.g. a topic that is selected on personal interested) stimulates students' intrinsic motivation and on the other hand, decision making as a group enhances the extrinsic motivation. Within a project group, extrinsically motivated students appear to work harder (Musa et al., 2012; Ryan & Deci, 2000). Project teams often exists to manage or solve complex problems that are

based on real-world cases. This problem solving is discussed in next section, also called 'problem-based learning, which relates to project-based learning, and includes team and individual learning of students.

2.2.3. Problem-based learning. Problem-based learning requires students to find meaningful solutions to contextualized problems, and challenged to engage with real-life problems and settings (Gholami et al., 2016). Among other things, problem-based learning is used to introduce new topics and providing relevant and real world examples of concepts (Ocon, 2012). The method is used to develop problem solving, creative thinking, critical thinking, adaptability, and self-awareness of individual learning experiences (Musa et al., 2012). Although problem-based learning appeared to be a natural way of learning for students, teachers do play an essential role within the implementation of this method. Teachers need to offer students appropriate assignments, which correspond with the knowledge and needs of students (Ocon, 2012). Moreover, teachers are important for giving immediate and informative feedback, and also to learn and encourage the student different ways of (critical) thinking. This learning method aims to make students self-directed and self-regulated in their learning (Wijnen, Loyens, Smeets, Kroeze & Van der Molen, 2017).

Problem-based learning is often applied in small groups, 3-4 students, to enhance collaborative and active learning (McLean, 2016). A problem-based learning assignment includes a case or problem e.g. in the neighbourhood or school community that needs to be solved. Examples of these presented problems are: 'How can we limit food waste in the cafeteria?' or 'How could we improve access to healthy food in our community? (Education World, 2017). Additionally, problem-based learning assignments are, as well as project-based learning, adaptable to the experience of the students and instructor, which increases the motivation of students to work on these assignments (Ocon, 2012). Similar with the theory of deliberate practice, the assignments lend themselves to be specifically designed to the knowledge and skills of the student and have a "one-size does not fit all" identity which is characteristic for this learning method (McLean, 2016). A final similarity can be found in executing the assignments. These methods are implementable in the 21st century education, because of the possibility to complete the assignments within the classroom and within distance learning courses (Franklin, 2015; Witte, Gross & Latham, 2014/2015).

To sum up this paragraph (overview presented in table 2), it can be stated that Web 2.0 technology and problem-based learning can be implemented within individual students as well as in students teams. Additionally, Musa and colleagues (2012) stated that project teams are very beneficial for communication and collaboration skills, as well as problem-based learning for individuals. Students' participation is improved in all methods through discussion classes, online platforms, and student presentations to interact, provide feedback and be critical towards each other's' work (Ocon, 2012). However, in order to generate 21st century skills such as critical thinking, collaborative problem solving seems to be essential for our future society (Uchino, Okubo & Watanabe, 2015). Therefore, concluded is that the method of problem-based learning is most effective for the development of 21st century skills

when applying in teams or groups of students, although, the method also contributes for individual development. In regard of developing 21st century skills, and especially critical thinking, engagement in continuous, self-directed learning is of great importance. Therefore, next paragraph will elaborate on continuous learning and why this is such an important factor for the future labour market.

Table 2

Overview of effective teaching methods.

	21st century skills	For who	How	Teachers' role
Web 2.0 technology	Technological-based method. Includes development of ICT and information literacy, critical thinking, communication, and problem solving.	Team and individual learning	Through online platforms, and discussions forums.	Teachers have a supportive and facilitating role.
Project-based learning	Project-based method. Includes collaboration, communication, and ICT skills	Team learning	Through activities that are integrating classroom lessons with the real world. Real-life projects and cases.	Teachers have a role in supervising the project group, and evaluating the progression of a case.
Problem-based learning	Problem-based method. Includes developing problem solving, creative thinking, critical thinking, adaptability, and self-awareness of individual learning experiences.	Team and individual learning	Through problems based on community or neighbourhood problems. Real-life problems.	Teachers have a role in offering assignments which correspond with the knowledge and needs of students. Additionally, providing feedback and encouraging students.

2.3 Continuous and self-directed learning

It can be concluded that 21st century skills have a crucial role within the labour market and workplaces. However, it is often expected that employees already possess these 21st century skills. Where the labour market is expecting students and young professionals to be ready and fully skilled when entering the labour market, students are expecting acknowledgement for their investment in higher education, and in addition, they expect to be well prepared as a (young) professional (Kiener, Ahuna & Tinnesz, 2014). Therefore, it is essential for educational institutions to start early with getting students ready for the workplace (Lawrence-Fowler et al., 2015). Additionally, research found that many skills take months or even years to develop, so the earlier employees (students) start developing these skills, the higher outcomes and better performances they deliver (Lawrence-Fowler et al., 2015; Musa et al., 2012). However, educational institutions are currently more focussed on basic skills and technical skills, which results in a lack of transition and preparation to the labour market and practical workplace settings.

A common problem within the curricula of current education is that learning methods do not provide a transition of skills towards the labour market. This means learning methods require changes for students to become capable of keeping up with innovations and changes, and using all skills within the labour market (Izzo et al., 2010). For example, project-based learning enhances team work and communication skills which students can use in practice, however, they have to figure out themselves how to apply these skills in real workplaces (Garcia & Gracias, 2012). On behalf of this problem, continuous learning is necessary to encounter the challenge of all fast changes in the world of work and society, the increased development of technology, and the changes in work environments (Tynjälä, 2013).

2.3.1. Continuous learning. Continuous learning can be described as a process in which the need to learn, the motivation, learning experiences, and applications are presented within an ongoing cycle. There is a continuous drive to learn, and improve knowledge and skills (London & Sessa, 2007). It helps to keep all employees updated of todays and future innovations (Ericsson et al., 1993). Continuous learning is of great importance in responding correctly on the changing economy and social environment, and also in adaptation to the innovations on and requirements of the labour market. Continuous learning has its basis within educational programs, where students are responsible of their own continuous learning (Bronkhorst et al., 2014). In this regard, continuous learning is required to become self-directed, because self-directed learning is a process where the individual develops a major advancement of self-image by taking own responsibility and initiative to grow (Knowles, 1975; Siminica & Traistaru, 2013). Additionally, self-directedness allows students to be independent in their own learning and development (Jossberger et al., 2010). Within the long term, continuous learning ensures that students are less dependent on school and formal education. Workplace learning methods

such as experiential learning (Kolb, 1984), reflective learning (Schön, 1983), on-the-job learning (Braddell, 2007), and deliberate practice (Ericsson et al., 1993) are successful methods for students to be able to determine their own learning goals and needs, and take initiative to accomplish these goals and needs. Experiential learning and deliberate practice are further discussed below, because these are most appropriate for using in education.

2.3.2. Experiential learning as way of continuous learning. Experiential learning can be described as the way of learning through real-life experiences, and reflecting on these experiences for future situations (Kolb, 1984). As an example of experiential learning, internships are often used within the educational curriculum (Lawrence-Fowler et al., 2015). Internships give students the opportunity to develop relevant 21st century skills which is crucial with preparing students for the workplace (Galvan, Casman, Fisher & Nair, 2014). Furthermore, internships are a meaningful interconnection between the taught theoretical knowledge in education, and the demanded experience and practical skills of the employers in workplaces (Chen, Hu, Wang & Chen, 2011). In order to adapt well to the exigent and demanding practices of the labour market, students are required to be careful and progressively introduced into workplace settings (Moore & Morton, 2017). Internships stimulate continuous learning of students and young employees through new influences and learning experiences (Lawrence-Fowler et al., 2015). Students learn how to deal with different methods of workplace learning, which increasingly stimulates employees to develop (personal) skills and learn to be self-directed in their learning. Moreover, internships help students to create a clear career path, which can be useful within the transition to enter the labour market (Vafai, 2016). Moreover, it stimulates the motivation of students, and provides a clear vision for students to grow in their educational career as well as in their professional career.

Disadvantages of internships contain lacking places for internships, and secondly, internships often coincide with other deadlines and study courses (Galvan et al., 2014; Lawrence-Fowler et al., 2015). Research found that internships are most successful during the summer when it is not in combination with other courses, which is often the case with internships during fall or spring (Galvan et al., 2014). Negative evaluations or disadvantages in previous research often relates to expectations of students which are not always met within the company (Vélez & Giner, 2015). Whereas internships are implemented for a short term within the educational curriculum, research found that implementing 21st century skills require long term learning. In this regard, implementing deliberate practice in the daily routine is necessary to decrease the time investment, and increase effective learning in workplace settings. The earlier deliberate behaviour is applied, the more employees are likely to use these learning methods (Lawrence-Fowler et al., 2015). Next paragraph elaborates on the theory of deliberate practice, and the advantage of using this method into education.

2.3.3. Deliberate practice as way of continuous learning. Deliberate practice literally means that 'individuals purposefully counteract tendencies toward automatism by actively setting new goals and higher performance standards, i.e. forcing themselves to reflect on the situation at hand, to consider goals and strategies and to decide which skills are appropriate to attain those goals' (as cited in Wouda & Van de Wiel, 2013). Deliberate practice (DP) is a highly effective way of practice and learning within many domains. It could be stated that DP is of great importance when it comes to professional development (Bronkhorst et al., 2014), and improving performance through interpersonal (e.g. communication, collaboration, responsibility, and leadership) and intrapersonal skills (e.g. self-development, adaptability, flexibility, and citizenship) (Galvan et al., 2014). However, few research is done on how DP can be beneficial in education. Because of the gap of skills between educational institutions and the labour market, education is required to adapt to the demands of the labour market.

