Learning for New Outcomes in Professional Contexts: Positioning Practical Simulations

Anne Khaled[1]*, Judith Gulikers*, Harm Biemans*, and Martin Mulder*
[1]anne.khaled@wur.nl
*Wageningen University, The Netherlands

1. Introduction

Past decades, the intended learning outcomes of vocational and higher education have changed; the aim of modern education is not only to educate students to participate in working processes any longer, but also to train students to become professionals who can deal with a wide range of ill-structured problems in a competent way. Consequently, education increasingly pays attention to the development of new learning outcomes like competencies (i.e. integrated knowledge, skills, and attitudes) and professional identity (Biemans et al., 2009).

Ideal situations to develop these new learning outcomes are authentic learning environments which resembles professional practices as much as possible. Learning experiences should than become meaningful and useful for students (de Bruijn & Leeman, 2011). However, simply being in a work-related environment does not automatically mean that optimal learning occurs (Chisholm, Harris, Northwood, & Johrendt, 2009). There is increasing evidence that working environments lack opportunities to engage in essential learning processes, such as performing connective and reflective learning tasks, for making connexions between professional practice and school (Onstenk & Blokhuis, 2007). Learning in *constructed* learning environments should therefore not be underestimated and be seen as an integrated part of learning for professions (Fuller, Hodkinson, Hodkinson, & Unwin, 2005).

Widely used constructed professional learning environments are practical simulations (i.e. 'hands-on simulations'). These are often being seen as powerful learning environments for professional related learning because of the focus on learning by deliberate practice, reflection, and feedback (Maran & Glavin, 2003). However, integration of constructed learning environments such as practical simulations in today's school curriculum is often being experienced as a tough task. There is very little insight in which new learning outcomes students exactly learn in practical simulations and which specific learning environment characteristics contribute to learning new learning outcome (Van der Sanden, de Bruijn, & Mulder, 2003).

For theory about designing effective professional learning contexts and for teachers who have to implement learning theories, it is important to position practical simulations in today's educational system. Present research contributes to this by a systematic literature review on reported learning outcomes and learning environment characteristics of three professional learning contexts which are being used regularly in European secondary vocational and professional higher education, namely practical simulations, authentic projects, and internships. The following research questions will be answered: 1) What are typical learning environment characteristics of practical simulations compared to other professional learning contexts (i.e. student projects and apprenticeship)? 2) Which learning outcomes can

typically be developed in practical simulations compared to learning outcomes in other professional learning contexts?

1.2 Theoretical Framework

To achieve the development of the new learning outcomes, researchers and educationalist increasingly tend to focus on designing Powerful Learning Environments (Gijbels, van de Watering, Dochy, & van den Bossche, 2006; Winters, Meijers, Kuijpers, & Baert, 2009).

The theoretical framework that is being used for this study is the Model of Powerful Learning Environments (de Bruijn & Leeman, 2011). The model of PLEs includes several design principles which are specifically important for professional education. Based on extensive research, the model is a combination of traditional principles, like direct instruction, and innovative principles, like self-regulative and reflective learning. Each principle is worked-out in concrete powerful learning environment characteristics.

Programme characteristics
1. Formation of vocational identity as the starting point for learning
2. Authenticity
3. Reconciliation of thematic and subject-oriented contents

Student learning
4. Construction
5. Reflection

Guiding activities of teachers
6. Adaptive instruction and modelling
7. Coaching
8. Supporting self-regulation skills

Evaluation
9. Instrumental testing of partial- knowledge, insight, and skills
10. Assessment of competencies

Because this study will analyse types of learning outcomes reported in literature, the variety of possible learning outcomes of professional learning are brought to attention.

