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AND HEALTH SCIENCES

# **ASSESSMENT OF REFLECTION IN UNDERGRADUATE HEALTH SCIENCES EDUCATION**

Thesis submitted to obtain the degree of  
Doctor in Medical Sciences

Sebastian Koole

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# General introduction

## General introduction

### 1. A century of reforms in health care practice and education

Since the Flexner report in 1910, health sciences education has experienced three generations of educational reforms (Frenk *et al.* 2010). The first generation was grounded in Flexner's recommendations to introduce a strong foundation of basic sciences into the curriculum before the start of the clinical years in which students learned to use their knowledge in patient care (Cooke *et al.* 2006; Weatherall 2011). This approach assumed teaching knowledge before its application and perceived learning in a model of (doctor involved) apprenticeship (Mann 2011). Flexner intended research as a method to investigate questions derived from patient care, to be carried out by clinician-investigators and leading to improved patient care and teaching (Cooke *et al.* 2006). Today, this view on teaching by clinician-researchers is superseded as the pressure on clinical productivity and the specialisation of research methods raise a big obstacle to integrate both aspects in one teacher (Cooke *et al.* 2006).

The second educational reform in health sciences education was around mid-20<sup>th</sup> century and involved a shift towards a constructivist approach to learning (Frenk *et al.* 2010). Initially, the perspective on knowledge and knowing in sciences was strongly influenced by positivism, which assumes an objective external reality and provides, through empirical study, a source for the development of value- and context-free knowledge (Playle 1995; Kneebone 2002; Mann 2011; Mann *et al.* 2011). Constructivism has an opposite view on knowledge and knowledge acquisition. It focusses on a learner actively constructing knowledge, influenced by a personal representation of the world based on previous experience, perceptions and knowledge (Mann *et al.* 2009a; Mann 2011; Mann *et al.* 2011). The adoption of a constructivist approach to learning assumes learning as an active process rather than passively receiving information, changes the teacher's role from supplier of information to coach of the learning process in students and stresses the importance of social context in learning (Mann *et al.* 2009a; Frenk *et al.* 2010; Mann 2011).

Today, a third generation of reforms is proposed, driven by the globalisation of health care. Considering the emerging imbalance between health care and patient- and population needs throughout the world, these reforms advocate instructional change towards transformative learning and institutional change towards interdependence of education (Frenk *et al.* 2010). Transformative learning can be viewed in a social emancipatory perspective and focusses on learners as subjects that continuously reflect and act to transform their world in becoming a more equitable place for all (Taylor 2008). In health sciences education the purpose of transformative learning is about educating learners to become change agents for a balanced global health system (Wartman 2010). The discovery-care continuum describes the pathway of innovative ideas from the discovery in sciences and in-vivo analysis to preclinical and clinical research to the adoption in practice and ultimately to global use (Dzau *et al.* 2010). To overcome the gaps between scientific discovery and clinical application and between experts acceptance and global adoption, institutional reforms are proposed to ensure the interaction of all components in the discovery-care continuum both locally and globally. They encompass the shift from individual isolated institutions providing fractured research, patient care and education towards interconnected health systems integrating research, health care provision and education improving health and well-being of both the local and global community (Dzau *et al.* 2010; Wartman 2010).

These reforms, both fuelled by changing views on health care and education (Frenk *et al.* 2010) have led to an increased focus on reflection as an important attribute for health professionals and health sciences education (Schön 1983, 1987; Boud *et al.* 1985; Atkins and Murphy 1993; Clouder 2000; Plack and Greenberg 2005).

## 2. Reflection and professional practice

The increased attention for health care professionals to reflect is a consequence of the increasing complexity of the health care environment. The knowledge base and related skills have grown exponentially, patients become more demanding with higher expectations and the provision of care is considered an interdisciplinary effort with each professional being in permanent collaboration with others (Cooke *et al.* 2006). In response to this complex work context and to maintain high quality care, Schön (1983, 1987) stated health care workers should evolve to reflective practitioners. He used a metaphor to describe the environment of professional practice.

*“In the varied topography of professional practice, there is a high, hard ground overlooking a swamp. On the high ground, manageable problems lend themselves to solution through the application of research-based theory and technique. In the swampy lowland, messy, confusing problems defy technical solution. The irony of this situation is that problems of the high ground tend to be relatively unimportant to individuals or society at large, however great their technical interest may be, while in the swamp lie the problems of greatest human concern. “*

(Schön 1987, p.3)

Opposed to the use of straightforward solutions in problems on the ‘high ground’, Schön advocated reflection as an approach for professionals to address these messy, ill-defined problems in the ‘swamp’. In line with the constructivist view on learning, he rejected the idea of real world practice that exclusively is presented in well-formed structures. Instead he recognised the uniqueness of situations that cannot be solved by solely applying theory and techniques. As alternative he proposed reflection, allowing practitioners to become aware of the various aspects of unique situations in search for solutions.

This thoughtful approach to professional practice has also been adopted as an important attribute for continuous professional development and lifelong learning (Schweinfurth 2007; Tagawa 2008; Collins 2009). Continuing professional development and lifelong learning have become increasingly important for professionals to ensure safe and up-to-date health care as the advancement in health care knowledge and skills is unprecedented (Gosling 1997; Schrock and Cydulka 2006; Lehtinen 2008). It implies learning does not end at the moment of graduation, but is a process throughout life (Titmus 1999; Schrock and Cydulka 2006; Collins 2009). Initially, this process was driven by continuing professional education in conferences, continuing professional courses and the necessity to fulfil certification criteria, leading to passive learning (Schweinfurth 2007). This initial view of lifelong learning, however, has been shifted towards a perspective promoting continuous development of

health professionals as a social-personal process (Schweinfurth 2007; Billett 2010). Focus of this concept is the professionals' active involvement in learning within their own authentic professional workplaces (Charlton 2001; Teunissen and Dornan 2008). Personal commitment to lifelong learning requires skills in goal setting, knowledge acquisition, self-assessment and self-reflection. But also the interaction with peers and the perception of health professionals as members of a larger social context will contribute to an effective continuous professional development strategy (Teunissen and Dornan 2008; Collins 2009). Opposed to the dominant external directive approach in initial perspectives on continuing professional development, the present view stresses the importance of internal control of the learning process (Ryan 2003). This process is also called self-directed learning and encompasses the interconnected dimensions of self-management, self-monitoring and motivation (Garrison 1997; Schweinfurth 2007).

In terms of lifelong learning, the workplace is not only to be seen as an environment solely focussed on the provision of health care but also as a rich authentic learning context. This learning environment is characterised as informal, incidental, experiential, social, situated and practice-bound of nature (Tynjälä 2008). To understand the complexity of this learning environment three constituent components of workplace learning have been proposed (Teunissen and Wilkinson 2011). 1. Each 'learner' in a workplace has specific responsibilities. The main concern will be the provision of optimal patient care, but also cost effectiveness and education can be objectives. In the same workplace 'learners' may have various tasks which influence their learning. 2. The context in which the task is performed will also effect learning. This concerns both the physical context as well as the social environment. 3. The characteristics of the 'learner' form the last component. In a workplace they bring their own unique frame of reference, their unique intentions, goals and beliefs as active participants in the performance of the task and their emotions and physical state. The interaction of all those components will ultimately influence learning of health care professionals on the workplace. The ability to reflect will allow practitioners to become aware of these components in understanding their work experiences and to direct their learning and practice (Boud *et al.* 1985; Williams 2010).

Aukes *et al.* (2009) visualised the interaction between reflective practice and behaviour in their float model. This model uses a metaphor of a float in fishing to describe the effect of personal reflection on behaviour. To function effectively the float has to be balanced in the water. The visual behaviour of health care professionals is viewed as the part above the water's surface. Underneath the water, which symbolises the context of the work environment of the health care professional, lie the covered elements controlling this visual behaviour. Closest to the surface lies professionals' clinical reasoning. This aspect contains expert knowledge and expert thinking and focusses on problem-solving. Directly under this layer, but linked to clinical reasoning, lies the scientific thinking. This layer is conceived in scientific evidence and provides the scientific foundation for clinical reasoning. Underneath these layers lies the layer of personal reflection. This layer has a subjective character and is complementary to the other layers. It directs practitioners to inquire own experiences and involves attending to thoughts, feelings and bodily experiences as a source of learning in pursuit for effective behaviour. On the bottom of the float lie the unconscious aspects, because they are deeply hidden in a health care professional's identity and affect all layers above. Balanced reflection will lead to a standing float and effective professional behaviour. Inappropriate reflection will lead to a submerging float and exemplifies practitioners overwhelmed and burdened in a sea of their practice, unable to deal with the demands of their workplace and leading to uncertainty. Consumed by worries and stress they are unable to display appropriate actions. The opposite of superficial or non-

reflection will lead to a tilted float, which will also prevent effective behaviour. This type of practitioner will have trouble in coping with feedback and criticism, tend into routine like behaviour without questioning, present a rigid way of thinking and find themselves also overwhelmed by the demands of practice obstructing adapted behaviour.

The perspective on reflective practice in health sciences has evolved from a solely individual process to promote individual development to a socially engaged thinking process. The insights arisen from the situativity theory have contributed to this increased focus on context (Greeno 1998). Situativity theory follows the basic principle that knowledge, thinking and learning are situated in experience (Durning and Artino 2011). It argues that knowledge and thinking (situated cognition) and learning (situated learning) are uniquely connected to their context including participants, culture and physical environment and their interactions they emerged from. Related to reflective practice, situativity of knowledge, thinking and learning encompasses the increased attention for physical and social environmental factors and their influence on reflections about professional practice, because all are interdependent (Durning and Artino 2011).

Also the emerging doubt about the accuracy of self-assessment in health professionals has contributed to the perspective of reflection as a social process (Eva and Regehr 2005). The ability to investigate one's own experiences and perceptions is central in the concept of reflection (Boud *et al.* 1985; Atkins and Murphy 1993). Based on literature review from multiple angles on self-assessment, including research on self-efficacy and self-concept, cognitive and metacognitive theory, social cognition, models of development of expertise and reflective practice, however, it was concluded that research does not support the notion of health professionals having the ability to accurately self-assess themselves (Eva and Regehr 2005). Paradoxically it was suggested that health professionals should triangulate their perspectives against peer observations to validate their own thoughts. In this respect interaction with others is an important attribute to obtain valuable feedback.

From a social perspective the role of health professionals has broadened from a provider of care to an active member of the community. To become a reflective practitioner does not solely involve individual professional development but also include social accountability and leadership skills in support to the development of society (Frenk *et al.* 2010).

Education is a key element in preparing students for their future role as successful health care professionals. Similar to professional practice, the perspective on educational institutions has changed from educating health care professionals to social accountable organisations to meet the public needs of health care (Fleet *et al.* 2008; Boelen and Woollard 2009). With respect to reflection and educating students towards reflective practice, there has been a debate about the nature of reflection. Has it to be regarded as a personality trait, that may be hard to develop or as a skill, that can be fostered and enhanced. The available evidence, which still is modest, suggests that reflection can be developed over time and may benefit from various training strategies (Mann *et al.* 2009b; Sandars 2009), although reflection as a stable personality disposition has not been completely ruled out either (Boenink *et al.* 2004). The current view on reflection incorporates both the ability to develop reflection and the presence of a stable personality disposition (Boenink *et al.* 2004). This perspective on the nature of reflection may be compared to becoming a soccer superstar. Talent and training are the key ingredients of a superstar. Without talent, training can help an individual to

reach a certain level of skill, but he/she will never become an excellent player. In the opposite situation, training is needed to optimise talent. In both situations training is needed.

### 3. Reflection and health sciences education

To be efficient, education needs to address the competences required for professional practice and to be updated with most recent insights concerning learning. The previous paragraphs described the context in which reflective practice emerged as important attribute for health care professionals. The next paragraphs concentrate on the educational context and the perspectives on learning in relation to reflection.

The constructivist perspective emphasises the active role of learners in the construction of knowledge. Reflection has been suggested to support this active process of learning. Kolb introduced reflection in the context of **learning from experiences** (Kolb 1984). His concept, the experiential learning cycle, described four stages of learning: 1. experiencing, 2. reflective observation of this experience, 3. abstract conceptualisation based on reflection and 4. active experimentation. He argued that each learner, to be effective, should incorporate four kind of abilities corresponding with the four stages. Although this concept was useful as a model to learning, it did not uncover the elements of reflection itself (Boud *et al.* 1985). Boud *et al.* (1985) did, they described reflection as a process that looks back on experience to identify new perspectives and inform future behaviour in a three-stage model: 1. Returning to an experience; 2. attending to feelings; and 3. re-evaluating the experience. With this model they emphasised the role of emotions and additionally identified the re-evaluating skills needed as association, integration, validation and appropriation.

Based on the focus, reflection has been categorised to facilitate the concept by Argyris of single- and double-loop learning, what later has been complemented with triple-loop learning (Greenwood 1998; Rushmer *et al.* 2004). Single-loop learning is the simplest form and focusses on problems and their solutions. Consequently reflection grounding single loop learning is based on action and instrumental problem-solving. Double-loop learning digs deeper and is the result of reflection based on assumptions, norms, values and social relationships grounding human action. It targets the understanding behind the solution which allows to transfer solution into other environments. Triple-loop learning goes beyond instrumental problem-solving and understanding and considers also the context in which understandings are developed. It targets the learning processes in the single and double-loop learning and can be considered as a level of learning about learning or meta-learning.

Furthermore, reflection has also been related to students adopting deep or superficial approach to learning (Leung and Kember 2003). Students with a superficial approach to learning have been characterised as extrinsically motivated, do not form relations between tasks or aspects within tasks, are concerned about time investment, avoid any personal connection with the task and use predominantly memorisation techniques (Biggs 1987, p.15). In contrast, students that adopt a deep approach to learning are intrinsically motivated, search for the meaning of the task, relate it to their own experiences, try to integrate tasks and aspects into a whole and theorise about the task and formulate hypotheses (Biggs 1987, p.15). A superficial approach was related to non-reflective habitual action, whereas a deep approach to learning went together with reflective action (Leung

and Kember 2003). These findings are supportive to the view that reflection and adopting an active learning approach are interrelated (Mann *et al.* 2009b).

As a result of the second educational reforms and the shift towards constructivist approach to learning, many health sciences curricula introduced problem-based learning (PBL). PBL has been defined as *an instructional method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about basic and clinical sciences* (Albanese and Mitchell 1993, p.53). Favourable effects of this PBL approach to learning were identified as the active processing of information, activation of prior knowledge, the acquisition of knowledge in meaningful contexts, triggering epistemic curiosity, and the opportunities to elaborate and organise knowledge through small-group discussion (Schmidt 1993; Charlin *et al.* 1998). Consequently the PBL environment is considered to promote reflection (Lim 2011). Although the PBL approach is widely adopted in medical, dentistry, pharmacy, veterinary medicine and nursing schools, there is still on-going debate about the long and short term effectiveness of PBL on learning (Colliver 2000; Polyzois *et al.* 2010; Khatami *et al.* 2011).

Whereas health sciences curricula in the past were focussed on the solitary provision of knowledge and skills, curricula today, in search to meet the requirements of professional practice, have shifted towards a **competency-based approach to education** (Kneebone and Nestel 2011). A competence is defined as *an integrated body of knowledge, skills and (professional) attitudes enabling proficient performance in certain real-life settings* (Driessen *et al.* 2011, p.211). The rationale for competency-based education has been identified as 1. focus on outcomes of education to match the professional demands, 2. emphasis on abilities to be acquired rather than individual knowledge and skills, 3. shift from focus on time spent on training to actual achieved learning and 4. the promotion of learner-centeredness (Frank *et al.* 2010). This learner-centred approach and the focus on the integration of knowledge and skills within their context of application share common grounds with the previously described PBL approach (Yip and Smales 2000). The acquisition of competences elapse in stages from novice to expert to world class and implies the development of competences as a continuing process throughout one's professional career (Drejer 2000; Yip and Smales 2000). Nevertheless, critics argue that the reductionist view of identifying professional outcomes into competences limits the focus on reflection, intuition, experience and higher order competence needed for expert, holistic or well developed practice (Talbot 2004). Additionally over-focus on the individual competences could lead to lose track of the bigger picture of clinical practice which is considered to exceed the sum of individual competences (Kneebone and Nestel 2011).