In contrast to the method of DP, which is an often used and successful method in workplace learning, project-based learning and problem-based learning method are characterised by the importance of the teacher, who is responsible to teach these 21st century skills to students. When applying DP in education, the student is responsible of its own learning, developing, and refining skills, supported by the teacher who is providing feedback and resources to facilitate students' (independent) learning (Dochy et al., 2011). Additionally, Web 2.0 technology is similar to DP with providing an (online) environment for the student where he or she can develop learning goals and study methods to students' own preference. In other words, where project-based learning and problem-based learning are teaching methods, and can be used by teachers, Web 2.0 technology and DP can be used as a learning method, which can be used by students and are supported by teachers. In the end, many educational methods for the 21st century are aiming to get students more self-directed in their learning (Musa et al., 2012; Ocon, 2012; Wijnen et al., 2017).

As was mentioned before, continuous learning is important in the adaptation to the innovations on and requirements of the labour market. DP is one of the theories of how continuous learning is regulated and facilitated on the workplace and is essential to be brought into education to enable students to become independent and autonomous after their school career. Refining skills and performance, and improve outcomes is fundamental in the theory of DP (Eskreis-Winkler et al., 2016). Through DP, learning happens intentionally, is planned, and time is set aside specifically for this learning. DP mainly consists of learning on-the-job and is often used to achieve professionalization or mastery in a specific task or skill (Dochy et al., 2011). Due to the fact that every individual is automatically developing skills over years through experiences (also called 'every day skills'), DP ensures that every individual is able to improve themselves and reach the highest level of professional mastery (Ericsson, 2006). Therefore, DP is of great importance for the individual development of becoming an expert or professional in a certain domain (Dochy et al., 2011). DP stimulates and enhances the development of an expertise and the mastery of skills, which is necessary for students to be well prepared when they enter the labour market (Bronkhorst et al., 2014). The development of an expertise and the mastery of skills enables

students to become independent of school and formal courses. In comparison with experiential learning and the disadvantages of an internship, the present research is using DP as method for stimulating critical thinking.

2.4 The theory of Deliberate Practice

According to Dochy and colleagues (2011), and Ericsson (et al., 1993), the theory of DP consists of seven principles which can support the improvement of learning performance, refine skills or develop expertise. These principles can be used as guidelines to stimulate 21st century skills of students. Within this section, every principle will be discussed and how this principle can be taken into practice. First, in order to refine knowledge and skills, informative and immediate feedback should be given (Dochy et al., 2011). Secondly, it is important to measure and analyse the current performance to have a cornerstone for improving the performance. Third, practice activities need to be specifically designed for the learner, with regard to improve performance and aspects that need improvement. Additionally, practice activities need to be repetitive, and also allow for reflection on outcomes and processes. Fifth, motivation to improve performance is a prerequisite to achieving expertise. Sixth, time and effort need to be invested. Finally, in guiding individual development, teachers and coaches cover a crucial role (Dochy et al., 2011).

2.4.1. The seven principles. As the first principle suggests, the theory has its fundamentals in informative and immediate feedback in order to refine current knowledge and skills. Feedback is needed for the student to constantly improve certain skills, goals or tasks (Jossberger et al., 2010). Furthermore, feedback increases the awareness of the development of an expertise and is mostly given by supervisors, peer-students or in some cases, the costumer (or patient) itself (Dochy et al., 2011). In this regard, it is important that feedback is immediately given after or during a practice. For example, computerized simulators that offer immediate feedback on a test or a reflection form directly after an activity. Moreover, the feedback should be substantively directed to the activity or practice and should be short and understandable for the student (Eskreis-Winkler et al., 2016). This means that the content of the feedback is related to the current practiced activity instead of activities of (e.g.) a week ago. In addition, to ensure the feedback is understandable, feedback can be given through a reflection form. Therefore, the student can view the feedback and ask questions. Teachers, peer-students or self-reflection are three ways of how feedback can be provided. At first, in this study, the teacher is mainly responsible for giving this feedback towards the student, additionally, students can also provide each other with feedback and reflections can be used (Bronkhorst et al., 2014).

Secondly, the current performance has to be measured and analysed as a cornerstone in order to improve the skill. Within the workplace, this is often done by defining certain tasks and cases, and giving guidelines for improving and measuring these tasks (Dochy et al., 2011). In addition, there should be a clear interpretation of the desired performance and outcomes to optimally evaluate the gap between the

levels. For example in medicine, guidelines based on clinical research are available to bridge the gap between starters and recognised specialists (Dochy et al., 2011). In education, a curriculum is present to give students guidelines which competences are required in every stage of their educational career. In order to get an academic credential, performance outcomes of students are necessary to measure. Without this measurement, it is not possible to analyse whether a student meets the requirements and demands of an academic degree (Bronkhorst et al., 2014; European Commission, 2016b). Therefore, formative knowledge tests and examination of practical skills are examples of activities which can be deployed for setting the performance standards and measure improvement (Dochy et al., 2011). In addition, teachers and students can monitor the progress through feedback (Locke & Latham, 2006).

The third principle suggests that practiced activities have to be specifically designed for the learner, in order to improve performance and aspects that need improvement. However, not only the activity or task should be specifically designed, also the learning environment should be adaptive to the needs of the students (Jossberger et al., 2010). On the one hand, the student has the responsibility to define their own goals and achievements (Eskreis-Winkler et al., 2016). Goal setting resulted in higher outcomes and better task performances and is therefore necessary for the student to motivate their existing ability of skills (Locke & Latham, 2006). Goals can be assigned by others, within group participation or by itself. However, personal goals are found to be most efficient for learning (Locke & Latham, 2006; Siminica & Traistaru, 2013). On the other hand, teachers have the responsibility to monitor the goals of the student and to facilitate suitable activities for achieving these goals that enhance the development of skills of the student. For example, assigning a random assessment for the student is not that beneficial, because most of the time it does not fit within the goals, strengths and weaknesses of the student (Wang & Zorek, 2016).

Fourth, practice activities need to be repetitive, and also allow for reflection on outcomes and processes. This means that, in combination with the third principle, the designed activities for a student also need to be repetitive in order to measure improvement and to correct errors (Eskreis-Winkler et al., 2016). Repeating and practicing an activity or skill positively influences the mastery of a skill. Repetition can lead to understanding, which is important for students to recognize and apply new innovations (Straker, 2008). By reflecting on these activities, students become aware of their mistakes and repeating the activity gives the student the opportunity to fix this error and learn. Therefore, repetition and reflection results in automation of skills and behaviour, and full mastery of the skill can be reached (Dochy et al., 2011). Repetitive practices in e.g. the clinical world are often provided in simulators or specific training settings. In order to improve experiential learning, educational institutions have the opportunity to make use of internships where students practice in real-life settings (Dochy et al., 2011).

The fifth principle of DP assumes that motivation is a prerequisite to improve performance and to achieving expertise (Dochy et al., 2011). In addition, intrinsic motivation might be even more important than extrinsic motivation. Intrinsic motivation refers to ‘doing something because it is inherently

interesting or enjoyable' (as cited in Ryan & Deci, 2000) and is known as 'a mastery goal orientation' (Dochy et al., 2011). Intrinsic motivation positively influences the need of self-improvement, the satisfaction of performing a task (Siminica & Traistaru, 2013), and improves learning outcomes and the creativity of a student (Ryan & Deci, 2000). In addition, intrinsic motivation gives students the possibility to take responsibility in their own learning plan and supports the personal efforts and interests of a student. Vice versa, in relation with the third principle, learning what a student aims to learn also enhances the intrinsic motivation (Siminica & Traistaru, 2013). Teachers are essential with the stimulation of motivation. As an example, intrinsic motivation can be enhanced by providing explicit choices of learning goals or tasks. Teachers must ensure that these given choices meet the needs of students (Jossberger et al., 2010). Moreover, research outcomes showed that motivation can be increased by building a safe environment for the student where they can openly discuss their insecurities (Dochy et al., 2011).

The sixth proposition is composed of the investment of time and effort and applies to all principles of the theory. No principle is attainable without investing time and effort in it. Characteristic for the theory of DP is that activities are planned, and time is specifically set aside in order to practice an activity (Dochy et al, 2011). To improve or learn skills, training and practice is needed, and this requires time and effort of students. Moreover, research found that the amount of time that is invested, positively influences the level of performance (Ericsson et al., 1993).

At last, the seventh principle includes the crucial guidance of teachers and coaches in the development and mastery of skills. Looking form a more practical perspective, teachers and coaches are essential to support the student in their (individual) development by evaluating performance, providing feedback, and create a safe and supportive environment for the students (Bhatti & Ahmed, 2015; Dochy et al., 2011). Evaluating performance and providing feedback can be done through reflection forms and evaluation sessions with the students. It is the responsibility of the teacher to monitor the progress of the students and analyse the current performance (Wang & Zorek, 2016). For example, immediate feedback can be provided through a reflection form that is filled in directly after the activity or lesson. In this regard, the teacher facilitates time and room for the students to reflect on their skills. Furthermore, teachers need to stimulate students in their motivation and encourage the ability and learning activity of the students (Siminica & Traistaru, 2013).

2.4.2. Using deliberate practice. The present research used DP to stimulate the level of critical thinking of students. Often, critical thinking happens unconsciously, as well as reflecting on the skill (Paul & Elder, 2008). For this reason, DP might be a positive resulting way of continuous learning, to stimulate the level of critical thinking of students. Therefore, deliberate learning has three important requirements in order to be successful. First, the time-consuming factor has to be taken into account (Gonzalez & Kardong-Edgren, 2017). Time is needed for students to fully master a skill. Students start with mastering simple tasks before comprehension with more complicated tasks can take place. In this

regard, it might occur that the progresses of students differ from each other, which makes the specifically designed activities essential for students. Controversially, to stimulate critical thinking, creating a specific context makes it difficult to generalize critical thinking skills in other contexts (Wouda & Van de Wiel, 2013). In other words, in order to make use of DP, activities should be specifically designed for a student, however, it should be repetitive in other contexts.