New learning outcomes	Competencies	The ability of a person to a certain performance and includes both knowledge clusters such as interactive, affective, (if necessary) psychomotor skills, and attitude aspects necessary to perform certain tasks, solve problems, and act effectively in a specific situation, profession, or organization (Mulder, 2001)
	Professional identity	Students' awareness of what motivates him, what his interests are and what his options are in his (or another) professional field (Savickas et al., 2009)
	Transfer	The ability of students to isolate skills and knowledge from a specific context and apply these in different situations (Illeris, 2009), i.e. de-contextualize and re-contextualize.
Traditional learning outcomes	Knowledge	1) Factual knowledge: memorization of terms and specific details 2) conceptual knowledge: establishing connections between various elements 3) procedural knowledge: knowing how knowledge can be applied 4) metacognitive knowledge: knowledge of cognitive tasks and self-knowledge (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956)
	Skills	1) Cognitive skills referred to as decision making, problem solving and logical thinking 2) psychomotor skills or technical skills 3) interactive skills such as leadership, coaching and sales techniques 4) reactive skills like attentive behaviour (Romiszowski, 1999).
	Attitude	Students' affective behaviour e.g. control of emotions and attitudes towards religion (Martin & Reigeluth, 1999).

2. Method

2.1 Search Procedure

A list of word combinations was generalized in order to find studies that reported on the learning outcomes fostered by learning in professional learning contexts. Three sets included terms referred to the learning environments: practical simulations *("simulation", "simulator", "simulated"),* authentic projects *("project-based learning", "student projects", "service learning"),* and internships *("internship", "student placement", "apprenticeship").* When testing the word sets, hits on computer simulations were overwhelmingly. Therefore, the sets for practical simulations were extended with NOT *"computer"* and NOT *"virtual"*. The learning outcomes set contained *"learning outcomes", "student learning"*, and *effect**. Because of the large variation educational systems and diversity in terminology, the search for educational level (secondary vocational and professional higher education) also contained a lot of noise. In some countries secondary vocational education equals low skilled education while in other countries students can be educated to become a manager. Furthermore, in many countries there is barely a distinction between professional higher education and higher education. 'Undergraduate' education represents both academic as well as practical, literature provides little information about this. The authors therefore chose to expand this review to vocational and higher education in general and used the terms "*vocational education*" and "*higher education*" in the fifth set. Each term in set 1, 2, and 3 was combined with each term in set 4 and 5 (e.g. internship x learning outcomes x vocational education). This resulted 54 word combinations.

In March and April 2011 the literature search was conducted by entering the combinations through the electronic databases Educational Resources Information Centre (ERIC) and Web of science. The search was limited to English written peer-reviewed publications which were published in 2001 to 2011 to trace empirical research on current education. The search of the word combinations in the title and/or abstract resulted in 206 hits for practical simulations, 291 for authentic projects, and 213 hits for internships.

2.2 Inclusion Criteria

After the electronic search, relevant articles were selected. A study was selected when it met following criteria:

- learning activities focused on students of vocational and/or higher education;
- students' learning outcomes (as a result of the intervention) and a clear description characteristics of the learning environment must be reported;
- learning outcomes should have been measured by a test, observations, and/or student evaluation (survey, interview);

Additional criteria for selection were formulated per type of learning environment. For practical simulations 1) the learning goal of the simulation had to be education 2) students had to practise a complete professional task 3) the learning environment was a physical replica of the professional context or took place in the real professional environment 4) students actively participated ('hands-on') in the simulation (Gaba, 2004; Miller, 1990). Articles about authentic projects were included when 1) the problem/task was generated by a real client 2)

the problem was representative for problems students can encounter in their future profession 3) students conducted the task in cooperation with the client 4) the product was useful for the client (Boud & Costley, 2007; Helle, Tynjala, Olkinuora, & Lonka, 2007). Articles about internships were included in present study when the students fully participated in the working processes in a specific organisation for a pre-determined period of time (no dual education) (Onstenk & Blokhuis, 2007).