Experience in clinical professional environments is an important aspect of reflection and learning in competency-based education. The learner-centred approach advocated by this perspective however, may conflict with the patient-centred approach in professional practice (Eriksen *et al.* 2008). In response to the discrepancy between patient safety issues and the needs of learners, simulation has been proposed to complement clinical practice as a learning environment (Kneebone *et al.* 2004). Based on learning needs, derived from the clinical environment, simulation based practice allows learners to develop competence within a controlled (and safe) environment. Competence which can be applied in a clinical environment in response to the learning need. Through this interplay between clinical environment and simulated environment a porous barrier is created to benefit both clinical context and learners' needs (Kneebone *et al.* 2004). Both high and low fidelity simulators are used for the purpose of teaching and assessing (Hammoud *et al.* 2008; Ennen and Satin 2010).

Very much alike simulators, video-cases can provide a realistic perspective on clinical practice. Compared to written cases they are more authentic and illustrative, present a holistic view of the patient, are motivating and challenging and are better retained in memory (de Leng *et al.* 2007). For efficient learning it is important to challenge learners with problems of an adequate degree of complexity, related to their prior knowledge (Schmidt 1993; Oliver *et al.* 2008). In support to practice-based learning, cases can be used to present selected problems in their authentic context as a trigger for problem-solving and clinical reasoning. Similar experiences and ill-defined problems are identified to stimulate learners to reflect (Boud *et al.* 1985; Schön 1983, 1987). Descriptions on paper of professional situations (case vignettes) have been used to trigger and assess reflection in an educational context (Boenink *et al.* 2004; Spalding and Phillips 2007).

Similar to the current perspective on professional practice emphasises practitioners in relation to society, modern insight about learning stresses the social dimension too (Doolittle 1995). Vygotsky identified social interaction as a critical role in learning (Vygotsky 1978). He identified the zone of proximal development (ZPD) as a concept to illustrate how learners develop new skills. He described ZPD as:

*The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.*

(Vygotsky 1978, p.86)

Cooperative learning is an instructional strategy to learning, incorporating the framework of ZPD (Doolittle 1995). It focusses on academic and social learning experiences in the development of competences. Various approaches to cooperative learning have in common small group instruction where students work together to learn academic material, providing the opportunity to discuss and practise information and skills otherwise instructed by a teacher (Slavin 1991). Cooperative learning is considered to positively affect student achievement (Slavin 1996). Benefits result from the creation of an environment which allows group members to discuss their perspectives, provide and receive feedback, stimulate knowledge construction and organisation of knowledge through debate and argumentation. From a motivational perspective, collaborative learning also provides incentives for attaining personal and group goals and motivates group members to learn (Slavin 1996). Similarly peer-orientation is identified as an important factor in student motivation (Hancock 2004). From a social perspective, cooperative learning contributes to the development of skills needed to act in a cooperative orientated environment, such as communication, leadership, group dynamics and inter-relationship skills (Attle and Baker 2007). Social interaction in cooperative learning also provides an stimulating environment for reflection. Individual experiences and perspectives can be triangulated against the view of group members which leads to further understanding (Eva and Regehr 2005).

Whereas the recent educational perspective on learning emphasises competency-based, workplace-based, simulation-based and collaborative learning, the question emerged on how to assess these approaches to learning. To categorise learning contexts and methods of assessment in medical

education, Miller suggested a framework for clinical assessment (Miller, 1990). In a four layer pyramid, the base is formed by the *knows* level. This reflects the knowledge base needed in clinical practice. However merely knowledge is not enough, students need to *know how* to use this knowledge. This is identified as the second layer. Demonstration of the know how in an controlled environment is captured in the performance in the *shows how* level. The top of the pyramid reflects the clinical action in an authentic professional environment and is identified as the *does* level . To evaluate the lower three levels of the Miller's pyramid, *knows, knows how and shows how*, assessment methods were suggested considering knowledge, practical knowledge and skills, including multiple choice questions, written and oral examination, short essay questions and objective structured clinical examinations (Mattheos *et al.* 2009). The top level *does* integrates the other levels, consists of the clinical performance and cannot be captured by traditional methods. To visualise and assess competence development in health science education, **portfolios** are proposed to demonstrate the development of competence, similar to the world of arts (Snadden and Thomas 1998; Gadbury-Amyot *et al.* 2003; Kjeaar *et al.* 2006; Kardos *et al.* 2009; Vernazza *et al.* 2011). Portfolio-based learning directs learners to gather evidence in their portfolio demonstrating they have acquired certain competences. This learner-centred approach directs the responsibility to the learner to demonstrate their progress (Driessen *et al.* 2007). This responsibility forces learners to actively consider their learning goals, their starting competences, their experiences and a strategy needed to fulfil the learning goals to be acquired. This active approach also is considered to stimulate reflection, hence portfolios are often related to reflective learning (Tigelaar *et al.* 2006; Goldie *et al.* 2007; Plaza *et al.* 2007; McKenna *et al.* 2011).

The previous paragraphs provide a rough sketch of the context in which health science professional practice and education operate. It has been characterised by the perspective of professionals and learners adopting an active strategy to practice, learning and professional development while being fully aware of the social environment they work/learn in. Reflection is a recurring common theme in described professional related aspects including reflective practice, lifelong learning, self-directed learning, workplace learning and social interaction and in discussed educational approaches including experiential learning, reflective learning, problem based learning, competency based learning, simulated based education, cooperative learning and portfolio learning. Consequently, reflection is considered as an important attribute for health care professionals and for learners to develop.

#### **4. Main argument and research questions**

The increased focus on reflection in health care and health sciences education has resulted in a considerable body of published literature and has in education led to the inclusion of reflection in various guidelines for health care professionals and in health sciences curricula (Hendricson *et al.* 2006; SDMCG 2007; Cowpe *et al.* 2009; GMC 2009; NFU 2009). Nevertheless understandings about reflection are still in an early developmental stage. Empirical evidence demonstrating the effects of reflection on professional and student performance are scarce (Mann *et al.* 2009b) and an efficient approach to reflection in practice and education remains elusive.

Lack of an agreed method to assess reflection is an important barrier to further progress. In research, assessment is of vital importance for collecting data, which will drive further findings to increase our understandings about reflection in professionals and students. In education, assessment is needed to identify whether students have attained the requisite level of competence (in reflection) and consequently whether the applied educational strategy was efficient (to develop the ability to reflect (Plack and Greenberg 2005; Grant *et al.* 2006; Sandars 2009). Furthermore assessment has been identified as an important motivator for students to learn. Hence the development of an approach to the assessment of reflection is a crucial element to go forward from the present unsatisfactory situation.

In response, the present dissertation targets the **assessment of reflection in undergraduate health sciences education**. The line of research focusses respectively on the obstacles to the assessment of reflection, the development of an assessment method for reflection in undergraduate health sciences education and using this assessment approach to investigate the relation between reflection and student performance. In line with these objectives we have formulated five research questions (RQ):

RQ 1: What are the main barriers to reflection assessment?

*(The diversity of situations that trigger reflections was identified as an important barrier to the assessment of reflection. Hence an additional RQ was included in search for solutions.)*

RQ 2: How can assessment take into account the diversity of situations that trigger student reflections in undergraduate health sciences education?

RQ 3: Can an assessment method be developed that overcomes the barriers to reflection assessment?

RQ 4: How can assessment methods of reflection be implemented in undergraduate health sciences education?

RQ 5: What is the effect of reflection on student performance in undergraduate health sciences education?

These RQs are addressed in five research projects, that are described in the following chapters.

**Chapter 1: Factors confounding the assessment of reflection: a critical review.**

Based on literature review, this chapter identifies factors that complicate the assessment of reflection and searches for solutions (RQ1, RQ3).

**Chapter 2: Using online periodontal case-based discussions to synchronize theoretical and clinical undergraduate dental education.**

This chapter investigates the value of cases to simulate a clinical context (RQ2).

**Chapter 3: Using video-cases to assess student reflection: Development and validation of an instrument.**

In search for a method of assessment this chapter describes the development and validation of an approach using video-cases to trigger student reflections in combination with a scoring rubric in undergraduate medical education (RQ2, RQ3, RQ4).

**Chapter 4: The influence of student reflections in portfolio based undergraduate dental education.**

This chapter describes the introduction of a method to assess reflection in a portfolio-based undergraduate dental course. Furthermore the relation is investigated between reflection and other competences in the course (RQ4, RQ5).

**Chapter 5: Does reflection have an effect upon case-solving abilities of undergraduate medical students?**

This last chapter studies the predictive value of reflection on undergraduate medical students case-solving (RQ4, RQ5).

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# Chapter 1

## **Factors confounding the assessment of reflection: a critical review**

Based on:

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**Factors confounding the assessment of reflection: a critical review**

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## **Abstract**

### **Background:**

Reflection on experience is an increasingly critical part of professional development and lifelong learning. There is, however, continuing uncertainty about how best to put principle into practice, particularly as regards assessment. This article explores those uncertainties in order to find practical ways of assessing reflection.

### **Discussion:**

We critically review four problems: 1. Inconsistent definitions of reflection; 2. Lack of standards to determine (in)adequate reflection; 3. Factors that complicate assessment; 4. Internal and external contextual factors affecting the assessment of reflection.

### **Summary:**

To address the problem of inconsistency, we identified processes that were common to a number of widely quoted theories and synthesised a model, which yielded six indicators that could be used in assessment instruments. We arrived at the conclusion that, until further progress has been made in defining standards, assessment must depend on developing and communicating local consensus between stakeholders (students, practitioners, teachers, supervisors, curriculum developers) about what is expected in exercises and formal tests. Major factors that complicate assessment are the subjective nature of reflection's content and the dependency on descriptions by persons being assessed about their reflection process, without any objective means of verification. To counter these validity threats, we suggest that assessment should focus on generic process skills rather than the subjective content of reflection and where possible to consider objective information about the triggering situation to verify described reflections. Finally, internal and external contextual factors such as motivation, instruction, character of assessment (formative or summative) and the ability of individual learning environments to stimulate reflection should be considered.

## Background

Physicians and other health care workers act in challenging professional environments. There is an exponential growth in knowledge and treatment options, patients are becoming more articulate and demanding, and inter-professional collaboration is the rule rather than the exception. Lifelong learning is, consequently, crucial to the provision of up-to-date health care services (Collins 2009). Rather than just attending conferences, lifelong learning today is seen as a continuous process, embedded in everyday professional practice. At its core lies practitioners' ability to reflect upon their own actions, continuously reviewing the processes and outcomes of treatments, defining new personal learning objectives, and planning future actions in pursuit of excellence (Plack and Greenberg 2005; Andersen *et al.* 2008; Sandars 2009; Li *et al.* 2010). Hence, the ability to reflect is an important outcome parameter for health care professionals (SDMCG 2007; Cowpe *et al.* 2009; GMC 2009; NFU 2009). As a result, many educational institutions incorporate the ability to reflect as an objective of their vocational programs, premised on a belief that reflective thinking is something that can be developed rather than a stable personality trait (Boenink *et al.* 2004; Mann *et al.* 2009; Sandars 2009).

There is, however, uncertainty about how best to help people develop their ability to reflect (Mann *et al.* 2009). Lack of an agreed way of assessing reflection is a particular obstacle to progress because assessment is needed for the identification of effectiveness of educational strategies and for research purposes (Plack and Greenberg 2005). Assessment has also a motivational influence as a source for feedback (formative assessment) and when to judge whether requisite levels of competence have been attained (summative assessment) (Plack and Greenberg 2005; Grant *et al.* 2006; Sandars 2009). The persisting lack of clarity about how to operationalise reflective learning is symptomatic of an even deeper problem. Different, widely accepted theories define reflection in different ways, consider different outcomes as important, define different dimensions along which reflection could be assessed and point towards different standards (Mann *et al.* 2009). Consequently, research findings are hard to compare. This unsatisfactory state of affairs leaves curriculum leaders without practical guidelines, ways of identifying and supporting students who are weak reflectors, and ways of judging whether interventions are improving learners' ability to reflect. The purpose of this article is to review four factors, which confound the assessment of reflection:

1. Non-uniformity in defining reflection and linking theory with practice.
2. A lack of agreed standards to interpret the results of assessments.
3. Threats to the validity of current methods of assessing reflection.
4. The influence of internal and external contextual factors on the assessment of reflection.

Our approach was to identify all widely quoted theories, read them in depth, and triangulate them against one another to find what they (dis)agreed on and gaps between them. Findings were discussed with experts in search of common ground. The result of this exercise was an interpretative framework, which we used to structure the 'Discussion' section. A test of the framework is beyond the scope of this article, whose aim is to make the framework and guidelines available to other people interested in implementing and/or assessing reflection in education.

## Discussion

### 1. Defining reflection

Studies about reflection in professional practice and education are widespread in the literature; however, their results are hard to generalise or compare because they conceptualise reflection in such different ways. Boenink *et al.* (2004) described reflection in terms of the number of different perspectives a person used to analyse a situation. Reflection ranged from a single perspective to a balanced approach considering multiple relevant perspectives. Aukes *et al.* (2007) emphasised emotional and communication components when they conceptualised personal reflection as a combination of self-reflection, empathic reflection, and reflective communication. Sobral's emphasis on reflection-in-learning approached reflection from a learning perspective (Sobral 2000).

If those three perspectives exemplify inconsistency in the field, the work of Dewey, Boud, Schön, Kolb, Moon, and Mezirow exemplifies shared ground between reflection theories and used terms. Dewey is usually regarded as the founder of the concept of reflection in an educational context. He described reflective thought as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends" (Dewey 1910 p. 6). He saw **reflective thinking** in the education of individuals as a lever for the development of a wider democratic society.

In line with his work, Boud *et al.* (1985) emphasised reflection as a tool to learn from experience in **experiential learning**. They identified reflection as a process that looks back on experience to obtain new perspectives and inform future behaviour. A special feature of their description of reflection in three stages – 1. Returning to an experience; 2. attending to feelings; and 3. re-evaluating the experience – was the emphasis it placed on the role of emotions.

Moon described reflection as an input-outcome process (Moon 1999). She identified reflection as a mental function transforming factual or theoretical, verbal or non-verbal knowledge, and emotional components generated in the past or present into the output of reflection (e.g. learning, critical review or self-development).

Schön's concept of the **reflective practitioner** identified reflection as a tool to deal with complex professional situations (Schön 1983, 1987). Reflection in a situation (reflection-in-action) is linked to practitioners' immediate behaviour. Reflection after the event (reflection-on-action) provides insights that can improve future practice. Those two types of reflection together form a continuum for practice improvement.

The term '**reflective learning**' describes reflection in the context of experiential learning. Kolb's widely accepted experiential learning cycle describes four stages of learning: 1. having an experience (concrete experience), 2. reflective observation (reflecting on this experience), 3. abstract conceptualisation (learning from the experience) and 4. active experimentation (trying out what you have learned) (Kolb 1984). These four stages are conceptualised as a spiral, each of whose turns is a step forward in a person's experiential learning.

**Lifelong learning** is considered today as essential for maintaining a high standard of professional practice. Mezirow's transformative learning theory described lifelong learning in terms of learners' transforming frames of reference, in which reflection is the driving force (Mezirow *et al.* 2000).