Secondly, to engage DP, students should have clear objectives with regard to have specially designed activities and to be motivated for their own learning (Gonzalez & Kardong-Edgren, 2017). Therefore, DP can be supportive with critical thinking, to make students aware of their learning objectives and to trigger them to think about their critical thinking. At last, applying DP into education requires a major involvement of teachers (Panero, 2016). On the one hand, teachers are required to have an overview and clear sense of the progress of the students to master independency and flexibility. On the other hand, teachers must understand the current progress of the students in more detail in order to strengthen (communication) skills (e.g. writing, oral expression and reading). Teachers should be able to give useful and concrete feedback which gives the students the opportunity to grow and master their skills (Gonzalez & Kardong-Edgren, 2017). However, in the end, the goal of stimulating the 21st century skills through DP, is for students to become independent of school and are able to reflect upon their own activities. Next paragraph discusses how 21st century skills are used in the labour market, and which 21st century skills are extremely important. Furthermore, the paragraph elaborates on the transition of 21st century skills from education to the labour market.

2.5 21st century skills into the labour market

As mentioned before, the labour market asks for a broad variety of skills of graduates and young professionals (Wang & Allen, 2016). In the past, skill requirements were rather focussed on technical and specific skills, whereas today's job requirements are more focussed on general skills, which include learning, reasoning, communicating, collaborating, and problem solving (Lawrence-Fowler et al., 2015). As project-based learning and problem-based learning are methods that are successful in education when it comes to developing and triggering more skills at a time, DP is more practical with focussing per skill and very individual based. This could be a reason why DP is currently deployed often within workplace settings. However, in order to learn on the workplace, employees are already required to possess skills such as communication, collaboration, and adaptation (Lawrence-Fowler et al., 2015). In this regard, these 'basic' skills help employees to further develop other 21st century skills. Below, three 21st century skills are elaborated, because of their major importance on the labour market and workplace. The role of DP is included to give examples of how this method is used within the workplace, and how this refers to DP in education.

2.5.1. Communication. First, in order to achieve high performances and positive outcomes for companies, effective communication on the labour market is extremely important. Employees should be able to formulate and share thoughts and ideas by using oral, written and nonverbal communication. Furthermore, in order to cooperate with each other and other companies, employees should be able to use these communication skills through various forms and contexts, such as social media, e-mail, and phone (Cooper & Bray, 2011; Witte et al., 2014/2015). Listening is crucial in oral communication to analyse meaning and ask questions for further knowledge, and intentions. In addition, employees should be able to communicate in different environments, different languages, and practice their communication in different contexts. DP is important in refining communication skills through the importance of continue practice (possible in different situations) and the feedback from others, which is necessary for an employee to further develop his/her communication skills (Dochy et al., 2011). Moreover, communication between employees and/or peer students is found to be stimulating for collaboration, and enhances self-confidence which is increasingly important within the labour market (Aslan, 2015). Finally, communication can be established by means of various sources. Multimedia and technology are today's often used sources, which requires ICT literacy of employees (Witte et al., 2014/2015).

2.5.2. Digitalisation. Second, using digital technologies is not only popular in education, it also infiltrates the labour market and our daily life. Access to the technological tools and online curricula is a precondition with developing 21st century skills (Izzo, Muray, Buck, Johnson & Jimenez, 2015). Technology is used as a tool for research, organizing, evaluation, and communication. Therefore, employees should understand the use of these tools, to access, manage, and implement these tools in order to make them effective and successful (Witte et al., 2014/2015). Furthermore, as Franklin (2015) stated in her research, technology can be used to analyse processes, synthesize information and evaluate possible outcomes. Employees can use technology and digital resources to collaborate in teams and apply possible solutions to problems. Usage of all these technological resources and digital tools can especially be learned by doing and practicing these tools during work activities. For developing and refining ICT literacy, DP is important in practicing the tools and repeat them. Additionally, teachers and coaches can be of great importance in implementing and developing ICT skills of employees (Dochy et al., 2011). However, nowadays it is likely that (young) employees already possess a part of these ICT skills, because of their educational history or private experiences.

2.5.3. Critical thinking, problem solving, and decision making. Finally, the overview of the 21st century skills (paragraph 2.1) shows the importance of teaching critical thinking, problem solving, and decision making. Noteworthy, making judgements and decisions is necessary for successful and effective problem solving (Witte et al., 2014/2015). Critical thinking, problem solving, and decision making is a skill which consists of three phases (Binkley et al., 2012), and are especially needed for

creating new, innovative products and concepts which makes the skill interesting for analysis and measuring (Rotherham & Willingham, 2010). Critical thinking means that students need to understand systems, strategies and the importance of evidence to tackle problems. Therefore, students need to be able to use various types of reasoning, be able to analyse, interpret and draw conclusions upon the best analysis, and evaluate and explain the results. In addition, a critical analysis of a new product, idea or concept ensures that concepts become concrete and understandable (Rotherham & Willingham, 2010). It allows students to participate in the community and to work on new and veracious problems (Rotherham & Willingham, 2010). In order to solve problems, students need to be open to innovative solutions and honest about own biases. In addition, problem solving includes aspects of collaboration and team work skills (Geisinger, 2016). Finally, as well as critical thinking and problem solving, decision making is necessary in many situations and work settings. Therefore, students need to be flexible, trustful, autonomous and confident in reasoning (Binkley et al., 2012; Siminica & Traistaru, 2013). Translated to workplace settings, employees should be able to analyse and evaluate evidence, arguments, claims and beliefs (which is a very important aspect of critical thinking). Additionally, this skill requires correct information interpretation and drawing conclusions on reliable analysis and evidence. Preliminary on correct decision making, critical thinking and using the context of the problem is crucial to increase the probability of a desirable outcome (Chouari & Nachit, 2016). Therefore, critical thinking is one of the most important skills to possess for the transition of learned skills in education to meet the demands of the 21st century's labour market (paragraph 2.4).

In order to get concrete results, critical thinking is used with measuring data and predicting results. Little is known about critical thinking skills in higher education, thus the present research adds on previous studies of critical thinking in education (Utrianen, Marttunen, Kallio & Tynjälä, 2016). Critical thinking is essential in our daily life to improve the quality of our products, innovations, and life (Paul & Elder, 2008). Therefore, students need to formulate clear questions and problems, be able to gather relevant information, effectively interpret abstract ideas, be open minded, and provide conclusions and solutions to complex problems that are well-reasoned. The present research is using the Halpern Critical Thinking Assessment (HCTA) in measuring five important aspects of critical thinking. Namely, (a) verbal reasoning, the ability to identify and evaluate the assumptions, definitions, labels, and connotations at work in persuasive uses of ordinary language (Wade & See, 2014), (b) argument analysis, the ability to seek and provide reasons and to recognize the differences between conclusions and assumptions. The ability to assess the strength of an argument, (c) thinking as hypothesis testing, the ability to reason scientifically, to determine whether or not the given information confirms the hypothesis (Halpern, 2012), (d) likelihood and uncertainty, understanding the appropriate or inappropriate use of hedging in the support of claims, as well as judging the probability of a certain statement (Wade & See, 2014) and (e) decision making and problem solving, generating and selecting from alternatives based on relevant criteria, and finding solutions to a situation, or more informally, moving from a starting point to a goal (Halpern, 2012). Critical thinking can also be seen as self-directed

and self-monitored thinking, which is essential to continuously learn in education and transfer learned skills in education into the labour market (Paul & Elder, 2008). Next section discusses the transition of the 21st century skills from education to the labour market, through the use of critical thinking and DP. This section can be seen as a reciprocity of used methods in education to learn skills, and the skills demanded and used on the labour market.

2.5.4. Critical thinking for transition. Critical thinking is seen as a higher order skill which is required for lifelong learning of students and so, young employees. The skill is required in the labour market (Kiener et al., 2014), and moreover, critical thinking is even more crucial in the transition for all 21st century skills on to the labour market. According to the theory of DP, critical thinking and correct decision making can be stimulated and developed through feedback of colleagues, critical questions of coaches/managers to think beyond the problem, and most importantly, investment of time and effort (Dochy et al., 2011; Ericsson et al., 1993). Moreover, critical thinking can transit developmental skills into a professional level of using skills (Wolcott & Karlin, 2011). The skill stimulates other 21st century skills, such as innovative thinking, creativity, responsibility, decision making, and problem solving, by making students aware of their performance (Hunter, 2014). Thereby, a student with a critical attitude implies to develop on a higher intellectual level, because of the active learning attitude and well reasoning in decision making (Wolcott & Karlin, 2011). Moreover, critical thinking is essential for the autonomy of students and young employees (Chouari & Nachit, 2016; Hunter, 2014).

Although critical thinking was found to be an essential skill for the transition of 21st century skill on to the labour market, teachers often lack teaching critical thinking. Research found that outcomes performance of critical thinking is most beneficial when it is taught through a 'stand-alone' course instead of being a component of a course (Chouari & Nachit, 2016). In this regard, teachers should take into account real-life situations in order to create clear contexts for students that they can really use (Halpern, 2014). Through using ICT devices (e.g. laptops) and tools (videos, data shows etc.), motivation and involvement of the students can be enhanced, which is necessary for a successful transition on to the labour market. These ICT devices and tools make it possible to interactively work in classrooms (and outside classrooms) and ensure engagement of students between each other and the course materials (Chouari & Nachit, 2016).

A successful example of teaching and enhancing critical thinking includes a 16-week course where aspects of critical thinking (e.g. analysing research, synthesizing data, and developing appropriate goals) were discussed, refined, and used by students to complete a case study. During the course, students became able to analyse, provide self-assessment opportunities, and created thinking routines that resulted in competent treatment plans and a professional way of thinking (Kiener et al., 2014). Finishing the course with an evaluation and reflection on the 16 weeks resulted in a professional attitude of students, who became aware of their responsibilities as a professional, became able of thinking critical about problems, and learned how to act as effective professionals. Teachers took part in providing

support in studying and developing critical thinking of the students, in order to achieve these results. Related to the theory of DP, teachers were supportive in analysing current performance in order to amplify 21st century skills, facilitating sources for performing exercises and practices, and last but not least, in providing feedback to students to improve 21st century skills (Dochy et al., 2011; Kiener et al., 2014). Results found to be effective for the transition of students on to the labour market, however, it is unexplored how students eventually will function as a professional (Kiener et al., 2014).