2.3 Analysis

For the analysis, a top-down and a bottom-up method was used respectively. First, each article that met the criteria for inclusion was coded on learning environment characteristics and learning outcomes previously described in the theoretical framework. Next to the type of learning outcomes the impact of the intervention was also coded[1]. The analysis also included a description of the learning situation, the duration of the intervention, and the students to provide an overview of the kinds of learning environments that were included in the study.

While coding the articles, the researcher repeatedly encountered several learning environment characteristics which could not be coded with the established coding scheme. Therefore, the learning environment characteristics which the researcher surprisingly often encountered and did not fit into the coding, were also included in the coding scheme.

In the final phase, differences in learning environment characteristics and learning outcomes between practical simulations and the other professional learning environments were analysed. Characteristics and outcomes that were mentioned more frequently compared to the other learning environments were seen as typical for that learning environment.

3. Results

This chapter describes respectively the overall findings of this review, the results concerning the learning characteristics and learning outcomes of practical simulations, authentic projects and internships, and an overview of typical learning characteristics and learning outcomes of practical simulations compared to the other two learning environments.

3.1 General Findings

The thorough screening resulted in five relevant studies for practical simulations, five studies for authentic projects, and seven studies for internships[2]. The most striking finding is that almost all studies were in higher education, no study was conducted in secondary vocational education. Second, the results show that most relevant articles for practical simulations were conducted in the medical discipline. Disciplines of authentic projects (e.g. food science, business administration, accounting, biology) and internships (e.g. social services, planning, medication) were more varied. Moreover, the research methods were remarkable. A common method to evaluate learning outcomes, especially in authentic projects and internships, were student responses. Performance ratings were relatively much more used in practical simulations (four out of five studies).

[1] Codes can be requested from the first author
[2] A detailed overview of relevant studies can be requested from the first author

3.2 Typical Learning Environment Characteristics

The application of top-down and bottom-up approach has led to an overview of learning environment characteristics (Table 3.1). Some characteristics from the original model of PLE were omitted from the model or have another place in the model.

First, because it is quite obvious that development of professional identity is an important goal of learning in professional contexts and a lot of subjectivity was involved in coding this characteristic, it was decided to exclude this characteristic from the coding scheme. However, it is interesting whether students actually got the chance to develop their professional identity during learning in professional contexts. According to Meijers and Kuijpers (2007), students develop their professional identity best when they experience many (different) professional roles during training. Therefore it was decided to examine *the variety of professional roles* students were exposed to during learning. Second, the authors have chosen to replace the third characteristic (reconciliation of thematic and subject-oriented contents) into *integration in curriculum* to examine how the learning environment is related to other subjects or activities of the curriculum. Third, the characteristics of functional testing knowledge, insights and skills and assessment of broad competencies, the authors merged into one characteristic *'examination'*. Fourth, the analysis also showed that the environments differed in types of cooperation. And as a result of the bottom-up method, the authors divided construction into *construction (individually)* and *construction (cooperative)* and added *complexity* and *ownership of learning process* to the model.

Table 3.1 illustrates that all three learning environments somehow differ in programme characteristics, student learning, guidance, and evaluation. Compared to authentic projects and internships, typical for practical simulations is that 1) practical simulations are used for tasks which vary in complexity from moderate complex to complex 2) students are able to practise various professional roles 3) practical simulations have structural reflection moments 4) students give peer-feedback 5) nothing was reported about how students take ownership of the learning process, which may indicate that this was hardly expected of the students 6) teachers give feedback, and that 7) the actual performance of students is assessed.