### *Towards an 'eclectic model' of common elements*

Although contemporary reflection models build on those theories, the diversity between them is a cause of continuing uncertainty. In response, we have assembled a simple comprehensive model from their common parts (table 1). Atkins and Murphy (Atkins and Murphy 1993) identified reflection as: 1. 'awareness of uncomfortable feelings and thoughts', resulting in 2. an 'analysis of feelings and knowledge', finally leading to 3. 'new perspectives'. They described self-awareness, critical analysis, synthesis, and evaluation as requisite skills for this process. Since those three phases are common to the work of previous authors, they provided a logical starting point for our model. We complemented Atkins and Murphy's phases with insights from other models. Korthagen's ALACT model ('Action, Looking back on action, Awareness of essential aspects, Creating alternative methods of action, and Trial') (Korthagen and Vasalos 2005) describes the first phase of 'becoming aware' in two steps: a general retrospective action and a more interpretive action. Integrating those two theories, resulted in a first phase ('reviewing an experience') with two subcomponents: 1. generally describing what happened and 2. identifying essential aspects by considering both thoughts, feelings and contextual factors.

**Table 1: Overview of theories/models/findings integrated into the model of common elements**

<b>Author</b>	<b>Theory/Model/Finding</b>	<b>Summary</b>
<i>Atkins &amp; Murphy</i>	<i>Reflective processes (model)</i>	<i>Three key stages of the reflective process: 1. Awareness of uncomfortable feelings, 2. Critical analysis of feelings and knowledge, 3. New perspectives; associated skills: self-awareness, description, critical analysis, synthesis and evaluation.</i>
<i>Boud</i>	<i>Promoting reflection in learning (model)</i>	<i>Reflection process consists of 3 interrelated stages: 1. returning to the experience, 2. attending to feelings, 3. re-evaluating experience, triggered by experiences and leading to outcome.</i>
<i>Bourner</i>		<i>Interrogating experiences with searching questions distinguishes reflective from unreflective thinking.</i>
<i>Korthagen</i>	<i>ALACT model</i>	<i>Reflection is a cyclic process of: Action, Looking back on action, Awareness of essential aspects, Creating alternative methods of action, and Trial.</i>
<i>Mamede &amp; Schmidt</i>	<i>The structure of reflective practice in medicine (finding)</i>	<i>Reflective practice consists of a 5 factor model: deliberate induction; deliberate deduction; testing and synthesising; openness for reflection, and meta-reasoning.</i>
<i>Mezirow</i>	<i>Transformative learning theory</i>	<i>Reflection leads to changed assumptions and frames of references which ground transformative learning.</i>
<i>Moon</i>	<i>Input-outcome model</i>	<i>Reflection is a mental process that is based on input (theories, constructed knowledge or feelings) that has an outcome/ purpose (self-development, learning, decisions, resolutions of uncertainty, ...).</i>
<i>Schön</i>	<i>The reflective practitioner (theory)</i>	<i>Reflection is a key factor for professionals to deal with complex situations and for professional development. He identified reflection-in-action and reflection-on-action.</i>
<i>Stockhausen</i>	<i>Clinical learning spiral (model)</i>	<i>Reflective practice is related to professional growth; Clinical learning consists of preparative phase, constructive phase, reflective practice and reconstructive phase.</i>

Just reviewing an experience, however, does not necessarily lead to effective reflection. For Bourner (2003), using searching questions to interrogate an experience was the key difference between reflecting and thinking and he saw 'reflective inquiry' as a crucial component of reflection. This aspect of reflection was also represented in Mamede and Schmidt's proposed structure of reflective practice as 'openness to reflection' (Mamede and Schmidt 2004). Bourner only emphasised posing searching questions, however, not answering them. Korthagen's approach supplements Bourner's by contributing 'creating alternative methods of action' as a process of answering questions. This addition is compatible with Boud's characterisation of analysis as a combination of association, integration, validation and appropriation. The internal dialogue that results is conducted within a 'personal frame of reference' that, according to Mezirow, directs the analysis and represents "the structure of assumptions and expectations through which we filter sense impressions" (Mezirow *et al.* 2000 p.16). This personal perspective, made up of our perceptions, cognitions, feelings and dispositions (intentions, expectations and purposes), creates a context in which we give meaning to our sensory experiences<sup>1</sup>. If the first phase of reflection, then, is identified as the description of an experience and the awareness of feelings, thoughts, and other essential aspects, our second phase of reflection is analysing experiences by reflective inquiry, which triggers a process of analysis within a person's unique frame of reference.

Moon's input-outcome model emphasises that reflection is purposeful (Moon 1999). This purpose is identified by Atkins and Murphy in the third phase of reflection as the 'identification of new perspectives' (Atkins and Murphy 1993). Both Korthagen and Boud, however, included an additional stage - the conversion of those new perspectives into actions that are the starting point for new reflective cycles (Boud *et al.* 1985; Korthagen and Vasalos 2005). The 'reconstruction phase' of Stockhausen's clinical learning spiral model of reflective practice among undergraduate nursing students in clinical practice settings had the same function (Stockhausen 1994). During this phase, reflective insights were transformed into plans for future actions. Since those actions could lead to further reflections, reflecting on experiences was identified as a cyclic process that transformed significant experiences into deliberate, well informed practical actions. We incorporated those insights into the eclectic model by defining the outcome of a reflection process as the identification of new perspectives, which leads to future actions informed by reflection. Stockhausen also described a preparatory phase to establish objectives for a new clinical experience. This phase, which other authors have labelled as reflection-before-action (Greenwood 1993; Cheetham and Chivers 2000), is incorporated into the eclectic model by representing reflection as a cyclical process. It allows reflection to be informed by learning goals arising from past reflections and stresses the importance of reflection as a developmental process. Both Korthagen and Stockhausen have highlighted this process with the term reflection spiral with each winding leading to a higher order of understanding, practice or learning (Stockhausen 1994; Korthagen and Vasalos 2005).

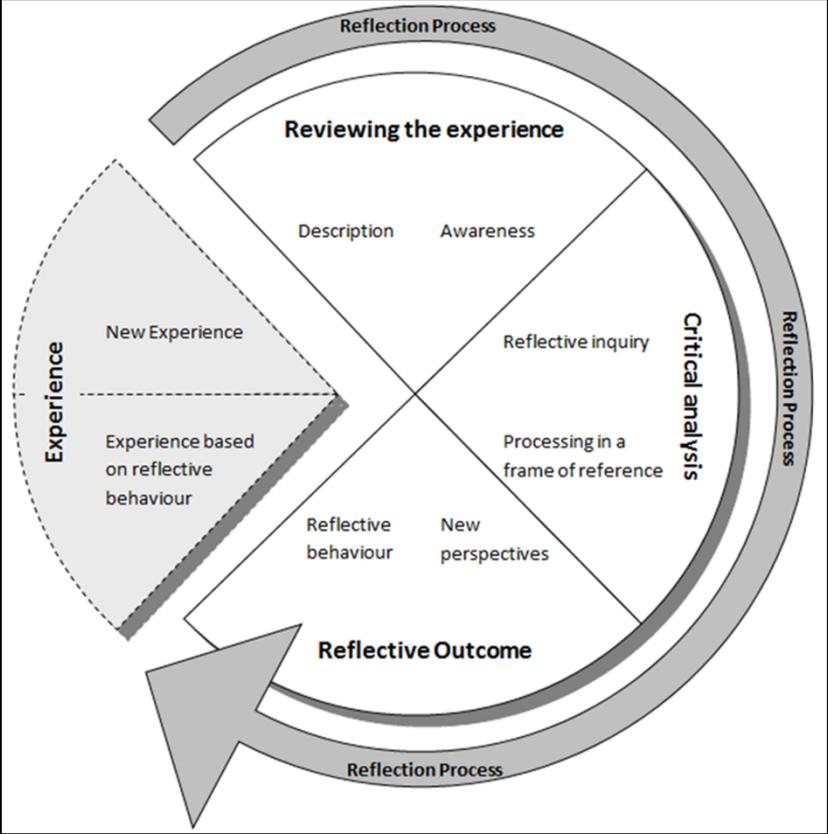
Figure 1 shows the complete eclectic model, which describes reflection in three phases: 1. 'Reviewing the experience', 2. 'Critical analysis', and 3. 'Reflective outcome'. Reflection, according to the model, is a cyclical process, which originates from experience and informs future behaviour. Each phase has

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<sup>1</sup> In this dissertation the term 'frame of reference' is used in three contexts. 1 the whole of a personal perspective as described above by Mezirow (unique frame of reference), 2. a specific element within this personal perspective that individuals use to guide a thought, decision, behaviour (used frames of reference), 3. a more general meaning as individuals use the same frame, eg. theoretical frame, an agreement, play rules (common frame of reference).

two items, described in practical terms to make it possible to put the model into practice. Reviewing the experience has two components: ‘description of the experience as a whole’, and ‘awareness of essential aspects based on the consideration of personal thoughts, feelings, and important contextual factors’. Critical analysis starts with ‘reflective inquiry’ - posing searching questions about an experience - and progresses to ‘searching for answers’ while remaining aware of the ‘frame of reference’ within which the inquiry is being conducted. Reflective outcome comprises the ‘new perspectives’ resulting from phase two, and the ‘translation of those perspectives into behaviour that has been informed by reflection’. This behaviour generates new experiences and so a new reflection cycle begins.

**Figure 1: Model of common elements describing the reflection process**



*From model building to developing indicators for assessment of reflection*

The aim of identifying common elements was to ground the assessment of reflection in existing, widely used theories. It is practically useful because each of the six items in the three phase model can be translated into an indicator of the adequacy of reflection processes (table 2). Together, they provide a comprehensive overview of a person’s ability to go through the process and are in line with the reflective skills identified by Duke and Appleton (2000). Taken individually, the indicators can provide specific feedback about components of reflection, which makes it possible to give structured, focused feedback, and direct training towards aspects of reflection that the indicators have defined as insufficient. Such training could, for example, provide exercises on describing personal thoughts and feelings or identifying learning goals. So, in summary, the modular nature of the model and its indicators makes it possible to tailor education to individual needs. But, for that, criteria to judge someone as competent in reflection are needed.

**Table 2: Operational indicators of the reflection process**

<b>Aspect of the reflection process</b>	<b>Indicators</b>
<i>Reviewing the experience</i>	1. <i>The ability to describe an event/situation adequately.</i> 2. <i>The ability to identify essential elements and to describe own thoughts and feelings</i>
<i>Critical analysis</i>	3. <i>The ability to ask searching questions.</i> 4. <i>The ability to answer searching questions and being aware of the frames of reference in use.</i>
<i>Reflective outcome</i>	5. <i>The ability to draw conclusions.</i> 6. <i>The ability to describe concrete learning goals and plans for future action.</i>

## **2. Standards to interpret reflection assessment**

Here, again, there is a lack of consensus in published literature. A few researchers have attempted to rank reflections. Wong *et al.* (1995) evaluated reflection in written papers by identifying reflective activities using two coding schemes. One, based on Boud's theory, had six items: attending to feelings, association, integration, validation, appropriation and outcome of reflection. The other, based on the work of Mezirow, labelled students as: non-reflectors (no evidence of reflective thinking), reflectors (evidence of relating experience to learning opportunities) and critical reflectors (evidence of integrating reflective outcomes in professional behaviour). The researchers found Boud's categories hard to apply to written materials, resulting in less reliable coding than using Mezirow's scheme. With only three categories, however, this latter scheme had a limited capacity to discriminate between people. Kember *et al.* (1999) addressed this issue by using a finer-tuned coding scheme based on the work of Mezirow. Their seven categories ranged from unreflective thinking (habitual action, introspection and thoughtful action) to reflective thinking (content reflection, process reflection, content and process reflection and premise reflection). They dealt with the complexity of the coding scheme by providing guidelines for assessors, which resulted in an acceptable inter-rater reliability (Cronbach alpha 0.74). Boenink *et al.* (2004) used an alternative approach, which ranked reflections from 1-10. Their scale was based on the number of perspectives students described in short written reflective reactions to a case vignette describing a challenging situation. The advantage of this approach was the limited need to make interpretations when identifying the perspectives. The scale was limited, however, by measuring only one aspect of reflection (being aware of the frame of reference used). Duke and Appleton (2000) developed a broader marking grid to score reflective reports. It assessed eight skills that support reflection, identified by a literature review, on five-level scales, 'anchored' and linked to a grade (A, B<sup>+</sup>, B, C and F). By providing grades, these authors were the first to set standards for reflective skills. Despite having based the reflection skills that were included in the scale on a literature review, however, the authors did not disclose how they linked the levels to grades.

Coding schemes have also been used to evaluate reflection in interviews. Boyd (2008) assessed reflective judgement using a coding scheme based on seven stages of intellectual development described by King and Kitchener: Pre-reflective thinking (stages 1-3); quasi-reflective thinking (stages 4 and 5); and reflective thinking (stages 6 and 7). Measurements made with the scale had a reliability in terms of internal consistency of three raters of 0.76 (Cronbach alpha).

Based on the approach coding schemes can be divided into two groups. A first approach ranks reflections according to levels, ranging from descriptive and/or unreflective to reflective or critical reflective based on the used theory (Wong *et al.* 1995; Kember *et al.* 1999; Boyd 2008). The other approach is the identification of phases in the reflection process considering items of reviewing an experience, analysis and reflective outcome based on the used model of reflection (Duke and Appleton 2000; Wong *et al.* 1995). This discrepancy is a complicating factor for interpreting results as levels and phases are incompatible.

Notwithstanding limited ability to compare the findings in the reported studies, because of the variety in used the scales and models of reflection, their results share a common feature. Within their own scale, all studies demonstrate learners to have very limited mastery of reflection, indicating an apparent room for improvement. Inadequate reflection has a negative effect on practice (Schön 1983; Evans *et al.* 2002; Plack and Greenberg 2005) presumably because learners with a limited ability to reflect let 'tunnel vision' stop them questioning their behaviour in response to significant positive and negative experiences (Schön 1983; Pinsky *et al.* 1998). That situation need not be left unchallenged because there is research showing reflection can be influenced positively by training (Sobral 2000; Driessen *et al.* 2005; Boyd 2008), but the minimum level of reflection needed to have a positive effect on practice remains to be defined.

Until standards have been formulated that can identify practitioners whose level of reflection is adequate, it seems reasonable to clarify to stakeholders (curriculum developers, students, practitioners, assessors) what reflection skills are expected and urge learners to develop them as far as possible. We offer the presented model of common elements as a way of doing that. In promoting reflective learning, however, a balance has to be struck between developing an ability to reflect and increasing the frequency of reflection. It has been argued that critically analysing personal practice after every experience can cause a disabling level of uncertainty (Burnard 2005; Aukes 2008). Future standards will therefore have to consider the balance between the quality of reflection and its efficient and systematic application in practice, but not to the stage of being counterproductive.