In sum, in order to have a successful transition of skills, and to successfully participate in the future labour market, critical thinking is crucial for students. It helps students to think beyond the problem, and critically reflect on complex problem solving. Noteworthy, enhancing critical thinking is most beneficial when the objectives of critical thinking are explicit and clear (Gonzalez & Kardong-Edgren, 2017).

2.6 Key findings of literature review

The main focus of the literature review was to elaborate on the importance of 21st century skills, how these skills are taught in education and the role of the teacher within teaching these skills. Additionally, several methods where compared in order to examine the role and requirements of students. Table 3 presents an overview of the key findings of the literature review based on these questions.

Table 3

Key findings of the literature review.

21st century skills	Skills can be described as the ability and quality a student has to execute tasks or to accomplish certain goals (Cimatti, 2016). The 21st century skills focus on cognitive, intrapersonal, interpersonal, and technical skills (Geisinger, 2016).
Importance of 21st century skills	In order to be successful in the changing economy and innovating labour market, 21st century skills are necessary. 21st century skills are of great importance for students to continuously learn, solve complex problems, and become autonomous and self-directed within their learning process (Geisinger, 2016). 21st century skills are essential for effective communication and collaboration within the workplace.
Critical thinking	Critical thinking is especially needed for creating new, innovative products and concepts (Rotherham & Willingham, 2010). Critical thinking means that students need to understand systems, strategies and the importance of evidence to tackle problems and effective decision making.
21st century skills in education	Effective teaching, among other things, communication, collaboration, and critical thinking and problem solving, consists of using online discussions platforms (e.g. Web 2.0 technology), stimulating group and team work (e.g. project groups), and creating assessments in real-life situations (problem-based learning). The method of problem-

	based learning is most effective for the development of 21st century skills when applying in teams or groups of students, although, the method also contributes for individual development.
Deliberate Practice	The theory of DP consists of seven principles which can support the improvement of learning performance, refine skills or develop expertise. These principles include informative and immediate feedback, analysing current level for improvement, specifically designed activities that fit the learner, and the repetitiveness of these activities. Furthermore, motivation, time investment, and effort of the students are included in the principles (Dochy et al., 2011). The last principle contains the importance of a teacher or coach with refining and developing the skills of students (or 'learners). The principles are used as guidelines to optimise skills and learn new skills. DP is a workplace learning method that is often used in companies, however educational settings are new for this learning method.
Students' requirements	The literature was clearly evident that motivation of the student is the key requirement in stimulating and developing 21st century skills (Ryan & Deci, 2000). Moreover, a combination of intrinsic and extrinsic motivation results in optimal skill performances of students. Therefore, time investment is equally important in order to develop and refine skills.
Role of the teacher	Instead of a teaching role, teachers increasingly obtain the role of facilitating and supporting students in their learning process and achieving individual learning goals. According to the literature of the theory of DP, teachers have a stimulating and inspiring role that helps students developing 21st century skills (Bhatti & Ahmed, 2015; Kiener et al., 2014; Tucker, 2014).
Transition of 21st skills in education to the labour market	Real-life cases are often used to transfer learned 21st century skills into practice. Through these cases, students are introduced to situations they can encounter within the workplace. A second key finding for the transitions of 21st

century skills to the labour market is the importance of the development of critical thinking. The ability of critical thinking helps students to think beyond the problem, and critically reflect on complex problem solving.

2.7 Research question

The present research is answering the following research question: *'Can the level of critical thinking of students in higher education be stimulated through deliberate practice?'* This study is focussing on critical thinking as one of the '21-century skills'. Aim of the study is to give practical implications for educational institutions how to improve and stimulate the level of critical thinking of students through the use of DP. Therefore, the following sub questions are answered in the method:

- What is the difference in blog use between students?
- How is the student motivated to make use of DP?
- How much time did the student invest to practice critical thinking?
- What is the role of the teacher using DP and stimulating critical thinking?

3. Method

This section will start with a description of the organisational context (3.1). Followed by an overview of the respondents of the present research (3.2). Elaboration on the procedure of the research and instrumentation of the intervention will follow (3.3 and 3.4) and finally, a description of the data analysis will be given (3.5).

3.1 Description of University of Applied Sciences Windesheim

University of Applied Sciences Windesheim (hereafter named as Windesheim), located in Zwolle, is nominated to be one of the three best universities of applied sciences of the Netherlands (Quality of Windesheim's study programs, 2016). Windesheim has about twenty-five thousand full-time and part-time students and more than two thousand staff. The vision of Windesheim comprises of the aim to play a significant role in the region, in the Netherlands and in the international community (Mission and Vision, 2017). By doing so, Windesheim strives that students develop into responsible, valuable and principled professionals. Professionals whose actions are guided by a vision of good citizenship in which personal, institutional and governmental values play an important role. Windesheim continuously strives for improvement (Mission and Vision, 2017). The educational offer of Windesheim consists of four domains; Engineering and IT, Human Movement and Education, Business, Media and Law and Health Care and Welfare. Especially the business part of the domain Business, Media and Law offers several master programs for graduated students and (young) professionals. Within the improvement of these master programs, Windesheim came up with a research question on how to improve these programs by adapting to the demands of the labour market and thus how 21st century skills can be stimulated.

3.2 Respondents

Data is collected from students within the Business, Media and Law department of Windesheim. Participants consist of students in the first year of their education and students in the second year of their education. The control group contained $N = 22$ students in their first year of their studies, with an average age of 19.59 years old. The treatment group consisted of $N = 24$ second year students who follow the "Trends and Analysis" course, where critical thinking is one of the 21st century skills that triggered within the course. The average age of the treatment group is $M = 21$ years old. All participants passed the course 'critical thinking' in the first year, where students were asked to solve a case by means of problem statement, analysing, hypothesis testing, giving alternatives and arguments for decision making, and finish with problem solving. Therefore assumed was that all participants know the meaning of critical thinking. $N = 28$ students participated within the post-test, which is a response rate of 60.9%, and 18 students dropped out of the study.

3.3 Instrumentation

The present research is structured as a pre-test, post-test control group design, with use of mixed methods. A pre- and post-test for measuring the current level of critical thinking provides quantitative data. In addition, an intervention for using DP as stimulation for critical thinking provides qualitative data.

3.3.1. Pre-test and post-test. Critical thinking is usually measured through two main methods, namely, through the use of cases, essays, and forms of constructed measures, or through the use of multiple choice items (Utrianen et al., 2016). The present study used the latter approach to measure the level of critical thinking by providing a multiple choice test previous on the intervention and after three weeks of intervention. In contrast to the treatment group, the control group did not get an intervention. The pre-test measured the current level of critical thinking. The post-test examined what influence the intervention had on the level of critical thinking of the students. The instrument used to measure critical thinking is the HCTA, the Halpern Critical Thinking Assessment (Halpern, 2012). The reliability of the total instrument was set on α = .85 or higher. The instrument consists of 20 forced multiple choice questions about everyday scenarios, and is used as a short form, with a Cronbach's Alpha of α = .79 (Halpern, 2012). The everyday scenarios consist of several disciplines that participants may encounter in daily life, such as social situations or medical research (De Bie, Wilhelm & Van der Meij, 2015). The HCTA measures five categories of critical thinking: (a) verbal reasoning, (b) argument analysis, (c) thinking as hypothesis testing, (d) likelihood and uncertainty, and (e) decision making and problem solving. The sum of these five categories can result in a score between 0 and 80, where 80 represents a high level of critical thinking (Halpern, 2012).

3.3.2. Intervention of deliberate practice. For the measurement of the stimulation of 21st century skills through DP, an open blog was developed. This open blog consisted of open questions without a maximum amount of words for the answers. Blogs are a valid and reliable measurement for self-directed learning, and since self-directed learning is important for continuous learning, blogs are used in this research (Endedijk, 2010). In addition, blogs compare the different learning experiences of the students, which is relevant for the outcomes and implications of this study (Endedijk, 2010). Two versions of the intervention were tested through a pilot test in order to examine which version results in the most useful data. The versions consisted of a seven-item blog and a four topic blog. Results of the pilot test showed that students are confused when more questions about one topic were asked. Additionally, the results showed that the seven-item blog provided data that was clear and more organized. Therefore, the seven-item version was used for the intervention with a few adjustments. The questions used in the intervention are based on the appliance of DP on developing critical thinking.

The treatment group was asked to write a blog every week with guidelines from the theory of DP and will be supported with questions based upon the log questions of the research of Endedijk (2010).

The intervention (see appendix A) started with a small introduction about critical thinking, so students would not be confused where to write about. Followed by seven items which are related to the seven principles of DP. For example, students were asked to reflect on their critical thinking skills during class or private situations. Moreover, in order to have specifically designed activities for every student, the students were asked to set up individual learning goals, related to critical thinking. Another example includes questions about the level of motivation of students, and the time and effort they invested in developing critical thinking. The intervention was e-mailed every week and a possibility was created for the students to write the blog during class. In order to provide the students some instructions for applying DP, the blog contained question and guidelines which helped the students to think about the practiced skill (critical thinking), to reflect on this skill, and to transfer this way of thinking and developing on to other skills and situations.