3.3 Typical Learning Outcomes

Table 3.2 summarizes the developed learning outcomes as reported in the articles. Remarkably, the new learning outcomes are underrepresented in this overview and although not all differences between the types of learning outcomes are that obvious, there are two types of learning outcomes which were only measured in studies on practical simulations, namely transfer (McCaughey & Traynor, 2010; Rush, Acton, Tolley, Marks-Maran, & Burke, 2010) and metacognitive knowledge (McCaughey et al, 2010). McCaughey and others for example, showed that students felt that the simulation training was very useful for their subsequent internship and even helped them to apply the clinical skills during internship better. This survey was taken six months after the practical simulation which indicates that transfer of learning from practical simulation to the workplace is possible. The same students gained insights on their strengths and weaknesses and became aware of what they have to work on in order to complete their final assessment successfully, this shows that practical simulations can contribute to students' metacognitive knowledge. Table 3.2 also illustrates

that conceptual knowledge was measured more often in practical simulations than the other learning environments. McCaughey and Taylor (2010) and Rush et. al., (2010) report that students learnt to make relationships between subject matter (theory) and practice through participating practical simulations. Besides transfer, no other new learning outcomes were typically related to practical simulations.

Table 3.1 Learning environment characteristics

	Practical simulations	Authentic projects	Internships
Program characteristics			
Integration in curriculum*	One (Rush, et al., 2010; Zeng & Johnson, 2009) or more sessions (Alinier, Hunt, Gordon, & Harwood, 2006; Wenk et al., 2009) that are part of a course. Sometimes a preparatory session (Alinier, et al., 2006; Wenk, et al., 2009)	Usually part of curriculum (e.g. major) (Cooper, Bottomley, & Gordon, 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004). Focus on learning goals, design and preparation of project on campus as well in professional practice by literature, group discussions and exploratory visits (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004; Tschopp, 2004)	Part of curriculum, sometimes integrated in course (Jackson & Jackson, 2009; Karasik, 2009) or related to seminars in educational institute (Hoifodt, Olstad, & Sexton, 2007; Karasik, 2009)
Authenticity	Realistic replica of profession, tasks and physical context (Alinier, et al., 2006; Rush, et al., 2010; Wenk, et al., 2009; Zeng & Johnson, 2009)	Physical context: partly in school, partly in profession. (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004; Schäfer & Richards, 2007)	Completely performed in professional context (Cannon, 2008; Freestone, Williams, Thompson, & Trembath, 2007; Goldman, Plack, Roche, Smith, & Turley, 2009; Hoifodt, et al., 2007; Jackson & Jackson, 2009; Karasik, 2009; Mihail, 2006)
Complexity*	Moderately complex (Alinier, et al., 2006) to complex (Rush, et al., 2010)	Complex (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004; Tschopp, 2004) up to very complex (Schäfer & Richards, 2007)	Complexity varies. Simple tasks (e.g. administrative) (Jackson & Jackson, 2009) to complex problems (Goldman, et al., 2009)
Student learning			
Adopting professional roles *	Students adopt professional roles (Wenk, et al., 2009) or change roles during the simulation (Zeng & Johnson, 2009)	Students adopt one role during project (manager/performer) (Schäfer & Richards, 2007)	Variety in professional roles varies, sometimes not enough chance to experience different professional roles (Hoifodt, et al., 2007; Jackson & Jackson, 2009)
Construction (individual)*	Practicing/repeating tasks (Rush, et al., 2010) Learning from mistakes without consequences (Rush, et al., 2010) Observing peers (Alinier, et al., 2006; Rush, et al., 2010)	Learning from mistakes without consequences (Schäfer & Richards, 2007)	Practicing/repeating tasks (Goldman, et al., 2009) Learning from mistakes (Goldman, et al., 2009) Observing senior colleague/mentor (Goldman, et al., 2009)
Construction (cooperative) *	Work together in groups regularly (Alinier, et al., 2006; Rush, et al., 2010; Zeng & Johnson, 2009) and give each other feedback (Alinier, et al., 2006; Rush, et al., 2010)	Frequent cooperation with peers from same discipline (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004) or working in disciplinary teams (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Montgomery, 2004)	Informal cooperation with colleagues (Mihail, 2006)
Reflection	Looking back on performance after simulation or after each episode (e.g. in group discussions), formulate points of improvement and apply points of improvement in next session or episode (Alinier, et al., 2006; Rush, et al., 2010; Zeng & Johnson, 2009)	Reflection assignments, journals, self-assessments (Montgomery, 2004)	Reflection assignments, journals (Cannon, 2008; Karasik, 2009), capture learning outcomes on camera (Cannon, 2008)
Ownership of learning process*	xxx	Students choose content of assignment (Goto & Bianco-Simeral, 2009; Schäfer & Richards, 2007)	Proactive attitude of the student is expected. For example, students must find their own internship (Karasik, 2009; Mihail, 2006), self-directed activities (e.g. practice skills in simulation or reading books) (Goldman et al, 2009) and asking for feedback (Goldman et al, 2009; Jackson & Jackson, 2009)
Guidance			
Instruction/model	Teacher actively engage students in instruction by asking questions frequently (Rush, et al., 2010)	Teacher assists students during project (Schäfer & Richards, 2007)	Guidance by workplace supervisor: modelling, thinking aloud, asking questions, dialogues (Goldman, et al., 2009)