### **3. Factors that complicate assessment**

The metacognitive nature of reflection is an important complicating factor of reflection assessment (Sandars 2009). It implies a thinking process only accessible to the reflecting person and hence only observable by assessors through that person's interpretative descriptions. Subjects are most often asked to 'translate' their reflections into written words, which are assessed against coding schemes or scoring grids (Wong *et al.* 1995; Kember *et al.* 1999; Duke and Appleton 2000; Brady *et al.* 2002; Carr and Carmody 2006; Howe *et al.* 2009). Other suggested methods to 'visualise' reflections include the verbalisation in interviews (Hatton and Smith 1992; Peden-McAlpine *et al.* 2005; Boyd 2008), written responses to vignettes (Boenink *et al.* 2004), or reflective writings in portfolios (Pinsky *et al.* 1998; Tigelaar *et al.* 2006). Assessors' dependency on a person's interpretative description is a serious threat to the validity of assessments of reflection because they have to judge selective descriptions without being able to verify their adequacy. Accordingly this approach fails to detect bias caused by a lack of (un)intentional hindsight and introspection ability (Hargreaves 2004; Eva and Regehr 2005), reflections being determined by the requirements of the assessment and selectivity and/or incompleteness of aspects they portray (Hargreaves 2004). Interviews have the advantage

that they can pose clarifying questions and monitor a reflecting person's reactions, but they still leave assessors to ground their judgements in potentially subjective and selective narrative accounts of reflective activity. There are two related problems in that. Although the semantic skill of describing reflections is considered integral to effective reflection (Pee *et al.* 2002), skills other than pure reflective skills are needed to turn reflection into writing and/or speech, which has a self-evident effect on reflective narratives (Hargreaves 2004). The other problem lies in a decrease of motivation caused by the non-alignment between the written approach to assessment and a learners preferred learning style (Grant *et al.* 2006). Findings of Sandars and Homer (2008) suggest the discrepancy between 'net generation' students learning preference of group-based and technological multimedia activities (blogs, social networks, digital storytelling) and the text based approaches to reflective learning. Moreover, supporting learners to reflect with the creative use of multimedia, will likely increase their commitment to reflect and stimulate even more efficient reflection (Sandars *et al.* 2008).

Self-assessment questionnaires have the advantage of circumventing indirect observation (Kember *et al.* 2000; Sobral 2000; Mamede and Schmidt 2005; Aukes *et al.* 2007), but their requirement to introspect accurately introduces another validity threat (Atkins and Murphy 1993; Kruger and Dunning 1999), because it is then unclear if it is reflection or the ability to introspect that is being tested. Eva and Regehr (2005) concluded that it is best not to build solely on self-assessment approaches as they tend to be inaccurate and they recommended triangulating introspection with other forms of feedback. Assessor-based methods could meet this requirement, providing assessors could be relied upon to provide valid feedback.

Since there are such serious validity threats, the question remains whether it is possible to assess reflection at all. Two elements appear to be important. In search for a valid approach, Bourner (2003) suggested the content and the process of reflection should be viewed as two separate entities. While the content is a barrier to assessment because of its subjective nature, the process has a more general character. He transferred this approach from the assessment of critical thinking where the use of questions to analyse ideas, evidence and assertions demonstrates a person's capacity for critical thinking (Bourner 2003). Similarly Bourner proposed that observable items, like the ability to formulate learning goals, should be used to demonstrate a person's capacity for reflecting. This approach demonstrates some parallels with the content specificity of clinical reasoning (Wimmers *et al.* 2007). However, opposed to elements in reflections such as learning goals or plans for future actions which meaning for the learner is subjective, content specific knowledge has a more objective character.

Furthermore, reflections are intimately linked to their triggering situations (Boud *et al.* 1985; Schön 1983, 1987; Korthagen and Lagerwerf 1996) so information about this initial event can provide an objective frame of reference to verify elements of the reflection. For example, when someone describes his communication as good, the real-time presence of an assessor or video-recording of the event could give supporting information (Liimatainen *et al.* 2001). Finding a feasible way of obtaining a rich picture of events that precede the reflection that has to be assessed is an important topic for future development.

#### 4. Internal and external contextual factors affecting reflection assessment

The results of assessments of reflection are influenced by contextual factors as well as people's ability to reflect. Our argument now turns to those modulating factors. Motivation is considered to be an important mediator of learning and achievement in medical education (Mann 1999; Artino *et al.* 2010). The expectancy-value model proposed by Wigfield and Eccles (2000) identifies the subjective value of a task to a person and their expectation of performing it successfully as main predictors of task performance. Applied to reflection, it predicts that the perceived importance of reflection for (professional) practice will determine the time and effort a person is willing to invest in it; those who do not expect a positive return are unlikely to reflect profoundly and critically (Sandars 2009). This motivational model also explains how personal factors like prior experience of reflective learning and a person's understanding of the reflection process will influence motivation and consequently reflective behaviour. Hence introductory sessions are important to frame the value and intended outcomes of reflection (Sandars 2009). Furthermore the expectancy-value model also stresses external variables, which might include aspects of teaching and/or assessment. It is reciprocal in nature. If involvement in reflective activities results in perceived better performance (internal) and/or external appraisal, rewards, or reinforcement, a feedback loop starts to operate.

Whereas reflection was traditionally conceived of as a strictly individual process, ideas are shifting towards conceptualising it as a process facilitated by social interaction (Eva and Regehr 2005; Sandars 2009). A stimulating environment in which supervisors and peers give learners regular feedback and ask thought-provoking questions can, from that point of view, be expected to improve reflection. With non-judgemental questions, facilitators can encourage to fully explore the situation, to consider alternative perspectives and solutions, and to uncover taken-for-granted assumptions (Plack and Greenberg 2005). Furthermore, situations and reflection upon can provoke strong emotions and negative thoughts which could potentially form a barrier obstructing efficient reflection. A facilitator can help to assimilate these strong emotions and refocus on the reflection process (Boud *et al.* 1985; Grant *et al.* 2006). To fully explore reflective thoughts, feelings and possible emotions, it is crucial to create a safe environment established between the reflecting person and the facilitator(s) (Plack and Greenberg 2005). Next to supporting others, being a facilitator is also reported as even more effective for a person's own reflections (Dahlgren *et al.* 2006). Schön, however, warned that an unbalanced relationship between learner and coach and an undue influence of contextual factors could hinder reflective practice, as it could lead to defensiveness (Schön 1983). In line with this emphasis on contextual factors, Schaub *et al.* (2011) developed a scale to assess teachers' competence in encouraging reflective learning. It asks learners to identify whether teachers support self-insights, create a safe environment, and encourage self-regulation.

Because of their influence on reflections contextual factors should be accounted for in educational and assessment approaches. In education it will help to develop effective educational strategies and predict their results to match the intended outcome. In assessment considering contextual factors will contribute to the interpretation of results and in the understanding of the reflection process. Hence we suggest to consider internal and external contextual factors in education and assessment.

## Summary

Whilst it is generally accepted that the ability to reflect is an important attribute for health care professionals, there is considerable uncertainty about how best to foster it in educational practice. Lack of an agreed way of assessing reflection is a very important factor contributing to this uncertainty. There is, however, clearly discernible common ground between reflection theories. By defining that common ground, we have been able to assemble an eclectic model, which sees reflection as comprised of: 1. reviewing experience; 2. critical analysis; and 3. reflective outcomes. A way of reliably measuring reflection is needed so summative judgements can be made and learners can receive effective feedback but one has not, yet, been developed. Standards defining an essential minimum level of reflective ability are also needed. Until they are we urge to develop and communicate a local consensus between stakeholders (students, practitioners, teachers, supervisors, curriculum developers) about what is expected in exercises and formal tests.

Because reflection is a metacognitive process, it can only be assessed indirectly; through written reflections in vignettes or portfolios, or spoken expressions in interviews. These methods do not allow assessors to verify information related to the reflections reported, which is a serious limitation. The widespread use of self-assessment questionnaires shares both that validity problem and the inherent limitations of self-assessment. To counter these validity threats, it has been proposed that assessment should focus on the process rather than the subjectively coloured content of reflection. In addition, as reflections are intimately entangled with their triggering situational context, we suggest where possible to consider objective information about this triggering situation allowing assessors to verify described reflections. The reflection process is influenced by internal (eg. motivation, expectancy and prior experiences with reflection) and external factors (formative or summative character of assessment, presence of facilitators and introduction to the assessment). Awareness of these factors are important to develop effective educational strategies, interpreting assessment results and finally the increase in understanding about the reflection process. Based on the preceding discussion, we offer the following practical guidelines for educating and assessing reflection.

1. Clearly define the concept of reflection and verify that all stakeholders (curriculum developers, students, assessors and supervisors) adopt the same definition and intended outcomes.
2. Be specific about what level of reflection skills is expected, identifying good and inadequate reflection and communicate this to all stakeholders.
3. Be aware of possible bias in self-assessment methods, caused by inadequate ability to introspect.
4. Provide assessors with a perspective on the situation triggering the reflection to create the ability to verify the described reflections in an objective frame of additional information.
5. Consider and report contextual factors when assessing reflection and/or when engaging in reflective education in support to interpret the outcomes.

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## **Chapter 2**

### **Using online periodontal case-based discussions to synchronize theoretical and clinical undergraduate dental education**

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**Using online periodontal case-based discussions to synchronize theoretical  
and clinical undergraduate dental education**

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## **Abstract**

### **Background:**

Clinical experience is important in undergraduate dental education, but (suitable) patients to learn from are often lacking. Online case-based discussions were introduced to overcome patient dependency and to synchronize theoretical with clinical education.

### **Materials and methods:**

Undergraduate dental students in groups of 5–7 discussed online clinical case reports presenting either minor (2nd year) or complex periodontal pathology (3rd year). Each case consisted of a brief patient history, extra- and intraoral clinical pictures, periodontal chart, peri-apical and/or orthopantomographic radiographs. Students had to discuss diagnosis and treatment planning. Questionnaires assessed students' and supervisors' general appreciation (score on 20), time investment and opinions about organisation, relation case/course content, future planning, learning effect and online environment (5-point Likert scale). A crossover design with three tests (pre-test, test in between and post-test) was used to investigate whether the frequency of case introduction (one case per week vs. one case element per week) had an effect on learning. Data was analysed with descriptive statistics (questionnaires) and repeated measures ANOVA (crossover design).

### **Results:**

Students (n = 119) and supervisors (n = 9) highly appreciated the exercise. Students reported spending on average 74 min per week to read a case, prepare and post messages. Supervisors' total time investment was 342 min per semester to create a case, provide online feedback and to prepare a live-discussion. No significant differences in test-scores were found between the two modalities of case introduction.

### **Conclusion:**

Online case-based discussions, in conjunction with a theoretical course, are valuable additions to the dental curriculum, especially to reinforce the transition from theory to clinical practice.

## Introduction

Clinical experience obtained throughout patient consultations is important in dental education in order to prepare students for future practice and clinical thinking (Henzi *et al.* 2007; Divaris *et al.* 2008). It is crucial to provide students with sufficient training under the complex situation of clinical activities in a realistic and true professional environment (Masella 2006). However, clinical training by means of treating patients does not always provide the best learning condition for students. In professional contexts, treatment outcome and patient safety are the primordial aspects of attention, rather than the students' possibility to learn (Eriksen *et al.* 2008). Unforeseen clinical problems and mistakes made by students when acquiring clinical skills are useful as a trigger for reflection and to stimulate learning, but may be conflicting with the patient centred approach of professional practice (Schön 1983; Boud *et al.* 1985). Moreover, to optimise students' learning outcomes when encountering patients, it is important to match up the difficulty of patient problems with the expected theoretical competences or practical skills students should achieve within their curriculum (Oliver *et al.* 2008). From an educational perspective, clinical environments should under ideal circumstances expose dental students progressively from easy to more difficult and/or multi-factorial problems as well as to more complex patient demands. However, a lack of clinic efficiency and resultant unproductive time was identified in North American dental students as a major barrier for their learning (Henzi *et al.* 2007). To find suitable patients with problems of adequate complexity is also an important factor in specialist training. This was recently elucidated in a survey among dental schools within Europe in which academic centres mentioned that inadequate influx of patients was a possible barrier to include more specialised education and training in implant dentistry (De Bruyn *et al.* 2009).

Dental students also face other challenges in clinical training. When encountering patients, they are forced to rapidly translate the afore acquired theoretical knowledge into skillfull clinical action. In combination with the concern for patient demands and the need for oral health care, this may obstruct clinical learning. In primary encounters, students are often insecure to meet these demands and hence struggle to "survive" the patient's consultation. This consequently imposes stress and impairs their focus on learning. Pöhlmann *et al.* (2005) demonstrated increased transition stress levels in 4<sup>th</sup> year dental students, which decreased again in the 5<sup>th</sup> year. They attributed this observation to 4<sup>th</sup> year students not yet effectively coping with the required demands of clinical work. Notwithstanding the clear results in their study, the authors advised to interpret the findings with restraint until study results with the new instrument they used could be replicated. In a systematic review on stress among dental students, Alzahem *et al.* (2011) reported that students' uncertainty to complete clinical requirements is the major clinical related factor contributing to stress and may result to a diminished efficiency of learning. Additionally they also recommended a conducive learning environment and extra support during periods of transition in order to enhance the coping with elevated stress levels.

Case-based methods have been introduced in education to support learning. In the domain of nursing education, Popil (2011) concluded after literature review that case-based methods promote active learning, provide the opportunity to relate theory to practice and encourage the development of critical thinking skills. Furthermore, the ability to select patient cases that relate to the course context, provide teachers the possibility to challenge students with problems of adequate complexity that put the theoretical background of the course into a practical perspective. Discussing cases

among peers has been reported to stimulate learning even more. Levin (1995) found that case-based discussions stimulated reflection and meta-cognition in experienced teachers. In less experienced teachers they found an enhanced thinking about particular issues in contrast to a control group that solved cases without discussion. Based on research in management students, Flynn and Klein (2001) suggested that discussing cases was an effective and motivating method of instruction, but stressed the importance of preceding individual preparation. Discussions hosted on online asynchronous forums have the advantage of being time and location independent as they are accessible via the internet. This enables students to individually prepare and contribute to the discussion at their own convening time (Hara *et al.* 2000; Bernard and Lundgren-Cayrol 2001; Gilbert and Dabbagh 2005). Moreover, asynchronous discussions provide students with the necessary time to individually think, reflect and search for additional information before contributing to the discussion (De Wever *et al.* 2006). Hence, discussion groups on asynchronous forums offer students the possibility to engage into depth critical reasoning on clinical practice without the interference of stress accompanying real patient encounters.

Based on these findings online periodontal case-based asynchronous discussions were introduced in addition to real-life patient encounters, linking the theoretical background discussed in the periodontal course to the context of the practical reality. The current paper describes the use of online case-based asynchronous discussions, introduced as part of a theoretical periodontal course in the second and third year of an undergraduate dental curriculum. Additionally, students' and supervisors' opinions about the use of online case-based discussions, their time investment and whether the frequency of case introduction has an effect on student learning were investigated.

The study was guided by the following research questions (RQ):

- RQ1.** How did students/supervisors overall appreciate the online case-based discussions?
- RQ2.** What opinions do students/supervisors have regarding:
- the organisation of the exercise (Organisation)
  - the relation between the exercise and the periodontal course (Course)
  - future educational initiatives (Future)
  - the learning processes during the exercise (Learning)
  - the online case based discussion environment (Discussion environment)
- RQ3.** How much time did students/supervisors spend on the online case-based discussion exercise?
- RQ4.** Are there any differences in learning effect between providing students 1 case a week and providing students 1 case element a week?

## Materials and methods

### *Description of the exercise*

Online case-based asynchronous discussions were introduced in two theoretical courses in periodontics in the 2<sup>nd</sup> and 3<sup>th</sup> year of the undergraduate dental curriculum at Ghent University. Students were randomly assigned into groups of 5 to 7 and asked to discuss a total of 5 to 6 periodontal cases linked to the theoretical background of these courses. Group discussions were held on a secured forum, hosted on the University's central online learning management system. At the beginning of each periodontal course, students received an introduction lecture. This lecture explained the format of the presented cases, the learning goals, the expectations of the teacher regarding participation of students as well as the practical ways to discuss and post comments on the forum. During this introduction an example case was also presented and discussed. To standardise group discussions, students had to answer multiple guiding questions while discussing the different parts of the case (Table 1). The content of the discussions itself was not graded, but in the final exam of the course students received a similar case that had to be discussed. Hence, online discussions could be considered as a supportive method to prepare for the final exam. To ensure that students contributed to the discussion, they had to post a minimum of two messages a week on the forum. At least one answer to a guiding question was required and one reaction to a comment or message of a peer. Students were told that not posting the minimum of two messages a week would result in a decrease of final course grades. During case discussions, each group had an assigned supervisor, a specialist in training from the department of periodontology and oral implantology, who also authored the case and had treated the displayed patient in real-life. This supervisor followed the group discussions and provided feedback halfway and at the end of the week on the forum. After the online exercise an end-meeting with all student groups was organised. During this meeting, the course lecturer briefly discussed all presented cases, answered student questions and showed the treatment that was actually performed in the clinic.