3.4 Procedure

As a starting point, the first and second year students were asked to participate in this study. Through e-mail, sent by the teacher, the students were informed about the content of the intervention and the duration of the study. The participants were informed that all data of the logs are only used for research purposes and were processed anonymous. In addition, to avoid bias, students were not informed about the goals of the study. The logs are presented as part of the course. The pre- and post-test lasted around 20 minutes and were taken during class in order to have a high response rate. The data of the blogs were gathered during a period of three weeks. Every week, students received an e-mail, sent by the teacher, to write the blog. The teacher of the 'Trends and analysis' course reserved 30 – 60 minutes per class, to give the students the opportunity to write the blog. The opportunity for reflecting during class ensured students were immediately evaluating their critical thinking skills. Within these classes, the teacher was present for questions and students were free to use the time for their blogs. However, there was no control if students were actually filling in the blogs at that time. Additionally, the blogs were sent every week to give students the opportunity to reflect on critical thinking in different situations, and were accessible during the week so students could use different situations and reflecting moments. To stimulate students to complete the logs and send them back, a weekly reminder by e-mail was sent. However, 16 students wrote a blog in the first week, and only 5 students wrote a second blog in the second week. The third week did not yield any blogs. This might be due to the voluntary participation of the research.

3.5 Data analysis

3.5.1. Quantitative data. The data of the pre-test and post-test was analysed with help of SPSS. The independent *t*-tests gave insight about the influence of the intervention by comparing the control group with the treatment group, and tested if the level of critical thinking increased within the treatment

group (see section 4.1). The independent *t*-test was also used for zooming in on critical thinking with measuring the influence of the intervention on the sub concepts of critical thinking (such as argument analysis, thinking as hypothesis testing, and verbal reasoning).

3.5.2. Qualitative data. Additionally, data of the blogs (provided through Qualtrics), gave an overview of how students worked with the intervention. The blogs provided support for the statistical outcomes. The blogs were coded through Atlas.it with a coding scheme which includes six sub questions to find out how DP is used and if critical thinking can be stimulated through help of using DP. Inter coding was measured with Cohen's Kappa with 20% of all assigned codes, which resulted in $N = 22$ valid cases. The measure of agreement showed $k = .76$, which indicates substantial agreement. Appendix B contains the used coding schema which consists of 47 codes, divided in six sub questions which are related to the principles of DP. First, received feedback and students responds on this feedback was coded. Secondly, the current level of critical thinking, including the five aspects of critical thinking, was analysed through strengths and weaknesses of own discretion of the students. The third and fourth sub questions were concerned with of the motivation of the students and the time effort they put into practice. These sub question are of great importance to develop critical thinking skills (and possible other 21st century skills). A distinction is made between intrinsic and extrinsic motivation to analyse how students are motivated and give possible recommendations for future practices and methods. Fifth, the role of the teacher was examined and the value students gave this role. Finally, the moment of reflection is part of the coding schema, which is an aspect of the requirements of DP. Next chapter discusses the results of the present research.

4. Results

This chapter elaborates on the quantitative results of the pre- and post-test, and the qualitative data outcomes of the intervention. Aim of this research was to find out if critical thinking could be stimulated through implementing DP in education. Therefore, analyses of the pre- and post-test contain the differences in the scores of the students on critical thinking (4.1). Second, outcomes of the blogs focus on remarkable patterns within the blogs and the way students differ in applying the principles of DP (4.2).

4.1 Comparing groups

Results of the pre-test showed that the treatment group had an average score of $M = 52$ on critical thinking, and the control group had a slightly higher average score of $M = 52.4$. Results of the post-test showed that the treatment group had an average score of $M = 47.8$ on critical thinking in comparison to an increase of the control group, with $M = 54.7$ (see Table 4 for the means, standard deviations, and minimum and maximum scores of the pre-test and post-test).

Table 4

Means, standard deviations and minimum and maximum score pre-and post-test.

Group type	Critical Thinking pre-test					Critical Thinking post-test				
	M	*N*	*SD*	*Min*	*Max*	*M*	*N*	*SD*	*Min*	*Max*
Control group	52.4	22	7.8	39	66	54.7	13	8.8	30	62
Treatment group	52	24	10.2	26	65	47.8	15	11.1	25	61
Total	52.2	46	9	26	66	51	28	10.5	25	62

This means that at the start of the study, both groups almost score equally on critical thinking. This is also supported by executing an independent *t*-test, which showed non-significance (t (44) = .15, p = .44), which means that students in the control group did not significantly differ from students in the treatment group. After four weeks of intervention, a post-test measured the score on critical thinking again. A new variable was computed in order to test if the treatment group increased its level of critical thinking in comparison with the control group. Assuming equal variances in Levene's test ($F = 1.75$, p = .198), the difference between the pre- and post-test and between the control and treatment group showed non-significance, (t (24) = -1.70, p = .05). Which means that students in the treatment group did not statistically benefit from the blog intervention in comparison to the control group.

When zooming in on critical thinking, the concept consisted of five subcategories, (a) verbal reasoning, (b) argument analysis, (c) thinking as hypothesis testing, (d) likelihood and uncertainty, and (e) decision making and problem solving. An independent *t*-test showed non-significance for verbal reasoning (t (23) = 1.04, p = .31), argument analysis (t (23) = -.45, p = .66), thinking as hypothesis testing (t (23) = -.25, p = .81), and decision making and problem solving (t (23) = 1.86, p = .076), which means that students in the treatment group did not statistically differ on these subcategories of critical thinking in comparison to the control group. One subcategory made an exception, likelihood and uncertainty, which showed a significance within the independent *t*-test (t (23) = 3.05, p = .006). This means that students in the treatment group statistically benefit from the intervention when it comes to likelihood and uncertainty.

4.2 Outcomes intervention deliberate practice

This paragraph gives an overview of the principles of DP that are examined with the blog intervention, such as feedback, current level of critical thinking, and the role of the teacher. Within the treatment group, students are distinguished in three sub categories. Students were assigned to a category based on their answers in the blog in combination with the use of the assigned codes from the coding schema. First, students who participated in the treatment group, without filling in the blog, the 'non-users' (4.2.1). Second, students who filled in the blog in a concise and superficial, or even incorrect way, the 'average users' (4.2.2.). The last group consists of students who seriously reflect on their critical thinking skills and made specific use of DP, the 'excellent users' (4.2.3.). Figure 1 presents an overview of the mean scores of critical thinking on the pre- and post-test of all groups.

Figure 1. Mean scores of pre- and post-test of all groups.

4.2.1. Non-use of intervention within treatment group. There were *N* = 11 students who were member of the treatment group, and did not filled in the blogs. These students had an average score of *M* = 49.4 (*SD* = 12.88), on the pre-test of critical thinking and *M* = 42.5 (*SD* = 12) on the post-test. The mean scores showed a decrease between the pre- and post-test of students who did not actively participate in the intervention. Next paragraph discusses the average users.

4.2.2. Average use of intervention within treatment group. The second group consists of *N* = 6 students who did fill in the blogs, however, their answers were very concise or deviating from the question. Which resulted in answers that were not particularly related to DP. The average users had a mean score of *M* = 51.5 (*SD* = 10.50) on the pre-test, and *M* = 51.33 (*SD* = 10.96) on the post-test. Moreover, students assigned to this second group were characterised by their moderated motivation, little time investment, or lacking answers. Most students in this group claim that they did not received any feedback and so, no action on feedback was taken ("*I did not received any feedback*".). In addition, results of these blogs showed that most strengths and weaknesses did not cover any of the five aspects of critical thinking, e.g. "*I tend to overthink too much, which is a weakness*" or "*honesty*" as a strength.

Noteworthy for the average users, students admit that they did not spend any time with practicing critical thinking, did not make any time, or they do not find it important to spend time on critical thinking, or to fill in the blogs extensively (e.g. "*To be honest, I won't be practicing it next week*".). Students blame deadlines and other (school) commitments to be more important than practicing critical thinking. Students claim to be more motivated when their peer-students are motivated too, or when they have to perform in a group or team (e.g. "*When I know that my input is needed, I feel more motivated to put in the extra effort (…), my motivation is more extrinsic, driven by others needing my input*."). In some cases, students claim to be slightly dependent on the feedback and inspiration of the teacher.

Students aim to be critical in school as well as in personal situations e.g. family or friends. Although students claim to have little time to practice critical thinking in other situations. Moreover, reflection is seen as time consuming and an obligation ("*I was really busy, so I did not have so much time to reflect*".), and resulted in short answers which are not very useful for interpreting the influence of the intervention (e.g. *"I don't reflect on it often."*). Next paragraph discusses the results of students who correctly and actively made use of the intervention.

4.2.3. Excellent use of intervention within treatment group. The last group is characterised by students (*N* = 9) who extendedly filled in the blogs, or students with high time investment, concrete examples of their current level of critical thinking, and elaborated answers on most of the questions. Students who did made used of the guidelines of DP are describing the received feedback that are linked to aspects of critical thinking, e.g. how they analyse information, or how they argument or reason their statements ("*(…) I need to review my thoughts and words before speaking them*."). Moreover, these

students immediately reflect on this feedback by thinking how to use this feedback in other contexts and improve themselves in upcoming situations ("*In new situations or practices I will try to implement the feedback (...)*"). Furthermore, the mean score of the pre-test in this group was *M* = 55.63 (*SD* = 5.07), which is considerably higher than the other groups. An explanation could be the understanding of critical thinking as a practicing skill. Figure 2 shows a representation of students within the subgroups who filled in the pre- and post-test. Which also shows that generally, the excellent users have a higher score on the pre-test in comparison to the other two groups.