	Practical simulations	**Authentic projects**	**Internships**
Coaching	Teacher gives feedback on performance before and after the simulation (Alinier, et al., 2006; Rush, et al., 2010). (also see reflection)	Feedback from teacher and client (Goto & Bianco-Simeral, 2009). Client does not always have time to properly guide students (Goto & Bianco-Simeral, 2009)	Feedback from teachers (Cannon, 2008) Often no supervision on workplace (Hoifodt, et al., 2007) and is focused on correcting mistakes instead of structural coaching (Goldman, et al., 2009; Hoifodt, et al., 2007; Jackson & Jackson, 2009)
Stimulating self-regulated learning	xxx	xxx	xxx
Evaluation			
Examination*	Performance test (Alinier, et al., 2006; McCaughey & Traynor, 2010; Wenk, et al., 2009) essay and knowledge test (Zeng & Johnson, 2009), and collecting evidence for personal portfolio (Alinier, et al., 2006)	Assessment of process, report (Goto & Bianco-Simeral, 2009; Tschopp, 2004), or portfolio (Montgomery, 2004)	Assessment performance based on written reports (Morrison, Graden, & Barnett, 2009) or final interview (Karasik, 2009).

* Modified or added to original model based on literature review

Table 3.2 Types of learning outcomes

	Practical simulations	Authentic projects	Internships
Competencies	- Vocational competence of nurses (Alinier, et al., 2006)		- Vocational competence of school psychologists (Morrison, et al., 2009)
Transfer	- **Transfer of knowledge and skills to internships (McCaughey & Traynor, 2010; Rush, et al., 2010):**		
Professional identity	- Insight in developing professional role (McCaughey & Traynor, 2010)	- Broader view on professional roles (Cooper, et al., 2004; Schäfer & Richards, 2007) - Interest in professional field (Tschopp, 2004) - Career choice (Cooper, et al., 2004)	- Broader view on professional roles (Jackson & Jackson, 2009) - Broader view on professional field (Jackson & Jackson, 2009) - Insight in personal work habits(Jackson & Jackson, 2009)
Knowledge	- **Conceptual knowledge (McCaughey & Traynor, 2010; Rush, et al., 2010): understanding relationship theory and practice** - Procedural knowledge (Wenk, et al., 2009; Zeng & Johnson, 2009) - **Metacognitive knowledge (McCaughey & Traynor, 2010): Preparation for assessment**	- Conceptual knowledge (Montgomery, 2004) - Procedural knowledge (Goto & Bianco-Simeral, 2009)	- Conceptual knowledge (Goldman, et al., 2009) - Procedural knowledge (Goldman, et al., 2009; Karasik, 2009)
Skills	- Technical skills (Wenk, et al., 2009) - Cognitive skills (Zeng & Johnson, 2009): conducting logistic processes	- Technical skills (Schäfer & Richards, 2007) - Cognitive skills (Cooper, et al., 2004; Goto & Bianco-Simeral, 2009; Tschopp, 2004): Problem solving, planning, decision making, assessment, researching and project management - Interactive skills (Cooper, et al., 2004; Schäfer & Richards, 2007): Working in teams, leadership, customer service, communication - Reactive skills (Schäfer & Richards, 2007): interpersonal skills	- Cognitive skills (Freestone, et al., 2007; Goldman, et al., 2009):Problem solving, analytical skills, researching, critical thinking, creativity, planning/self-regulation, flexibility and adaptability, utilizing colleagues - Interactive skills(Freestone, et al., 2007; Goldman, et al., 2009; Karasik, 2009; Mihail, 2006): Working in teams, communication
Attitude		- (Cooper, et al., 2004): understanding the perspectives and views of others	- (Cannon, 2008; Freestone, et al., 2007; Goldman, et al., 2009; Hoifodt, et al., 2007) Self-confidence, self-awareness, willingness to learn, moral judgement