**Table 1: Guiding questions that students had to address when discussing a periodontal case. The questions are related to the case elements displayed in the example case in figure 1**

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#### **This patient enters your consultation...**

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##### **A. History:**

- What do you additionally want to ask / know? Why?
- What do you expect to see when looking in this patient's mouth? Why?

##### **B. Clinical pictures:**

- What information do you get from these clinical pictures?
- Is this information that you expected?
- What diagnosis would you suggest based on this information? Why?
- What additional investigations would you propose?

##### **C. Periodontal charts / D. Radiographic periapical status:**

- What extra information do you get from this radiographic periapical status / periodontal charts?
- Are these tests strictly necessary for this patient? Why?
- Give your diagnosis + treatment plan?

##### **Conclusion:**

- What alternatives (diagnosis + treatment plan) exist for this patient?
  - What arguments do you use to decide which treatment plan you will apply?
  - Give the prognosis for this treatment plan (periodontal status, oral hygiene, prosthetic recovery,...)
-

All cases were prepared by the supervisor in an electronic file, according to a format similar as described in Johnsen *et al.* (2009). Each case started with a brief case history and was followed by clinical pictures of the patient's frontal view as well as intra-oral lateral, frontal, and occlusal sides. These photographs visualised what the dentist would see when looking at first glance. Finally, cases displayed the radiographic peri-apical status in conjunction with a periodontal chart. Unknown case elements such as abbreviations, medication, used diagnostic indices were also expected to be clarified as part of the discussion. Cases were presented to student groups taking their theoretical knowledge into account. Second year cases displayed patients with plaque related periodontal diseases, such as gingivitis and moderate adult periodontitis. Students were asked to link clinical images to diagnostic indices and at the end of the discussion a treatment plan was required. The 3<sup>rd</sup> year course had more complex cases including tooth mobility, furcation involvement. Hence formulating a treatment plan was more difficult because of multi-factorial problems with more treatment alternatives such as extraction, flap surgery and prosthetic aftercare as a consequence. To show the principle of the periodontal cases used in this exercise, a shortened example version of an advanced case used in the 3<sup>rd</sup> year is presented in figure 1.

**Figure 1: Shortened example of a periodontal case presented in the 3<sup>rd</sup> year**

<p><b>A. History</b>          Man, 69 years old          ASA II          Medication: Amlor<sup>®</sup>, Sotalex<sup>®</sup>          Smoker (2 cigars a day)          No financial restrictions</p>	<p><b>C. Periodontal charts</b></p>
<p><b>B. Clinical pictures</b></p>	<p><b>D. Radiological Status</b></p>

### *Instruments and analyses*

A questionnaire was developed to examine students' and supervisors' opinions about online periodontal case-based asynchronous discussions in order to answer RQ1-3. This questionnaire included 13 items in the student-version and 12 items for supervisors about organisation, course, future, learning and environment. Those items were scored on a 5-point Likert scale (from strongly disagree to strongly agree). Additionally, students and supervisors were asked to report the amount of time they invested and to give an overall appreciation score on a scale of 20. This questionnaire was distributed to all 2<sup>nd</sup> and 3<sup>rd</sup> year students and supervisors between 2007-2010. During this period each student and supervisor filled in the questionnaire only once. All questionnaires were answered anonymously and on a voluntary basis.

To investigate RQ4 a crossover design was used. By differentiating the sequence of different conditions, it is possible to detect the unique condition effects on students and provide each student with the same educational conditions. This is required by ethical guidelines as each student in the course has to receive equal education. Third year students in 2008-2009 were randomly divided into 6 groups. All groups first received a pre-test ( $T_0$ ). This test displayed a patient case with guiding questions that had to be answered and was scored on 20. During the next 3 weeks half of the groups received each week a new case while the half received only one case element. This was followed by a second in-between test for all groups ( $T_1$ ). Afterwards the conditions were switched and the design ended with a post-test ( $T_2$ ). Three different test cases were used to avoid test-retest bias. The content of test cases were in line with the acquired theoretical knowledge in the course and increased gradually in complexity. Specifically, the first test case was merely focusing on diagnostic and oral hygiene measures. The second test case presented moderate adult periodontitis and smoking as a co-factor. The third test case was more advanced, both from a diagnostic as well as treatment planning point of view. Characteristics of the test cases are briefly summarised in table 2. All test cases were authored and assessed by the same person to ensure coherent scoring and to prevent bias caused by inter-rater variability.

**Table 2: Characteristics of test cases in the pretest ( $T_0$ ), in between test ( $T_1$ ) and the posttest ( $T_2$ ): Periodontal screening index Dutch Periodontal Screening Index (DPSI) (Van der Velden 2009), relevant patient's history (ASA risk scores and factors), diagnosis, treatment and level of difficulty are presented. This information was provided by the author of the case, who further treated the patients accordingly.**

Test case	DPSI	History	Diagnosis	Treatment	Difficulty
$T_0$	2	ASA I No medication Non-smoker	Gingivitis	Oral hygiene instruction Scaling	+
$T_1$	3	ASA II Medication: Asaflow® Smoker	Moderate chronic periodontitis No furcation involvement	Oral hygiene instruction Scaling + rootplanning	++
$T_2$	4	ASA III medication: Marcoumar® Smoker	Advanced chronic periodontitis Furcation involvement	Oral hygiene instruction Scaling + rootplanning Periodontal surgery	+++

Descriptive statistics were used to analyse the data from the questionnaires. Additionally repeated measures ANOVA statistics were used to compare between the test-scores of students in the two conditions and between the scores of the test-moments. All statistical analyses were performed using SPSS 17.0 with a preset significance level of  $p \leq 0.05$ .

## Results

Between 2007-2010, a total of 119 undergraduate dental students completed the questionnaire (response rate = 93%). Additionally 9 out of 10 supervisors answered the questionnaire during the same period.

With respect to general appreciation (RQ 1), students highly appreciated the case-based discussions with an average score of 15.71 on 20 (SD = 1.56, range 12-20). Supervisors rated this learning method equally high (average score of 16.08 on 20, SD = 1.38, range 14-18).

Students and supervisors were also positive about the specific aspects of the exercise (RQ 2). The detailed results per item are listed in table 3.

With respect to the time invested (RQ 3), students spent on average 74 minutes a week (SD = 41 minutes, range 25-180 minutes) on the case-based discussions. This included reading the case and the comments already made on the forum, preparing a contribution to the discussion and posting a comment on the online environment. Supervisors reported to have used on average 342 minutes per course period (SD = 94 minutes, range 240-600 minutes) to compose a case, to supervise all student groups on two feedback moments and to prepare the case for the live discussion with the course lecturer.

A total of 34 third year students participated in the crossover design. No significant difference between the conditions (1 case/week vs. 1 case element/week) was found, nor interaction effect of condition and test moment (RQ4). However, repeated measures Anova statistics identified significant increased student scores in  $T_2$  compared to  $T_0$  in both conditions and in total (Table 4).

**Table 3: Questionnaire (scale 1-5) item scores (mean and standard deviation) for students and supervisors.**

Question	Students		Supervisors	
	Mean	SD	Mean	SD
<b>Organisation</b>				
The end-meeting with the course lecturer was a valuable addition to the online discussion of the case.	4.42	0.78	4.71	0.49
The guiding questions for each part of the case were useful for the discussion.	3.95	0.71		
The introduction session was a good preparation to start the case discussions.	3.73	1.03		
The concept of working with electronic cases and 2 compulsory comments a week was feasible.	3.67	0.95		
The concept of an online case and 2 feedback moments was feasible.			4.33	0.78
Supervision during the case discussions was necessary for the progress of case solving.			4.08	0.79
<b>Course</b>				
The case discussion was a good preparation for the periodontal therapy course exam.	4.26	0.77	4.36	0.67
The cases were attuned to the theoretical course in periodontics.	4.23	0.86		
The case discussion was a valuable addition to the clinical practice.	4.21	0.78	4.36	0.81
<b>Future</b>				
In the future the online case based exercises should be expanded.	3.79	1.00	4.00	0.89
<b>Learning</b>				
Case discussions in group have an added value compared to individual case solving.	4.30	0.93	4.25	0.87
Case discussions stimulated profound clinical reasoning within a realistic framework.	4.22	0.74	4.25	0.62
Case discussions were very instructive.	4.21	0.71	4.50	0.67
I am satisfied with the quality of case solving by the students.			3.33	0.78
Discussion between students had a positive effect on the quality of case solving.			4.04	0.75
<b>Discussion environment</b>				
It was easy to view the case and post comments on the forum using the electronic learning management system.	4.51	0.69	4.25	0.75
The online supervision guidance was very useful.	3.63	1.23		

**Table 4: Student test scores in condition 1 (1 case element a week before 1 case a week), condition 2 (1 case a week before 1 case element a week) and in total during the pre-test (T<sub>0</sub>), test in-between test (T<sub>1</sub>) and post-test (T<sub>2</sub>).**

Condition	Moment of testing		
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>
1	9.61	9.67	11.61*
2	8.50	9.75	10.69*
<b>Total</b>	9.09	9.71	11.18*

\* significantly different with T<sub>0</sub>, p ≤ 0.05.

## Discussion

This study describes the introduction of online periodontal case-based discussion groups as an addition to a theoretical course in the transition to clinical practice. The value of this exercise was highly rated by the undergraduate dental students and their supervisors and proved to be feasible in terms of time investment. The frequency of introducing cases appeared not to effect student learning.

These findings are in line with previous studies suggesting that online learning is well-accepted by students as an addition to the dental curriculum (Bothelho 2001; Grimes 2002; Nurko and Proffit 2004). Technical imperfection of computer systems is often reported as a frustrating drawback to students interfering with their learning process (Grimes 2002). However the highly positive evaluation for electronic environment in this study indicates that students and supervisors did not experience any frustrations caused by a failing or complicated online system, discouraging students to think critically when solving cases.

Students experienced the aspect of group discussion as an added value to the exercise. This is in line with the results of Chumler *et al.* (2007) who reported the inability to communicate with others as the biggest disadvantage of an online individual case based exercise. Flynn and Klein (2001) reported that discussion group participants in a case based environment liked their method better than those who worked alone. They also suggested that group discussions enhanced student performances on cases when combined with individual preparation. In the present study discussion groups were asynchronous of nature providing students the opportunity prepare themselves before posting a contribution by giving time to think, rethink and consult theoretical background without the stressing factor of a real patient. Students and supervisors strongly agreed that this method was indeed instructive and enhanced clinical reasoning.

Students reported on average a weekly amount of 74 minutes to study the case, to follow the discussion and to formulate contributions to the discussion on the online learning management system. The exercise was an addition to the periodontics course, without replacing anything else. Hence, it could be argued that 74 minutes a week may be a heavy extra load in an already packed undergraduate dental curriculum. However, from students' perspective it appeared to be time well spent. Students reported that the exercise was well attuned to the course, the exam, and to clinical practice. Moreover, they claimed it was supportive to their learning process. Therefore, students' work-load in this exercise can be interpreted as beneficial for processing the course content, supporting students in their study efforts. From a faculty point of view, supervisors were only required to supervise during that week in the semester their case was discussed. In this respect, the introduction of online case-based discussion groups was easily manageable, with a minimum of extra workload for staff members.

Weekly presenting a new case compared to a single case element did not result in significant different test scores, assuming an equal learning effect. This finding suggests the possibility to differentiate between straightforward cases and multi-problem cases without altering the learning effect. Cases displaying patients with straightforward problems could be presented once a week to illustrate the lectured theory in its practical context. Introducing more complex cases with multi-problem patients at a pace of one case element a week could provide students with additional time to discuss cases more profoundly as multiple alternatives are present.

Although students and supervisors highly appreciated online case-based discussions and reported an acceptable workload, the current study is limited in identifying whether this exercise is beneficial to student learning opposed to students not executing the exercise. A study design with two control groups, being students not involved in online case discussions but receiving classroom teaching and a student group not involved with online case discussions nor receiving any classroom teaching could investigate this question. However this would imply that students in the same course would not receive the same course program. This approach is considered unethical and is not in line with the policy of the university. Nevertheless, students scored significantly higher on the post-test compared to the pre-test. Although results of the tests are hard to compare, since test were increasingly more complex towards the end of the semester (in accordance with the theory of the course), the increased scores of students may point at a positive learning effect, given that students scored higher when the tests were more difficult. However, it cannot be ruled out that this effect was caused by other factors such as the increasing theoretical knowledge acquired during the simultaneous periodontal course or the unanticipated influence of case complexity after all. In addition to this finding, students reported that the exercise was a good preparation for the examination which indicates that discussing online patient cases was perceived as supportive for learning. Additional research solving the control group issue is still needed to confirm the effect on learning of this exercise. Furthermore future studies should also focus on the modalities of online case-based discussions (eg. frequency and/or amount of compulsory student contributions to the discussion, structure of presented cases or structure and frequency of the provided feedback) to optimise this educational approach.

## **Conclusion**

Online periodontal case-based asynchronous discussions are well appreciated by both students and supervisors and can be applied with an acceptable time investment. The frequency of presenting one case a week or one case element does not have an influence of student learning. Introducing this exercise in conjunction with a theoretical course may be a valuable addition to the dental undergraduate curriculum for students to enhance knowledge and skills in the transition from theoretical courses to clinical practice.

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## **Chapter 3:**

### **Using video-cases to assess student reflection: Development and validation of an instrument**

Based on:

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**Using video-cases to assess student reflection: Development and validation of an instrument**

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## **Abstract**

### **Background:**

Reflection is a meta-cognitive process, characterised by: 1. Awareness of self and the situation; 2. Critical analysis and understanding of both self and the situation; 3. Development of new perspectives to inform future actions. Assessors can only access reflections indirectly through learners' verbal and/or written expressions. Being privy to the situation that triggered reflection could place reflective materials into context. Video-cases make that possible and, coupled with a scoring rubric, offer a reliable way of assessing reflection.

### **Methods:**

Fourth and fifth year undergraduate medical students were shown two interactive video-cases and asked to reflect on this experience, guided by six standard questions. The quality of students' reflections were scored using a specially developed Student Assessment of Reflection Scoring rubric (StARS®). Reflection scores were analysed concerning inter-rater reliability and ability to discriminate between students. Further, the intra-rater reliability and case specificity were estimated by means of a generalisability study with rating and case scenario as facets.

### **Results:**

Reflection scores of 270 students ranged widely and inter-rater reliability was acceptable (Krippendorff's  $\alpha = 0.88$ ). The generalisability study suggested 3 or 4 cases were needed to obtain reliable ratings from 4<sup>th</sup> year students and  $\geq 6$  cases from 5<sup>th</sup> year students.

### **Conclusion:**

Use of StARS® to assess student reflections triggered by standardised video-cases had acceptable discriminative ability and reliability. We offer this practical method for assessing reflection summatively, and providing formative feedback in training situations.