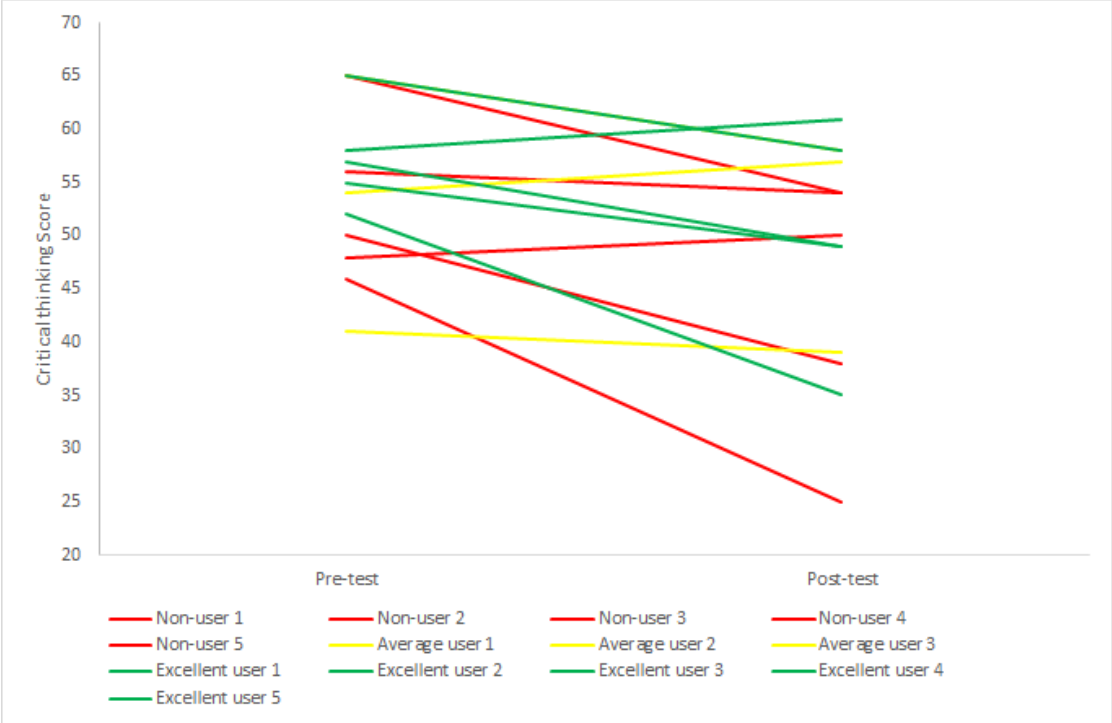

Figure 2. Pre-and post-test scores of individuals within the treatment group.

Students in this group were able to describe their strengths and weaknesses which were related to the five aspects of critical thinking. Noticeable is that argument analysis, likelihood and uncertainty, and verbal reasoning were mentioned most as strengths, and thinking as hypothesis testing is found to be complicated for students (e.g. "*My weakness is that I jump to conclusions too fast*".). In addition, students who took the time for reflecting, either during or after the activity, were found to be more elaborated and open about their critical thinking skills. They were precise in their reflection, and reflected critically on their own attitude, knowledge, and skills. These students were curious about improving their critical thinking, and showed intention to develop critical thinking (e.g. "(*...) and I try to broaden my view*."). Additionally, they do need teachers to coordinate group-oriented projects and providing assignments to stimulate critical thinking (e.g. "(*...) she actively encourages us to pay more attention to the construction of arguments in the essays that we hand in weekly*."). On the other hand,

some excellent users described their meaning of critical thinking and are really willing to develop this skill by their own (e.g. "*I simply motivate myself by my strong drive and desire to become better and more competent.").*

Moreover, users in this group tend to spend more time in comparison to average users, with developing and improving their critical thinking by "*trying to practice every day during discussions and conversations*". They are aware that critical thinking might take more time than three weeks to develop. An explanation for the decrease in the mean score (M = 51.33, SD = 9.97) might be the short duration of the present research. Which shows that excellent use of the intervention is not directly beneficial for a higher score on critical thinking. However, this group of students showed the intention to really work on the development of critical thinking.

5. Discussion

In this study, the main goal was to determine if the level of critical thinking could be stimulated through an intervention which includes the theory of DP. From a more practical perspective, how does this stimulation through DP apply in education? As DP was found to be effective within workplace settings, the present research hypothesized an increase of the level of critical thinking for students within the treatment group. Providing feedback, reflecting, time investment, and motivation are aspects that will constantly appear with discussing outcomes and results of the present research (Musa et al., 2012; Ocon, 2012; Tucker, 2014; Wijnen et al., 2017).

5.1 Outcomes

The present research included a literature review for complementing the data of the blogs. Previous literature showed several options to implement 21st century skills in daily education (e.g. project-based learning), however, DP was not included as a standard learning method. Although, there were some similarities found between the described methods and DP. In order to create a professional attitude, and develop collaboration and communication skills, literature described the importance of team work (Garcia & Gracias, 2012). To be fully dedicated to an assignment and improve matching skills (such as critical thinking), research showed the essence of choosing own topics and learning objectives within teams (Musa et al., 2012).

By zooming in on the treatment group, the 'non-users', 'average users', and the 'excellent users', showed a difference between groups. The level of critical thinking of the 'non-users' showed a decrease comparing the pre-test with the post-test, the 'average users' showed stability of critical thinking, and finally, the 'excellent users' also had a small decrease of critical thinking. However, comparing the control group with the treatment group, one of the most noticeable outcomes was statistical evidence of the intervention not to be beneficial for stimulating critical thinking. Explanations for the ineffectiveness of the intervention can be found in the blog data of the students. Two main findings are presented combining these blog answers with the literature.

5.1.1. Blog intervention. Presented intervention resulted in statistical evidence for insufficient stimulation of critical thinking, which can be explained through the high requirement of practice and time investment (Ericsson et al., 1993; Garcia & Gracias, 2012). Within the present research, reflecting on the current level of critical thinking gives students insight in their abilities, and helps students to generate new, individual learning goals. Through reflection on actions and received feedback, students are encouraged to deliberately think about their critical thinking skills. Moreover, students show intentions for improving critical thinking, however, because of the short duration of the present research, action for using DP in the daily routine is not developed yet. Refining critical thinking requires a longer process of intervention than three weeks. Research found that critical thinking requires minimum a year

of intervention to successfully develop and master the skills (Ongardwanich et al., 2015). Active use of DP in education, and an increase of the level of critical thinking can be created through stimulating extrinsic motivation, adding competitiveness, and implement activities and assignments referring to real life cases (Halpern, 2014; Ocon, 2012).

As was stated by Dochy (et al., 2011), the role of the teacher is extremely important for implementing DP and stimulating 21st century skills. According to students in the treatment group, feedback of teachers (or peer students) was not always present. In this regard, the ineffectiveness of the intervention can also be explained through the low involvement of teachers in a students' individual learning process. Literature showed a transformation of the role of the teacher within education. Were in the past teachers had a very authoritarian role and really focused on teaching knowledge, teachers nowadays are expected to facilitate learning environments, and in particular, support, encourage, and provide feedback for the student (Franklin, 2015). Teachers should provide challenging assignments with the use of, and reflection on real-life cases, which results in a successful transition for students to blend in the labour market. In this regard, teachers can help students to develop a critical attitude, which is beneficial for critical reasoning, out-of-the-box thinking, creative problem solving, and correct decision making (Chouari & Nachit, 2016; Wolcott & Karlin, 2011). Evaluating performance, providing feedback, and creating a safe environment are part of the characteristics of today's teachers (Bhatti & Ahmed, 2015; Dochy et al., 2011). None of the students talked about the teaching role of the teacher. The shift of the role of the teachers requires development in skills and flexibility of the teacher to adjust to the 21st century education. However, students are expected to become self-directed in their own learning to become independent within the long term. This suggests teachers to take a more supportive and challenging role (Dochy et al., 2011; Jossberger et al., 2010).

5.1.2. User difference of the intervention. It could be stated that not every student is using DP in the same way. This was shown through the distinction that was made within the treatment group. Learning and improving skills is individual, which makes appliance of the intervention also individual. The distinction has been established by the difference in motivation, feedback, and time investment. As previous research found, motivation is extremely important with regard to stimulate critical thinking, and additionally, with applying DP in education (Dochy et al., 2011; Siminica & Traistaru, 2013). The blog data showed a noticeable difference within motivation of the students. In general, students in the 'excellent user' group claimed to be motivated to develop and improve (new) skills, in contrast to students in the 'average user' group, who mentioned only be motivated, when others were too. Therefore, to successfully implement DP in education, students should be intrinsically as well as be extrinsically motivated in order to develop and improve skills themselves (Ryan & Deci, 2000).

Secondly, the groups differ in the way they described their feedback. In order to implement DP in education, feedback is one of the basic principles to successfully use the method. Whereas teachers are expected to provide feedback for the students, students should also learn how to give feedback to their

peer-students. This can help students to become aware of their skill weaknesses, independently of the teacher (Ocon, 2012). Many students in the present research claimed not to receive any feedback or cannot think of something. This suggests that students are not deliberately practicing their critical thinking skills, or are not aware of the feedback they are getting. This can be remedied by scheduled feedback moments from students and teachers.

Last, an important characteristic for the distinction of the groups concerned the difference in time investment for improving critical thinking. In this regard, the 'non-users' showed a decrease in the level of critical thinking by not investing any time in using the blogs for improving critical thinking. Moreover, the 'average users' practice with critical thinking by investing little time in improving the skill, however, not on a voluntary base. In comparison with the 'excellent users', where students tried to practice with critical thinking and reflection on a daily base and in various situations. Time investment was found to be partly dependent on the motivation of the students, however, teachers can enhance time investment through a competition-based aspects within assignments, and facilitating scheduled time for practice and reflection (Issa et al., 2014).

5.2 Limitations

The first major limitation includes the low response rate of participants in the present research. In order to measure if critical thinking could be stimulated with help of DP, it was essential to measure the level of critical thinking previous on the intervention, and after. Where the pre-test included more than 40 participants, only 27 students participated in the post-test, which resulted in a low number of completed pairs. Therefore, the sample size was too small for running tests in SPSS, such as the MANOVA which requires a minimum of 28 to have a large effect and even a desired sample size of 396 for a small effect size (f = .10) (Faul, Erdfelder, Bucher & Lang, 2013). Additionally, eleven students within the treatment group did not make use of the intervention, and only 21 blogs were received over three weeks of intervention. This can be explained through the crucial role of high time investment and motivation for developing 21st century skills, which was lacking with some students (Garcia & Gracias, 2012; Lawrence-Fowler et al., 2015; Ongardwanich et al., 2014). Corresponding with a noticeable quote of one of the students: "*It takes time to internalize a lesson learned through the setting of goals*". Although development over time and high time investment were missing within the present research, it gives opportunities for future research which should be set up on long term to actually improve critical thinking.