4. Conclusion

Present review study points out that practical simulations do have typical learning environment characteristics and learning outcomes compared to two other professional learning contexts. Table 4.1 summarizes this typology. Relationships between structure of the learning environment and the types of learning outcomes are difficult to explain. Possible explanations for the fact that practical simulations do focus on applicability in future work (reflected in transfer and metacognitive knowledge) is that simulations are an explicit form of training which offers students many opportunities to experiment and aims at delivering performance (performance of activities or tasks). This is also clearly reflected in the assessment method of practical simulations. Contrary to practical simulations, the other professional learning environments seem to be used for more generic skills like problem

solving and communication. The overview also shows that, in all three professional learning contexts, the new learning outcomes are still being overshadowed by traditional learning outcomes.

4.1 Learning environment characteristics and learning outcomes for practical simulations illuminated

	Program characteristics	**Student learning**	**Guidance**	**Evaluation**	**Typical learning outcomes**
Practical simulations	Part of course Realistic replica of professional context Moderate complex to complex	Adopting several professional roles Working with peers regularly Structural feedback and reflection No self-responsibility for learning process expected	Rather intensive guidance	Assessment of performance	**Transfer** Conceptual knowledge **Metacognitive knowledge**
Authentic projects	Integrated in educational program Partly in professional context Complex to very complex	Adopting one professional role Intensive cooperation with peers and externals Self-reflection Self-responsibility of learning process	Process guidance	Assessment of process and product	Professional identity Cognitive skills Interactive skills Reactive skills
Internships	Mostly isolated from activities in educational program Completely in professional context Varity in complexity	Adopting limited professional contexts Informal learning from colleagues Self-reflection A lot of self-responsibility of learning process	Incidental guidance	Assessment of process	Cognitive skills Interactive skills Attitude

5. Discussion

5.1 Limitations

The findings of this study should be taken carefully since this study has several limitations. First, the selected search terms and criteria for inclusion may have resulted in exclusion of possible other relevant published research on the learning characteristics and learning outcomes of both practical simulations and authentic projects and internships. Second, only seventeen studies were analysed on twelve learning environment characteristics. Thereby, not all studies provided much information about the learning environment. The learning environment characteristics could not all be equally represented in the results, this also holds account for the results of the learning outcomes. The third limitation is that no studies of secondary vocational education met the criteria for analysis and four out of five studies about practical simulations were conducted in the medical field which makes it difficult to generalize the findings of this literature review.

5.2 Future Research

It is advisable to continue research into positioning practical simulations in relation to other professional contexts since professional contexts are a central component of both secondary vocational education and professional higher education. The focus should be on learning outcomes which are relevant to today's education, namely competencies, transfer, and professional identity. An interesting addition to this research could be a deepening study of the relationship between learning environment characteristics and new learning outcomes. To achieve this, the learning outcomes should not only be measured by student evaluations, but also methods which match the types of learning outcomes such as performance assessments and observations. To conclude, the authors will give present literature research more body by incorporating relevant articles from the reference lists ('snowballing') in the near future.

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