## Background

The traditional view that learning results from transmission of knowledge is shifting towards a view that actively constructed knowledge underpins self-regulated and lifelong learning (Cornford 2002; Sperling *et al.* 2004). The concept of meta-cognition - awareness and active control over cognitive processes - is central to self-regulated learning (Brown 1987; Schraw and Dennison 1994; Moos and Azevedo 2009). Reflection is an essential part of meta-cognition. It is conceived of as a cyclic process comprising monitoring, evaluating, and planning (Brown 1987; Schraw 1998). Boud *et al.* (1985) defined reflection as “a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to a new understanding and appreciation” (p.19). In line with this definition, three elements of reflection have been identified: 1. Awareness of self and the situation; 2. Critical analysis and understanding of both self and the situation; 3. Development of new perspectives to inform future actions (Boud 1985; Atkins and Murphy 1993; Sandars 2009; Koole *et al.* 2011).

Schön's concept of the 'Reflective Practitioner (Schön 1983, 1987) captured the central place of reflection in professional practice. He identified it as a means of revisiting personal experience to learn and manage complex problems encountered in professional contexts. In health care sciences, the ability to reflect on experiences is regarded as an important attribute that allows professionals to respond to the demands of the complex environments they work in (Plack and Greenberg 2005; Robertson 2005; Kjeaar *et al.* 2006). It helps them identify shortcomings in their knowledge and skills, and understand their professional actions better (Branch and Paranjape 2002; Bethune and Brown 2007). Accordingly, many policy documents have identified reflection on professional experiences as an important outcome parameter for graduated physicians (SDMCG 2007; GMC 2009; NFU 2009). There is, however, a discrepancy between the growing consensus that reflection on professional experience is beneficial and the persisting lack of clarity about the best methods to teach and assess it (Sandars 2009; Mann *et al.* 2009). Education and assessment are interrelated. Assessment is needed to measure whether learners have achieved required learning goals, indirectly identifying the efficiency of the used educational method. It can also impact directly on learning by providing feedback on strengths and weaknesses that allows students to control and structure their learning (Tillema 2009; Cilliers *et al.* 2010).

The fact that reflection is a meta-cognitive process complicates assessment because it implies a process of thought only accessible to the reflecting person (Boud *et al.* 1985; Sandars 2009). Assessors can only observe this process indirectly through verbal and/or written expressions. Moreover, they usually access reflective thoughts without any knowledge of the situation that stimulated them. To put reflective thought into its proper context, it would be valuable if assessors had access to the triggering situation as well as the thought it provoked. In order to access the triggering situation assessors could be asked to observe situations live or by video but the time involved would make assessment of whole cohorts of learners impractical. As an alternative, Hulsman *et al.* (2009) asked students to review video recordings of their performances and select key fragments in which to ground their written reflections. Students had also to review video recordings of other students and provide peer feedback. This self and peer orientated approach solved the time efficiency issue, but presented only a selected and fragmented window into the triggering situation and depended on peers understanding reflection well enough to provide valuable feedback.

Vignettes or short stories based on simulations of real events can be used to stimulate reflection (Spalding and Phillips 2007). Boenink *et al.* (2004) demonstrated the utility of paper vignettes to assess student reflections. Kamin *et al.* (2003) and Balslev *et al.* (2005) found that video-cases triggered critical thinking better than written cases. Similar results were found by Botezatu *et al.* (2010), who used virtual patient simulation for both education and assessment. In the context of communication training in the third year of an undergraduate medical curriculum, Hulsman *et al.* (2006) found that short questions about standardised video-cases concerning history taking, breaking bad news and decision making could ground reliable and discriminating scoring. Also in the domain of communication skills, Mazor *et al.* (2007) showed that video-vignettes could provide good generalisability estimates. These findings suggest the use of such standardised video-cases to trigger reflection for the purpose of assessment as a worthy approach for further study.

To score written reflections various coding schemes have been proposed, using from three to seven categories (Wong *et al.* 1995; Kember *et al.* 1999) and introducing a variety of indicators (Duke and Appleton 2000). Wong *et al.* (1995) showed there was a tension between the reliability of coding schemes and their ability to discriminate between learners; a smaller number of categories had acceptable reliability but limited ability to discriminate whilst a larger number was more discriminant but less reliable. Recently, scoring rubrics have been used to score reflections (Ward and McCotter 2004; Wald *et al.* 2009; Devlin *et al.* 2010). These are scoring guides, which provide quality definitions that enable assessors to score efficiently and support learning in a way that can contribute to instructional quality (Popham 1997; Andrade 2000). Building on the reported findings about standardised video-cases and scoring rubrics, the current study replaced live situations with video-cases to trigger reflection within a standardised context. A scoring rubric was developed to score reflection reliably. Our objectives, then, were to:

1. Pilot an assessment method combining standardised video-cases to stimulate student reflection on consultation experiences and a scoring rubric to measure it, which could be used for training and to provide feedback.
2. Evaluate reflection scores resulting from this method in terms of:
  - their ability to discriminate between students
  - their reliability, as judged by inter-rater and intra-rater variation, and case-specificity

## Methods

### *Development of video-cases to trigger student reflections*

To trigger reflections, we developed four interactive video-cases, recorded from a physician's perspective to increase their authenticity. Scripts were drafted by skills lab teachers and patient roles were played by experienced simulated patients who had received five hours of training. Each video-case showed a patient consulting a general practitioner with a problem appropriate to students' expected level of competence. All cases followed the same structure: reason for encounter, history, physical examination, explanation of diagnosis, advice and treatment planning, and closure of the consultation. Each case lasted 15-20 minutes, similar to real life consultations.

The video-cases were made interactive to stimulate student involvement. The interactive element consisted of six interruptions. At each interruption the screen turned black and a question appeared, like “How would you react now?” or “What diagnosis do you think is appropriate and why?”. The questions were formulated to confront students with complex and multidimensional problems that could not be solved in a straightforward way in order to stimulate reflection (Schön 1983, 1987). While students were writing down their answers, a countdown timer informed them when the video-case would resume. The time limit was introduced to make the video-cases like real consultations where there is only limited time to think. Having finished a video-case, students were asked to reflect on their experience. Whilst reflection is characterised by a number of key elements, the boundaries between them are often blurred in reality (Boud *et al.* 1985; Moon 1999). People seldom take every step in full awareness and in strict succession. It is difficult to compare such diverse reflections. Hence we introduced six questions (table 1) to structure student reflections. These questions were developed to represent the three key elements of reflection (2 questions/element) as described in the ‘introduction’ (awareness, understanding and future actions). Afterwards these structured reflections were scored using the Student Assessment of Reflection Scoring rubric (StARS®) (table 2).

**Table 1: Reflection structuring questions posed after the interactive video-case to guide students through the process of reflection**

<i>Aspect of reflection process</i>	<i>Question</i>
<i>Awareness of the experience</i>	1. <i>Describe the progress of the consultation with attention to both patient behaviour and the physician’s actions.</i>  2. <i>A What people or factors had an impact on the progress of the consultation?</i> <i>B What did you think/feel when answering the case question?*</i> <i>C Looking back on the progress of the consultation: what went well?</i> <i>D What did not go well?</i>
<i>Understanding the experience</i>	3. <i>Formulate searching questions that help to analyse your own actions/thoughts during the consultation process.</i>  4. <i>A Try to answer your searching questions.</i> <i>B What knowledge/feelings/values/former experiences did you use to formulate your answer(s)?</i>
<i>Impact on future actions</i>	5. <i>What did you learn going through this consultation?</i>  6. <i>What concrete actions did you plan for future practice?</i>

\* In each case a question was selected that put students in a stressful and acute situation that demanded a reaction

**Table 2: Student Assessment of Reflection Scoring rubric (StARS®) used to calculate an overall reflection score.**

<b>Awareness of the experience</b>			
<b>Item 1: Being able to describe an experience adequately.</b>			
0	1	3	5
No description	Description contains unnecessary details or is incorrect	Description is incomplete	Description is complete and accurate
<b>Item 2: Being able to identify essential elements and describe own thoughts and feelings.</b>			
0	1	3	5
Sub question score 0	Sub question score 1-3	Sub question score 4-6	Sub question score 7-9
<b>Sub question score for item 2 is calculated by the sum of sub questions 2A, 2B, 2C/D (table 1)</b>			
<b>2A:</b> Physician, patient and symptom related factors had an impact on the progress of the consultation 0 = no element; 1 = one element; 2 = two elements; 3 = all three elements			
<b>2B:</b> 0 = no description; 1 = insignificant description; 2 = brief, significant description; 3 = broad, significant description			
<b>2C/D:</b> 0 = no description; 1 = answering only one sub question; 2 = brief descriptions; 3 = broad descriptions			
<b>Understanding the experience</b>			
<b>Item 3: Being able to pose searching questions.</b>			
0	1	3	5
No questions	Insignificant questions	1 significant question	Multiple significant questions
<b>Item 4: Being able to answer searching questions and being aware of the relevant frames of reference.</b>			
0	1	3	5
Sub question score 0	Sub question score 1-2	Sub question score 3-4	Sub question score 5-6
<b>Sub question score for item 4 is calculated by the sum of sub questions 4A, 4B (table 1)</b>			
<b>4A:</b> 0= no description; 1= insignificant description; 2= brief significant description; 3= extensive significant description			
<b>4B:</b> 0= no frame of reference; 1= one brief element; 2= two brief elements/one extensive element; 3= three brief elements/ two extensive elements			
<b>Impact on future actions</b>			
<b>Item 5: Being able to draw conclusions.</b>			
0	1	3	5
No description	Insignificant description	Brief description	Extensive description
<b>Item 6: Being able to describe concrete learning goals and plans for future action.</b>			
0	1	3	5
No learning goals/plans	Learning goals/plans are vague/ insignificant	Concrete but brief description of learning goals/plans	Concrete and extensive description of learning goals/plans
Total reflection score is calculated by adding all item scores (6 x 0-5). Item score 2 and 4 are calculated by first scoring the sub questions below. Those are added into a sub question score and transformed into an item score using the conversion formula in the rubric.			

### *Development of a rubric to assess student reflections*

The StARS® is based on a scoring grid developed by Duke and Appleton (2000) retaining only the items related to the construct of reflection. This resulted in a 5-item scoring rubric, which we complemented with an item about searching questions to represent all the elements in the construct of reflection (Bourner 2003; Koole *et al.* 2011). Item descriptions of the scoring rubric were tested for ambiguity in a pilot study among sixth year undergraduate medical students at Ghent University. After a consultation exercise with a simulated patient, four students were asked to reflect on this experience guided by the reflection structuring questions. Their structured reflections were independently scored by three assessors (SK, LA and AD) using the scoring rubric. Afterwards item descriptions displayed in the rubric were discussed by the assessors and, when experienced as unclear, revised accordingly. The number of scoring options was also reduced and boundaries between them were clarified, to minimise inconsistency between assessors. After revision, StARS® consisted of 6 items (2 items/element), to be scored on a 4-point scale. A total absence of any reflective expression in a scoring item is identified by 0. Because the presence of insignificant expressions are closer to no expressions than to significant expressions, 0, 1, 3, 5 scale was used. The 6 score items together are added to provide an overall reflection score (range 0-30). Good reflection, according to StARS® is:

- *A comprehensive and accurate view of an experience with attention to one's own and others' thoughts and feelings and an ability to make a distinction between essential and less important facets of the experience.*
- *Being able to explore the experience with searching questions and being aware of the frames of reference used to answer those questions.*
- *Being able to draw conclusions and translate them into concrete action plans for future practice.*

### *Participants and procedures*

This study was approved by the ethical committee of Ghent University Hospital. In the academic year 2008-2009, all fourth (n=206) and fifth year (n= 156) undergraduate medical students at Ghent University were invited to participate. Those who accepted had to attend two sessions in which they completed an interactive video-case and reflected on their experiences of the case. Each student completed two different cases in the same order, the content of which was related to the curriculum modules of the previous semester. Fourth year cases were about ventricular fibrillation (C1) and heart failure (C2); fifth year cases were about transient ischemic attack (C3) and neck/arm pain (C4). To limit interaction bias, all sessions using the same video-cases were held successively on a single day.

Student wrote their answers to the guiding questions on paper forms, which were scored with StARS®. All student reflections were scored by the same assessor (SK).

## Analysis

As we intended this method to be used by skills lab teachers, we recruited two teachers who were experienced in skills lab consultation training, but had neither been trained in marking reflective writings, nor involved in the development of StARS®. They were asked to score 40 randomly selected student reflections. Their training consisted of a 30 minute introductory session in which the underlying concept of reflection and the rubric were explained and they scored one student reflection to be discussed together afterwards. They then independently scored student reflections, from which we calculated the inter-rater variance using Krippendorff's alpha (Kalpha). Hayes and Krippendorff (2007) reported that many commonly used reliability coefficients such as Scott's pi, Cohen's kappa, and Cronbach's alpha are either limited to two observers, fail to control for chance agreement, or only use corrections for the number of categories and not the distribution of ratings across categories or intervals. In order to overcome these limitations, they proposed Kalpha, useable for any number of raters, level of measurement, and sample size, accommodating missing data and controlling for chance agreement.

In addition, all student reflections were scored by one assessor (SK) and results were analysed by descriptive statistics (mean, standard deviation and range) to explore the method's ability to discriminate between students.

Intra-rater variance was investigated by the same assessor (SK) scoring all student reflections for a second time 18 months apart. These data resulted in 4 reflection scores for each student (2 cases with each being scored twice), which were used in a generalisability study to analyse intra-rater and case specificity as possible sources of variance in reflection scores. A generalisability study shows the relative size of each source of variation and their interactions, which together provide a generalisability coefficient (G coefficient) between 0 and 1. This measure indicates whether differences observed between students are real. G values of 0.8 and higher are generally accepted as a threshold for high-stake judgments (Crossley *et al.* 2002). To investigate how the reliability of reflection scores could be optimised, G coefficients were calculated, varying number of cases and ratings in a decision or D study. All statistical analyses were performed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA). To calculate the Kalpha a macro downloaded from <http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html> was used in SPSS. G- and D studies were performed with a macro for SPSS downloaded from <https://people.ok.ubc.ca/briocconn/gtheory/gtheory.html>.

## Results

181 fourth year (88%) and 92 fifth year students (59%) reflected on two cases (C1 and C2 for fourth year students, C3 and C4 for fifth year students) and could therefore be included in the statistical analysis. Non-participation was due to circumstances like timetable clashes and illness, which were unlikely to have systematic effects on the findings.

Individual students' reflection scores ranged between 1-30 with a mean overall reflection score of 19.1 (SD 4.5) as shown in table 3. A Kalpha coefficient of 0.88 demonstrated acceptable inter-rater reliability between the scores of the two skills lab teachers. The variance components of generalisability studies in a two-facet crossed design with rating and case as facets performed

separately for fourth and fifth year students to limit student variation are detailed in table 4. The D study, shown in table 5, indicated that G coefficients of reflection scores could be improved by increasing the number of cases while increasing the number of ratings by the same rater had no substantial effect.

**Table 3: Student Assessment of Reflection Scoring rubric (StARS®) used to calculate an overall reflection score. Each item is scored on a scale of 0-5**

Case		Reflection score			
		Mean	SD	Range	Total of student
4 <sup>th</sup> year	C1	20.1	4.3	7-30	181
	C2	17.6	4.7	1-26	181
5 <sup>th</sup> year	C3	20.2	4.2	8-30	92
	C4	19.1	4.0	8-28	92

Descriptive statistics (table 3) have indicated a wide variation in reflection scores (range and standard deviation), which suggest the used method can discriminate between students. An alternative explanation, that inaccurate measurement could cause these wide ranged scores, proved inconsistent with the measured inter-rater and intra-rater reliability, that were satisfactory. Together, these findings provide evidence in support of a valid measure of inter-individual differences in reflection.