Second, the present research used an intervention for three weeks, which included subjective data from the blogs answers. The pre- and post-test provided objective data of the level of critical thinking previous on the intervention and afterwards. However, no objective data was obtained of the progress of students' level of critical thinking. Due to the short duration of the study, no intermediate measurements of the level of critical thinking are obtained, which means that the progression of students'

critical thinking cannot be identified. Whereas the present research used critical thinking in general, these intermediate measurements can be helpful for in-depth information and progression on the sub concepts of critical thinking (e.g. verbal reasoning, likelihood and uncertainty) (Halpern, 2012). In addition, teachers can use this data for improving their lessons, coaching, and feedback to students on a more in depth scale.

5.3 Implications

Where many studies examined the emergence of 21st century skills in general (Robles, 2012; Saavreda & Opfer, 2012), or the importance of 21st century skills as demands of the current labour market (Jossberger et al., 2010; Myagkov, 2016), few studies focus on stimulating 21st century skills in education, not to mention, studies focussing on critical thinking as a specific skill. Since the labour market has high demands regarding students and young employees, the development of critical thinking was examined in the present research in regard to meet these demands. The present research found critical thinking not only to be a practical skill to possess within the labour market, the skill can also be used for the transition and development of other 21st century skills. A workplace learning method, deliberate practice, used as intervention for stimulating critical thinking in education makes this study experiential. Using this intervention for stimulating critical thinking, and possibly other 21st century skills in the future, two important implications protrude above all results of this study (5.3.1.). In addition, scientific implication are discussed to identify what is learned from the present research and for future research (5.3.2). In this regard, this paragraph will end with suggestions for future research (5.3.3.).

5.3.1. Practical implications. First, in order to bridge the gap between education and the labour market, literature showed that future education strives for self-directed and continuous learning and is looking for possibilities and methods to succeed (Musa et al., 2012; Wijnen et al., 2017). It was found that motivation is essential for students in using DP. In this regard, combining intrinsic and extrinsic motivation can be enhanced by adding a competitive factor to assignments and courses (Issa et al., 2014). Second, whereas the present research focussed on the development of critical thinking, the transition of 21st century skills into the labour market was found to be highly dependent on skills and knowledge of teachers, experiences in workplace settings, and the professional attitude of students (Chouari & Nachit, 2016; Galvan et al., 2014 ; Kiener et al., 2014). Therefore, students should be facilitated with learning how critical thinking can be facilitated and regulated on behalf of transferring this skill into professional work settings. Educational institutions are required to provide developmental opportunities and provide well-trained teachers to accomplish this facilitation (Kiener et al., 2014). Internships during students' educational career is an example of a short term developmental opportunity, in which students are supported and trained in gaining experiences and creating a professional attitude.

5.3.2. Scientific implications. The present research, being of explorative nature, raises a number of scientific implications and possibilities for future research (5.3.3.). As the present research found, DP is successfully used within workplaces, because of the many opportunities for practicing and improving skills in real-life activities (Dochy et al., 2011). Moreover, employees have more responsibilities to enhance their own skills through individual activities and projects. In contrast, education is dependent of a general curriculum. Classes with approximately 25 students, who ultimately have to meet the same requirements to be able to obtain a diploma, causes little individualisation and possibilities for specifically designed activities (Dochy et al., 2011; European Commission, 2016a). However, aspects of DP, such as immediate feedback, time and effort investment, and the supporting role of the teacher (Ericsson, 2006), can be beneficial for stimulating critical thinking in education.

Second, the present research taught that critical thinking is a complex skill which includes many diverse aspects, and is too complex to stimulate in three weeks (Halpern, 2012). Because of the complex definition of critical thinking, students differ in the way they practiced the skill. Literature showed the importance of clear understanding and concrete objectives in order to improve 21st century skills (Gonzalez & Kardong-Edgren, 2017). In this regard, DP can be better deployed with some less complex 21st century skills such as communication or ICT literacy (Izzo et al., 2015; Witte et al., 2014/2015).

5.3.3. Future research. Clarifying and explaining the benefit and usage of critical thinking in daily life, ensures students understand the essence of critical thinking, and probably make more deliberate use of the skill (Gonzalez & Kardong-Edgren, 2017). In this regard, examining if the skill can be stimulated through DP, future research should start with measuring the knowledge of students about critical thinking and focus on the sub concepts of critical thinking. Intermediate measurements on these sub concepts can be used in order to adjust the teachers' role, or to create specifically designed activities which are focused on these sub concepts. After examining all sub concepts, an extensive research on long term should answer the overall question of how critical thinking can be stimulated in education. In addition, research on long term is also essential for measuring if DP can be part of the daily routine in education (Lawrence-Fowler et al., 2015). Furthermore, a larger sample size would be essential for a higher reliability (Faul et al., 2013). Multiple classes should be approached, to cover the chance of drop-outs. Making the intervention an obligatory part of the curriculum is important, so that students can really use DP and be able to make this learning method their own. Moreover, development over time and high time investment were missing within the present research, which means that future research on long term should be set up in order to achieve scientific evidence for improving critical thinking. In this regard, measurements with the blog intervention can take place more often, and more dispersed. As was mentioned, the earlier students start with practicing critical thinking, the more experienced they get (Garcia & Gracias, 2012). Therefore, suggested is that future research on stimulating critical thinking should start during first academic year, and continue this research intervention through students' whole educational career.

6. Conclusion

The main focus of the present research was to determine if the level of critical thinking of students in higher education can be stimulated through DP. Thereby, focus was set on mapping 21st century skills, the role of the teacher in developing critical thinking, and the transition of these skills from higher education to the current labour market. It turned out that the intervention with DP is not statistically stimulating critical thinking, however, the blog intervention created the intention of students to develop critical thinking. Moreover, the present research concluded that teachers are required to take a supporting and facilitating role within stimulating critical thinking, and are essential for motivating students in their learning process. In order to successfully stimulate critical thinking as one skill, future research should first focus on the separate aspects of critical thinking. In the end, the present research emphasizes the importance of intrinsic and extrinsic motivation as a basis for developing critical thinking, and moreover, all 21st century skills. So, can critical thinking of students be stimulated through DP? Statistically no. However, the present research concludes that the DP method is not completely stimulating critical thinking on short term, yet, guidelines of this method can be used for enhancing critical thinking on the long term.

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8. Appendix

Appendix A

Intervention DP (Dochy et al., 2011; Endedijk, 2010).

Introduction

Critical thinking is a very important 21st century skill for you, as a student, to have when you are entering the labour market. The skill helps with improving products and innovations, and develop new ideas. https://m.youtube.com/watch?v=ZLyUHbexz04

This movie shortly explains the aspects of critical thinking, the movie discusses critical thinking as skill where you need to understand systems, strategies and the importance of evidence to tackle problems.

Within critical thinking, it is important that you are able to use various types of reasoning. For example, within problem solving it is important to first find out what the real problem is and to find the underlying objective of the problem. Secondly, you have to be able to approach a problem with your own reasoning and beliefs and find relevant arguments and information that support your ideas for tackling the problem. It is possible that certain counter arguments will arise, so you need to interpret the information that you think is most relevant. Finally, it is of great importance to consider possible implications and consequences of your way of solving.

Please write about a situation in class, in your project group or in your social network, where you experienced critical thinking **last** week.

1. Describe a situation where you practiced with critical thinking. For example a situation at school, your job, or in your social environment. Include the following:

- What are your strengths when it comes to critical thinking?
- And what are your weaknesses when it comes to critical thinking?
- How did you analysed the information?
- What was important for you in reasoning pro's and con's?

2. Describe the feedback you got this week on critical thinking from your teacher or your peer students. Think about feedback on analysing, reasoning, or synthesizing information. Include the following:

- What would you do differently next time?

- How are you taking this feedback into new practices and situations? (Please elaborate with an example)

3. Describe how you reflected on your critical thinking skills. Include the following:

- When did you reflect on your critical thinking skills? For example, during the situation, right after the situation or now for the first time while writing your blog?
- How would you reflect on your critical thinking skills in a next time?
- Can you also use this reflecting with other skills?

4. Reflect upon your individual learning goal(s) within critical thinking. For example, your way of using literature, asking questions to peer students, discussing relevant information. Include the following:

- Describe why you wanted to learn this and how you practiced this.
- How did you make sure that you could work on your learning goals in a way that suited you?

5. Think again about how you practiced critical thinking last week and translate this to other situations. Answer the following questions:

- Can you use this way of practice in other situations?
- Give an example of how you would use this in other situations.

6. To solve problems and develop critical thinking, you have to be motivated.

- Describe how you motivated yourself to practice with critical thinking (e.g. in class, in your project group or at home).
- How much time did you invest to practice this skill this week?

7. Specify your new learning goals. Make sure your learning goals relate to critical thinking, the way you reflect or using the given feedback in other and new situations.

- Give a brief explanation of how you would practice with critical thinking next week.
- How do you want to accomplish this learning goal related to critical thinking?
- What role does the teacher have in your development of critical thinking?

Appendix B

Main question: Can the level of critical thinking of students in higher education be stimulated through deliberate practice?

Sub question 1: What feedback content is received and how did students respond?

	Direct action on feedback The student describes how he/she is taking (direct) action on the received feedback. This will be marked through words like 'from now on..' or 'directly'	**Intended action on feedback** The student has intentions to take action on the feedback that is received. This will be marked through words like 'in the future' or 'next time'	**No action on feedback** The student is not taking any action on the received feedback. This will be marked through words like 'not taking any action' or 'wouldn't do anything different'.
Feedback on educational outcomes Helpful information or criticism that is given to someone to say what can be done to improve a result or course grade e.g. an essay or test.	FEEDBOUT-DA 'I got an insufficient grade on my essay, so I directly processed the feedback to get a passing grade'	FEEDBOUT-IA 'In the future, I will not compare my grades with others'.	FEEDBOUT-NA 'I got a six on that course and I am satisfied with that, so I am not taking any action on the feedback of the teacher.'
Feedback on process Helpful information or criticism that is given to someone to say what can be done to improve a process or	FEEDBPR-DA 'We got the feedback that we did not analysed the data correctly, so we will use a different way now.'	FEEDBPR-IA 'The communication in our group went rough, so next time I will choose different group members'.	FEEDBPR-NA 'I took some extra time to complete the assignment, and in the end, it was not necessary, however, the

technical skill e.g. changing the way of working or processes such as writing or mathematics.			way of working suited me, so I would do the same in other situations'
Feedback on behaviour Helpful information or criticism that is given to someone to say what can be done to improve personal skills or personality traits e.g. adaptation, way of talking, or sensitivity.	FEEDBBE-DA 'I got the feedback that I am very empathetic, but that it sometimes takes over my professional objectivity, so I am now figuring out how I can separate my empathy for social connections and work related tasks.'	FEEDBBE-IA 'I would try to communicate more with my peer-students in the future.'	FEEDBBE-NA "I got the feedback that I should talk less, however, I do not agree with this, so I wouldn't do anything different".
No received feedback The student did not received any feedback	NOFEEDB-DA "I did not receive feedback, but if I did, I would directly do something about it".	NOFEEDB-IA 'I did not receive any feedback, but if I'd receive nice feedback I think I would make use of it and try to improve my critical thinking."	NOFEEDB-NA "I did not receive any feedback as far as I can remember, I also wouldn't do anything different". 'I did not receive feedback'.

Sub question 2: What is the current level of the student on the five aspects of critical thinking?

	Strength Student describes strengths of him/herself. This will be marked through words like 'my strength is', 'I'm good at…'	**Weakness** Student describes weaknesses of him/herself. This will be marked through words like 'my weakness is', 'I find it hard to…'
Verbal reasoning The ability to identify and evaluate the assumptions, definitions, labels, and connotations at work in persuasive uses of ordinary language (Wade & See, 2014). Verbal reasoning is the reasoning that fits the student, also called, the 'natural language' of the student (Halpern, 2003).	VR-STR 'I am good at giving reasons to be persuasive in a dilemma'.	VR-WEAK "I find it difficult to take a stand in a debate and to support my stand'.
Argument analysis The ability to seek and provide reasons and to recognize the differences between conclusions and assumptions. The ability to assess the strength of an argument. (Halpern, 2012) Argument analysis is about analysing existing claims of researchers/writers.	AA-STR 'My strength is to analyse the claims of authors and to find differences and comparisons between these claims'.	AA-WEAK "I find it hard to place the relevance of different perspectives and resources".
Thinking as hypothesis testing The ability to reason scientifically, to determine whether or not the given information confirms the hypotheses (Halpern,	THT-STR	THT-WEAK

2012). Critical thinkers recognize when a critical comparison is missing or when generalizations are made from small or biased samples.	‘My strength was to continue analysing questions and information in order to find the right answer.’	‘My weakness is that I quickly take information for granted and jump to conclusions too fast.’
Likelihood and uncertainty Understanding the appropriate or inappropriate use of hedging in the support of claims, as well as judging the probability of certain statement (Wade & See, 2014).	LU-STR ‘My strength is making sure, assumptions aren't just being made but also being supported by facts.’	LU-WEAK ‘I fail to ask questions that lead to deeper insights about motivations or sources.’
Decision making and problem solving Generating and selecting from alternatives based on relevant criteria. And finding solutions to a situation, or more colloquially, moving from a start space to a goal (Halpern, 2012). Alternatives need to be weighed for both positive and negative outcomes.	DMPS-STR ‘I compared several solutions to find out which one should be the best solutions for this given problem.’	DMPS-WEAK ‘For me my weakness is that I am not taking enough time which leads to forgetting things in the thinking and decision making process.’
Other Skills that are mentioned by the students as strength or weakness, but is not related to critical thinking.	OTH-STR ‘I am good at implementing excel documents’.	OTH-WEAK ‘I overthink too much’.

Sub question 3: Is the student motivated and how is the student motivated?

	Not motivated	**Moderately motivated**	**Very Motivated**
	The students is not motivated to deliberately improve his/her critical thinking. This will be marked through words like 'I'm not motivated' or 'I did not motivate myself..'	The students is moderately motivated to deliberately improve his/her critical thinking. This will be marked through words like 'somewhat motivated', ' a little motivated'.	The student is very motivated to deliberately improve his/her critical thinking. This will be marked through words like 'I'm excited to learn…, 'I'm motivated myself through…'
Intrinsic motivated The student is doing something because it is inherently interested in the topic or eager to develop him/herself (Ryan & Deci, 2000). This will be marked through words like 'motivated myself' or 'personal performance'.	INTR-NM 'I did not motivate myself to practice critical thinking'	INTR-MM 'I was very busy, but I did motivated myself a little to practice while watching the news.'	INTR-VM 'I am very motivated to improve my critical thinking skills, and to be more competent.'
Extrinsic motivated The student is doing something because others say so or it leads to a separable outcome (Ryan & Deci, 2000). This will be marked through words like 'drive by others' or 'depends on the group'.	EXTR-NM 'It totally depends on the group, if I am really like the group, I will be more motivated. Now I am really not motivated, because the others are not motivated as well.	EXTR-MM 'I needed to be somewhat motivated to keep up with my peer-students.'	EXTR-VM 'We have a very motivated group, so that helps me to be also extra motivated and put in extra effort that improves our discussions'.

Combination of intrinsic motivated and extrinsic motivated The student is doing something because it is inherently interested in the topic and is also motivated by others.	COMBI-NM "I don't make time to practice critical thinking, because I think I don't need it in class or for myself."	COMBI-MM 'I motivated myself a little to keep up with my peer-students'.	COMBI-VM 'I started to be interested in critical thinking through a course about critical thinking in my first year. Because of that course, I became eager to learn and develop critical thinking myself.'

Sub question 4: How much time did the student invest to practice critical thinking?

	No time is invested	**Few time is invested**	**Much time is invested**
	The student is not investing time on developing/practicing critical thinking. This will be marked through words like 'no time' or 'I did not practiced'.	The student practice few time in a week on critical thinking. This will be marked through words like 'some time' that is invested or students acknowledge that they don't spend much time in it.	The students practiced critical thinking regularly. This will be marked through words like '(almost) every day practice' or words as 'a lot' or 'many hours'.
	NOTIME " I haven't invested any time in it"	FEWTIME "I did not invest that much time this week"	MUCHTIME "We practiced almost every day since we had to complete the course."

Sub question 5: What is the role of the teacher and which value do students give this role?

	Teacher is not important The student thinks he/she does not need the teacher to improve or develop critical thinking. This will be marked through words like 'the teacher does not support..' or 'the teacher is not needed to ...'	**Teacher is slightly important** The student thinks he/she does need the teacher to improve or develop critical thinking, but only in a supportive/guiding role. The students is not dependent on the teacher. This will be marked through words like 'the teacher encourages..' or 'the teacher inspires..'	**Teacher is very important** The student thinks he/she is dependent on the teacher to improve or develop critical thinking. This will be marked through words like 'the teacher is important' or 'without teacher'.
Teacher arrangement The teacher provides opportunities for the student to work on individual learning goals. This will be marked through words like 'teacher gives the opportunity to..' or 'an assignment was given to..'	TEACHAR-NI 'The teacher does not provide any sources to practice'.	TEACHAR-SI 'The teacher encourages us to practice more with critical thinking and give tips about good reasoning and discussing our essays.'	TEACHAR-VI 'The teacher has to give an assignment to work on critical thinking'.
Teacher feedback The student values the feedback of the teacher. This will be marked through words like 'the teacher guided us...' or 'the feedback of the teacher..'	TEACHFB-NI 'I have my own thoughts about applying critical thinking, so the teacher does not play a role for me'.	TEACHFB-SI 'We asked feedback from our teacher to help us with solving problems.'	TEACHFB-VI 'Without feedback of our teacher, there is no motivation to stimulate my critical thinking'.

Sub question 6: When did students reflect on their critical thinking skills?

No reflection on situation	**Reflection during situation**	**Reflection right after situation**	**Reflecting for the first time writing a blog.**	**Constant reflection**
The student describes that he/she is not reflection on his/her critical thinking skills. This will be marked through words like 'I did not reflect' or 'never reflect'.	The student describes his/her moment of reflection as it was during the situation, practice or activity. This will be marked through words like 'during the situation' or 'while'.	The student describes his/her moment of reflection as it was after the situation, practice or activity. This will be marked through words like 'afterwards' or 'after the event'.	The student describes his/her moment of reflection as it was for the first time while writing the blog. This will be marked through words like 'first time' or 'haven't thought of it earlier'.	The student describes his/her moment of reflection as he/she is constantly reflection on his/her behaviour and critical thinking skills. This will be marked through words like 'constantly reflect'.
REFL-NO 'I did not reflect on my critical thinking skills, but maybe in the future I will do that.'	REFL-DS 'I usually reflect on my critical thinking skills during the activity (..).'	REFL-AS 'After the situation, I directly reflect on my behaviour and analyses how I applied critical thinking'.	REFL-FT 'This is the first time I reflect on my critical thinking skills (..)'.	REFL-CON 'I don't' have one particular moment to reflect, because I constantly reflect on my behaviour and skills.'