**Table 4: Contributions of student, rating, and case and their interactions as sources of variance (variance estimate VE and relative contribution RC) in reflection scores**

Component	Fourth year students		Fifth year students	
	VE	RC	VE	RC
Student	11.11	0.39	5.51	0.34
Rating	0.00	0.00	0.00	0.00
Case	5.17	0.20	0.05	0.00
Student x Rating	0.00	0.00	0.75	0.05
Student x Case	6.90	0.26	6.83	0.43
Case x Rating	1.02	0.04	0.26	0.02
Student x Case x Rating	2.92	0.11	2.60	0.16
<b>G coefficient</b>	<b>0.71</b>		<b>0.55</b>	

**Table 5: D study to investigate the effect of more ratings by the same assessor and more cases on the G coefficients in fourth and fifth year student reflection scores.**

Cases	Fourth year students				Fifth year students			
	1 rating	2 ratings	3 ratings	4 ratings	1 rating	2 ratings	3 ratings	4 ratings
1	0.51	0.55	0.56	0.57	0.35	0.39	0.41	0.42
2	0.67	0.71	0.72	0.73	0.50	0.55	0.57	0.58
3	0.76	0.78	0.79	0.80*	0.59	0.64	0.66	0.67
4	0.81*	0.83*	0.84*	0.84*	0.64	0.70	0.72	0.73
5	0.84*	0.86*	0.87*	0.87*	0.68	0.73	0.76	0.77
6	0.86*	0.88*	0.89*	0.89*	0.70	0.76	0.78	0.80*
7	0.88*	0.89*	0.90*	0.90*	0.72	0.78	0.80*	0.81*
8	0.89*	0.91*	0.91*	0.91*	0.74	0.80*	0.82*	0.83*
9	0.90*	0.92*	0.92*	0.92*	0.75	0.81*	0.83*	0.84*
10	0.91*	0.92*	0.93*	0.93*	0.77	0.82*	0.84*	0.86*

\* identifies an adequate number of cases and ratings to achieve a G coefficient  $\geq 0.80$

## Discussion

We have developed a method of assessing student reflections using standardised video cases and a scoring rubric, applied it to 270 fourth and fifth year undergraduate medical students, and demonstrated that the resulting reflection scores have acceptable psychometric properties including the ability to discriminate, inter- and intra-rater reliability, and case-specificity.

Replacing situations unique to individual students with standardised video-cases provided a common base for assessment without limiting variance between reflection scores. This variance can be attributed to two factors. First, students have unique frames of reference influenced by their individual prior experiences, knowledge, and beliefs (Mezirow *et al.* 2000), which lead them to reflect on different aspects of experience, pose different searching questions, and identify different learning goals. Second, the scoring items of StARS<sup>®</sup> identify the process of reflection (eg. the ability to ask searching questions or to draw conclusions) and this process varies independently of the content of reflection which is related to the triggering situation (Bourner 2003).

The inter-rater reliability of skills lab physicians, who had been trained for only 30 minutes, was sufficient. This finding reflects favourably on the use of guiding questions to structure reflections and the quality of the scoring rubrics. Each rater took about three hours to score 40 student reflections, proving StARS<sup>®</sup> is a practical instrument to evaluate student reflections in order to provide feedback.

Feedback about reflection is becoming increasingly important as the idea of reflection as a strictly individual internal process is changing into a notion of a thinking process that needs to be complemented with external feedback. This increased focus on external information is grounded in concerns about individuals lacking accurate introspection skills to fuel reflections and recognition of a need to verify one's reflecting thoughts and frame of reference against a broader perspective (Eva and Regehr 2005). Discussing experiences and the reflective thoughts that accompany them is key to bringing an internal process and external information together. Multiple formats have been proposed such as critical friends, formative feedback from supervisors and peer feedback (Dahlgren

*et al.* 2006; Makoul *et al.* 2010; Sargeant *et al.* 2011). However, interacting effectively about reflections, requires individuals to learn to verbalise their reflective thoughts. Our proposed method of assessment through facilitated reflection may be beneficial for this learning process as it structures reflections by means of structuring questions and provides feedback on essential aspects of the process of reflection as StARS® items are scored.

The generalisability study identified students, cases, and the interaction between them to be the main sources of variance in reflection scores. The variability between students is evidence of systematic individual differences in the quality of reflection and is not to be seen as error (Mushquash and O'Connor 2006). Variance between cases (case specificity), however, was an important source of error. The D study showed that increasing the number of cases had a much greater effect on the G coefficient than increasing the number of ratings. The content of cases and reflections that ensue from them have a complicated relation. According to Schön (1983, 1987) a complex, challenging context best stimulates reflection. We tried to match video-cases to students' expected level of competence but it is likely individual students found different levels of challenge in the same cases and were therefore stimulated differently by them. As well as case-related effects, Kreiter and Bergus (2007) recommended considering occasional influences like momentary insights and confusions as possible confounders. Despite those considerations, three to four cases (depending on the number of ratings) were enough to obtain the G coefficient of 0.80 needed for high stakes decisions in fourth year students, though fifth year students needed over six cases (Crossley *et al.* 2002). This result suggests the usage of this method spread over time during a course rather than on one day high stakes exams as students need approximately 1 hour to view a case and to reflect upon.

Whilst the standardised context of video-cases is useful for training and assessment purposes, it also introduces a limitation. The ultimate aim of reflection is to learn from experiences so future actions can be more purposeful and deliberate [16]. In real life, students choose which experiences to reflect on, related to their individual development as physicians-to-be and life-long learners. Fuelled, as they are, by less personal and meaningful experiences, reflections based on standardised video-cases might have a lesser impact on individual learning. That disadvantage may, however, be offset by the advantages of giving feedback on reflection that is informed by detailed knowledge of the triggering situation.

It could be argued that using a 4-point scale in StARS® (0,1,3,5) limits the diversity of reflection scores and hence discrimination between students. Our findings do not, however, support that claim as scores ranged between 0-30 with standard deviations above 4.0 in each year and for each case. Reflection scores were calculated as the sum of the scores on the 6 items in the rubric. That had the benefit of showing differences in students' overall ability to reflect but could also hide important differences between students with similar total scores. Totally different patterns of item scores, resulting from students' diverse reflection strategies could result in similar aggregate scores .

It could be questioned whether the 6-item structure of StARS® adequately represents the process of reflection. In fact, we reviewed the literature very carefully to search for items that were common to the various widely-used models/theories of reflection to develop the scoring rubric (Koole *et al.* 2011). Use of those common items to construct StARS® is an important factor contributing to its validity.

Medical students have a constant stream of encounters with colleagues, supervisors, patients, their families, and other health care workers. This continuous series of interrelated events, and the reflections they trigger are wide open to further research. The aim of the present study was to develop a method of meeting this complex educational challenge under well-defined, standardised lab conditions. Comparison with the learners' ability to reflect in more complex and authentic situations in real life is the next challenge. Further research, however will have to identify how to standardise the stimulus for these authentic reflections and how to make it possible for an assessing third party to observe them in whole populations of students. Furthermore, future research could focus on the relation between acquired reflection scores and academic or medical performance since empirical evidence about the effects of reflection on practice remains scarce (Mann *et al.* 2009).

## **Conclusion**

Reflections triggered by standardised video-cases and assessed with StARS® could be scored with acceptable discrimination between students, inter-rater reliability and generalisability properties concerning intra-rater and case specificity. We offer this practical method for assessing reflection summatively, and providing formative feedback in training situations.

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## **Chapter 4:**

### **The influence of reflection on portfolio learning in undergraduate dental education**

Based on:

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**The influence of reflection on portfolio learning in undergraduate dental education**

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## **Abstract**

### **Introduction:**

Disparity exists between the growing consensus about the positive effects of reflection on performance and the scarcity of empirical evidence demonstrating this effect. Portfolios are considered a useful instrument to assess and supervise competence-based education and to stimulate reflection. The present study describes the introduction of a portfolio in a social dentistry and oral health promotion course and investigates student reflection as a predictor for the acquisition of the other competences in the course.

### **Methods:**

Fourth year undergraduate dental students (n=110) in the course "Society and Health" between 2008-2011 collected evidence in their portfolios, demonstrating the acquisition of five competences: the ability to 1. assess the oral health profile of a target group; 2. integrate theoretical models in health promotion; 3. search for and apply scientific evidence; 4. work trans-, multi- and/or trans-disciplinarily; 5. reflect on personal development. Linear regression analysis was used to investigate the predictive value of reflection on the other course related competences.

### **Results:**

Reflection scores proved to significantly predict other course related competences, when analysing all students between 2008-2011 and for each year separately, explaining between 10.7 % and 25.5 % of the variance in the other competences.

### **Conclusion:**

Undergraduate dental students' competences related to social dentistry and oral health promotion were significantly predicted by the reflection scores obtained in a portfolio-based context. In line with the growing consensus about the benefits of reflection for dental students and professionals, results suggest the value to further develop the integration of reflection in dental education and practice.

## Introduction

The professional dental environment today is characterised by exponentially expanding knowledge and treatment options, more articulate and demanding patients with complex multicultural and socio-demographic backgrounds and an increased focus on multi-disciplinary collaboration. Reflection, a meta-cognitive process involving awareness of experience, analysis of experience and planning of future actions, has been identified as an important attribute to deal with this complex professional context (Schön 1983; Plack and Greenberg 2005; Redwood *et al.* 2010). It is key to professionals in maintaining awareness of their own behaviour and its effects on the context, and to engage in fully informed actions (Boud *et al.* 1985; Sandars 2009). Consequently, reflection is considered a critical aspect of continuous professional development and lifelong learning (Collins 2009; Mann *et al.* 2009).

Licensing bodies have acknowledged the importance of reflection for professional practice by including the ability to reflect as an expected attribute for graduating as a dentist (Hendricson *et al.* 2006; Cowpe *et al.* 2009) and in other health care professions (SDMCG 2007; GMC 2009) based on the assumption that reflection will enhance competence (Mann *et al.* 2009). While consensus about the ability to reflect as a requirement for high-standard professional practice has grown, empirical evidence demonstrating the effect of reflection on learning and practice remains scarce, which results in a persisting lack of clarity about the best approach to reflection in education and practice (Boyd 2008; Mann *et al.* 2009).

Portfolios have been introduced as an educational instrument to guide and evaluate competence-based learning in professional environments (Gadbury-Amyot *et al.* 2003; Driessen *et al.* 2007; Gardner and Aleksejuniene 2008; van Tartwijk and Driessen 2009). They contain evidence of competence collected by learners, which can take on various formats such as reports of work done, feedback, progress made, and plans for learning (Driessen *et al.* 2007; Driessen *et al.* 2011). The information collected in the portfolio allow supervisors to follow and provide feedback on the learners' progress. By inspecting available evidence at the end of a training period, this instrument can be used to assess whether required competences have been achieved (Gadbury-Amyot *et al.* 2003; Mattheos *et al.* 2009). Portfolio-based education is also thought to stimulate reflection (Challis 1999; Driessen *et al.* 2007; Plaza *et al.* 2007; Mckenna *et al.* 2011). Driessen *et al.* (2011) proposed two mechanisms. Gathering evidence to demonstrate the acquisition of competences stimulates learners to consider their learning goals and to plan, monitor and adjust their actions accordingly. This process requires learners to look back at their experiences and analyse what they have achieved and what they still need to accomplish (Boud *et al.* 1985; Driessen *et al.* 2011). Secondly, the inclusion of written reflections in portfolios such as diaries, reports, learning goals, and self-assessments can also support the process self-enquiry over a period of time and facilitate the process of planning and monitoring in professional development (Driessen *et al.* 2011).

The present study describes the introduction of electronic portfolios as an educational approach to guide and assess competency-based learning and reflection in the context of an undergraduate fourth year dental course in social dentistry and oral health promotion. Whereas reflection is considered to be closely related to competence development (Mann *et al.* 2009), it was also investigated whether the assessment results of reflection and course related competences in the

portfolio could demonstrate this assumed impact. The study was guided by the following research question.

Within a context of portfolio-based learning, does student reflection predict the acquisition of other competences in an undergraduate dental course in social dentistry and oral health promotion?

## Method

### *Introducing portfolios in an undergraduate social dentistry course*

The course “Society and Health”, taught in the fourth year of the undergraduate dental curriculum at Ghent University, focusses on competences related to health promotion and community dentistry. Students following this course are sent out in small groups (2-3 students) to experience health promotion and community work in local organisations as they are asked to do clinical and health promotional tasks, applying the theoretical knowledge they acquired in previous courses. The course aims to develop five competences (Table 1) based on “the profile and competences of the European dentist” (Cowpe *et al.* 2009) and the “Canmeds framework” for physicians (RCPSC 2005) and uses a portfolio, hosted on the university’s electronic learning management system to guide and assess this process.

The course begins with two introduction sessions to describe the structure of the course, the use of the electronic portfolio, the assessment procedure and the activities of the participating local organisations. These introduction sessions are also used to teach a common definition of reflection to all students and supervisors involved and to discuss its value for learning and practice (Aronson 2011). In the context of this course (and this study) reflection is defined as a metacognitive process, retrospective to an experience, characterised by 1) awareness of this experience, one’s own and others’ thoughts, feelings and essential aspects in this experience 2) reflective inquiry to analyse the experience within a personal frame of reference and 3) the development of new perspectives to be implemented in future actions (Boud *et al.* 1985; Atkins and Murphy 1993; Sandars 2009; Koole *et al.* 2011).

Each student group is linked to a local organisation and assigned a university supervisor and an electronic portfolio, comprising a repository space and a wiki-instrument. The repository space is used to store all collected documents during the course. The wiki-instrument serves as an electronic notebook, saving each change, assessable to all students in the group and to the supervisor. This wiki is structured in advance to comply with the course (Driessen *et al.* 2005<sup>b</sup>). It consists of a central page displaying a summary of the portfolio items and links to all other pages. Each competence has a separate page in which students have to present two pieces of evidence and describe why this evidence proved the acquisition of the competence in question. To demonstrate their ability to reflect, students have to individually write a reflection report about their experiences during the course. For guiding purposes the wiki also contains a page used by the groups to report on their monthly progress and receive feedback from their supervisor. Examples of portfolio entries are presented in Table 2.

**Table 1: Description of the competences to be acquired and used assessment criteria in the course “Society and Health” in the 4<sup>th</sup> year of the undergraduate dental curriculum at Ghent University**

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**Competences and criteria of assessment**

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**Competence 1:** *The ability to gather information concerning the oral health condition and related behavioural, socio-economic and environmental determinants of a specific target group, including accessibility of care. This happens with empathy and respect for the involved target group (oral health profile).*

- Local organisation was described
- Description of the oral health profile of the target population was clear
- Used methodology (validity/reliability of used measurement instruments, supportive/confounding factors)
- Analysis and description of results were reported
- Validation of results by relating to other findings was performed and reported
- Conclusion (focus on the essence and relevance) was clear

**Competence 2:** *The ability to test available theoretical models of health promotion and primary health care against project-driven work of local organisations, specifically with respect to projects that raise the accessibility to dental care and reduce socio-economic inequality.*

- Clear description of all phases in the project and timing was respected
- Foundation of project on theoretical models.
- Systematic structure in the project
- Relevance of project concerning its context (problem, target group)
- Implementation of the project
- Presence of project effect evaluation
- Conclusion (relation between project aspects, process evaluation, consequence of findings)

**Competence 3:** *The ability to scientifically search for underlying evidence and apply this on oral health promotion projects in cooperation with local organisations.*

- A relevant research question was transformed into a **Population Intervention Comparison Outcome (PICO)** format
- Structured search of relevant publications was performed
- Quality of literature was scientifically assessed
- Conclusions were applied in the project

**Competence 4:** *The ability to demonstrate the added value of multi-, inter- and transdisciplinary work in the executed oral health project with focus on own position.*

- Description of collaboration (with whom, about what aspects, when, how and why) was clear
- Experience and perceived benefits of collaboration were described
- Identification of level of collaboration (multi-, inter- and/or transdisciplinary collaboration) was reported

**Competence 5:** *The ability to reflect on the experiences related to the clinical and health promotion tasks and collecting evidence in the portfolio.*

- Description of the experience was clear and understandable
  - Personal and other persons thoughts and feelings were described
  - Distinctions were made between essential and less essential aspects in the experience
  - Reflective inquiry was used to analyse the experience
  - Student referred to a personal frame of reference
  - Answers were proposed to the reflective inquiry
  - Reflection contained new or confirmed perspectives as a result of reflective analysis
  - Relation between reflection and future actions was described
  - Reflections concerning personal development were relevant in the course “Society and Health”.
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**Table 2: Examples of portfolio entries in the course Society and health taught in the fourth year of the undergraduate dental curriculum at Ghent university**

<b>Competency</b>	<b>Portfolio-entry</b>
<b>Oral health profile</b>	<p><i>"...Both the clinical examination and the questions about oral hygiene posed to the parents, made us to conclude that the oral health of children, we examined, was excellent..."</i></p> <p><i>"...Questionnaires were used to study oral health, oral hygiene, food habits, smoking habits, frequency of dentist visits. We also investigated the family situation they were in..."</i></p> <p><i>"...We think screening provided us a relevant perspective about oral health status and oral hygiene. Our participants were selected based on voluntary grounds, hence they do probably not represent all workers, since their motivation will likely be increased..."</i></p>
<b>Project development</b>	<p><i>"...These are the concepts and models we based our project upon: The declaration of Alma Ata (1978), Ottawa Charter (1986)..."</i></p> <p><i>"...Based on the "Communication – Behaviour Change Model" we provided our target group with tangible but simple information and induced a change in behaviour. This was concluded by measuring differences before and after the entire project. This was confirmed by the feedback from our local organisation (supervisors and carers). Nevertheless we are aware that a significant long-term effect will require probably more than this isolated project..."</i></p>
<b>Evidence-Based dentistry</b>	<p><i>"... PICO question: Is it possible to use an oral health project (Intervention) to increase oral hygiene related behaviour (brushing one's teeth, dentist visit, ...) (Outcome) in children or adolescents with a low Social Economical Status (Patient/Problem) compared to children or adolescents who don't experience an oral health project (Comparison)..."</i></p> <p><i>"...When we project this evidence to our project, it suggests we have to consider the element of parents. Unfortunately, discussions with the local youth workers revealed the difficulty in reaching the parents, which we also have experienced during the activities..."</i></p> <p><i>"...The articles emphasised the active participation during oral health promotion. This was implemented by using a game approach to provide information..."</i></p>
<b>Multi-, inter- and trans disciplinary work</b>	<p><i>"...The cooperation with various persons was beneficial for our project. Each contact or employee provided us additional information about the profile of the target group, already executed prevention campaigns, cooperation between various supervisors and the general operation and objectives in each local organisation..."</i></p> <p><i>"... In order to achieve positive change in dental care, we also understand the necessity to approach a variety of persons on different levels and integrate these into a comprehensive strategy towards care and support. To encourage better oral hygiene it is insufficient to solely provide brush instructions..."</i></p>
<b>Written reflections</b>	<p><i>"... as I said before, I felt reasonably nervous, because we don't have the experience with the examination of children. During the examination I tried to keep my nerves under control and to remain calm towards the children and their parents. I noticed that my insecurity and nerves decreased with each child I examined, and treatment became more and more efficiently..."</i></p> <p><i>"...I noticed from the game that oral health of these children was not at an adequate level. With competency 2 in my mind, I wondered how theoretic models best could be applied to this target group and if they are usable in each population. What to do when persons are not receptive to change their health behaviour? Is it possible to 'force' persons to change their behaviour? Oral health is often not a priority in the families of these children. These children are accustomed to these habits and I wonder if it is possible to change this?..."</i></p> <p><i>"... Twice I had to report signs of initial caries. I was hard. Why? Most parents really try hard and I can imagine that this comes across as a personal attack. Delivering a message in such a manner that parents don't feel themselves attacked, but realise the importance, is hard..."</i></p> <p><i>"...I have the impression that our volunteers felt themselves tested, therefore I would phrase the questions differently in the future..."</i></p>

Various criteria are used to assess the acquisition of competences (Table 1). The assessment protocol encompasses multiple levels (Driessen *et al.* 2005<sup>a</sup>). First, the supervisor and an external assessor (= supervisor of another group) are assigned to provide a temporary score on each competence, based on the criteria. These scores are discussed in an assessment committee including all supervisors until consensus is reached (Pitts *et al.* 2002). These discussions were also used to calibrate supervisors' guiding and judgements. Finally, during these sessions also questions are formulated to be asked by the lecturer of the course during an end-exam when the portfolio is discussed with individual students to test their understanding (van Tartwijk and Driessen 2009). This is scored and integrated with the temporary score to finally form the total score for the course (Table 3).

To create a safe environment, reflection reports were evaluated by SK who was not involved in the supervision or assessment of other competences (Boud and Walker 1998). The involvement of SK in the development of the course ensures the assessor's familiarity with the students, the learning context and the competences to be acquired, to support the validity of the assessment (Kember *et al.* 1999). Reflection in the course was defined according to a model reported by SK in 2008, and published recently (Koole *et al.* 2011). It describes the process of reflection based on the common elements of widely used theories and models (Boud *et al.* 1985; Atkins and Murphy 1993; Stockhausen 1994; Moon 1999; Duke and Appleton 2000; Mezirow *et al.* 2000; Bourner 2003; Mamede and Schmidt 2004; Korthagen and Vasalos 2005; Koole *et al.* 2011). Criteria used to assess reflection embodied all relevant reflective skills derived from this model (Table 1). Reflection scores were integrated with scores on other competences into an overall score for the course based on a fixed weighting system (Table 3).

**Table 3: Weighting system used to calculate the course score of 'Society and Health' course in 2010-2011**

Score item	Weight
Competence 1: Oral health profile	20
Competence 2: Project development	20
Competence 3: Evidence based dentistry	20
Competence 4: Multi-, inter- and trans disciplinary work	20
Competence 5: Reflection	20
<b>Temporary score</b>	<b>100</b>
Portfolio discussion on exam	50
<b>Total course score</b>	<b>150</b>

#### *Participants and protocol*

Study protocol to investigate the predicting value of reflection on other course related competences was approved by the Ghent University Hospital ethics committee. The course "Society and Health" targets five competences related to reflection, oral health profile, project development, evidence based dentistry and multi-, inter- and trans disciplinary work. Scores on these competences were collected of students (n=110) that followed the course between 2008-2011. Scores were obtained through the course lecturer and anonymised to safeguard students' privacy.

## Analysis

Simple linear regression analysis was used to address the research question. This statistical method uses linear modulation to analyse the ability of a single factor to predict an outcome (Field 2009). Reflection score was introduced as the predicting factor in the analysis. The outcome was defined as the average of the four other competences in the course. This approach was preferred to analyses with individual competences, since student reflections were based on the integration of competences in experiences. This mean score was also used as a measurement for student competence rather than the end course score, because of the systematic influence of reflection on the end course score (Table 3). Analysis was applied to data of all students and data of students in separate academic years to investigate possible variance caused by minor adjustments to optimise the course format. Statistics were performed by using SPSS 17.0 (SPSS Inc, Chicago, IL, USA) with a pre-set significance level of  $p \leq 0.05$ .

## Results

Data from all undergraduate students in the course “Society and Health” during academic years 2008-2009, 2009-2010 and 2010-2011 were included, representing 100% of the total student population. Descriptive statistics demonstrate reflection and competence scores were stable over 2008-2011 (Table 4).

**Table 4: The course “Society and Health” during the period 2008-2011: Number of students (N students), Mean and Standard Deviation (SD) of reflection score and competence score**

Year	N Students	Reflection score		Competence score	
		Mean	SD	Mean	SD
<b>Total</b>	110	13.14	2.41	12.64	2.02
<b>2008-2009</b>	36	13.42	1.66	12.68	1.90
<b>2009-2010</b>	37	13.28	2.36	12.61	1.97
<b>2010-2011</b>	37	12.74	3.02	12.18	2.27

Linear regression analysis including data of all students (over the 3 academic years) demonstrated reflection score to significantly predict competence score (based on other competences in the course),  $F(1,109) = 27.81$ ,  $p < 0.01$ . Significant predictive value was also demonstrated in the separate academic years, 2008-2009:  $F(1,35) = 12.96$ ,  $p < 0.01$ ; 2009-2010:  $F(1,36) = 5.32$ ,  $p < 0.03$ ; 2010-2011:  $F(1,36) = 10.88$ ,  $p < 0.01$ . Analysis demonstrated reflection scores accounting for respectively 19.7% (total), 25.5% (2008-2009), 10.7% (2009-2010) and 21.5% (2010-2011) of the variance in competence scores (adjusted R-square). Characteristics of the linear regression models are described in Table 5.

**Table 5: Beta values (B), Standard Error (SE B) and the Standardised Beta ( $\beta$ ) of the linear regression analysis models, based on data per year and in total**

Year	Coefficient	B	SE B	$\beta$
<b>Total</b>	Constant	7.65	0.96	
	Reflection	0.38	0.07	0.45**
<b>2008-2009</b>	Constant	4.62	2.26	
	Reflection	0.60	0.17	0.53**
<b>2009-2010</b>	Constant	8.59	1.77	
	Reflection	0.30	0.13	0.36*
<b>2010-2011</b>	Constant	7.51	1.45	
	Reflection	0.37	0.11	0.49**

Note: \*  $p \leq 0.05$ , \*\*  $p \leq 0.01$

## Discussion

The results of this study identify reflection scores as a significant predictor for health promotion and community work competence scores in the context of portfolio-based learning in an undergraduate social dentistry course.

These findings are in line with the underlying assumption in literature of the effect of reflection on competence (Mann *et al.* 2009) and the resulting growing consensus on reflection as an important attribute for students and practitioners in health care professions (Pierson 1998; Plack and Greenberg 2005; Delany and Watkin 2009). Similarly, in undergraduate medical students, Sobral (2001) found reflection in learning to be related with grade point averages on (cognitive) courses. He addressed this relationship to the underlying metacognitive skills of reflection affecting also learning and both influencing academic achievement. Sanders (2009) identified these metacognitive skills as noticing, processing and planning altered action. Applied to the present study, these metacognitive skills may also have influenced students to adopt an active learning strategy while developing and executing the project and gathering evidence in their portfolio, influencing the scores on other competences. This mechanism also explains how variables, simultaneously measured, demonstrate a causal relation, as described by the parameters in the regression analysis.

Reflection in the present study was facilitated by various elements. Experiences in authentic professional contexts have a central role in the course "Society and Health". By developing and executing oral health promotion projects in cooperation with local organisations, students were placed in challenging environments, providing stimulating experiences to ground reflections (Schön 1983; Boud. 1985; Driessen *et al.* 2005<sup>b</sup>; Korthagen and Vasalos 2005). A second element relates to the used portfolio approach, introduced as an assessment method for performance in vivo (ie. "Does" level Miller's competence pyramid) (Miller 1990; Mattheos *et al.* 2009; van Tartwijk and Driessen 2009). The responsibility in portfolios to collect and present evidence, demonstrating the acquisition of required competences, lies with the students which will likely have contributed to active learning and reflection (Challis 1999). Finally, the interactions with persons involved in the oral health promotion project (target population, employees of local organisations), supervisors and peers provide a rich environment of feedback to triangulate personal thoughts, ideas and beliefs, facilitating student reflections (Eva and Regehr 2005; Embo *et al.* 2010).

Portfolios, however, do not automatically imply effective reflective learning (Bush and Bissell 2008). After the introduction of an electronic portfolio in undergraduate dental education to support the clinical teaching environment, Vernazza *et al.* (2011) reported the encouragement of reflection not to be perceived as a benefit by students and staff. Driessen *et al.* identified appropriate structure, assessment procedure, enough new experiences and sufficient teacher capacity for coaching and assessment as necessary conditions for successful reflective portfolios in undergraduate medical education (Driessen *et al.* 2005<sup>b</sup>).

To effectively introduce reflection in the course about social dentistry and oral health promotion, the following guidelines from literature were applied:

1. Reflection was clearly defined and communicated to all involved persons (students, supervisors, assessors) (Aronson 2011; Koole *et al.* 2011)
2. An introduction session was held to inform all persons involved (students, supervisors and assessors) about the definition of reflection, its value for dental practice, used method of assessment and criteria (Sandars 2009; Aronson 2011)
3. Reflection was assessed, as evaluation drives learning (Driessen *et al.* 2005<sup>b</sup> ; Aronson 2009)
4. Assessment of reflection was focused on the process of reflection rather than its content. Hence reflection skills were assessed without the influence of the subjective context of the experience (Bourner 2003; Koole *et al.* 2011).

Findings in the present study are limited to identify the influence of reflection on other competences. To determine whether students have developed their ability to reflect was outside the scope of the study and hence not supported by the results. Nevertheless reflection scores at the end of the course remained stable around 13.3 (max 20) between 2008-2011. These scores are above the low to moderate levels of reflection reported in other studies (Wong *et al.* 1995; Boenink *et al.* 2004; Boyd 2008) and may indicate that development of reflection skills occurred.

Future research could focus on the development of reflection skills in a context of portfolio-based learning to investigate the effect of this approach to reflective learning and to identify the effect of aspects as supervision, interaction and the context of the situation grounding the experiences. Also the effect of reflection scores as a predictor of course scores could be further confirmed with a more comprehensive assessment approach of reflection and investigated whether this effect could be expanded to other performance indicators of dental students and practitioners.

## **Conclusion**

Undergraduate dental students' reflection scores obtained in a portfolio-based context had a significant predictive effect on the other course related competence scores in a social dentistry and oral health promotion course. In line with the assumption that reflection enhances competence and the resulting growing consensus about the benefits of reflection for dental students and professionals, findings suggest it would be valuable to further develop the integration of reflection in dental education and practice.

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## **Chapter 5:**

### **Does reflection have an effect upon case-solving abilities of undergraduate medical students?**

Based on:

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**Does reflection have an effect upon case-solving abilities of undergraduate medical students?**

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## **Abstract**

### **Background:**

Reflection on professional experience is increasingly accepted as a critical attribute for health care practice; however, evidence that it has a positive impact on performance remains scarce. This study investigated whether, after allowing for the effects of knowledge and consultation skills, reflection had an independent effect on students' ability to solve problem cases.

### **Methods:**

Data was collected from 362 undergraduate medical students at Ghent University solving video cases and reflected on the experience of doing so. For knowledge and consultation skills results on a progress test and a course teaching consultation skills were used respectively. Stepwise multiple linear regression analysis was used to test the relationship between the quality of case-solving (dependent variable) and reflection skills, knowledge, and consultation skills (independent variables).

### **Results:**

Only students with data on all variables available (n= 270) were included for analysis. The model was significant (Anova  $F(3,269)=11.00$ ,  $p<0.001$ , adjusted R square 0.10) with all variables significantly contributing.

### **Conclusion:**

Medical students' reflection had a small but significant effect on case-solving, which supports reflection as an attribute for performance. These findings suggest that it would be worthwhile testing the effect of reflection skills training on clinical competence.

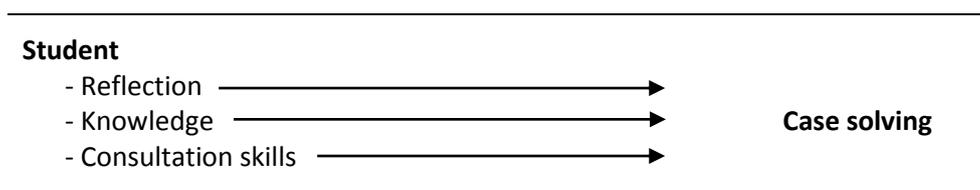
## Background

Reflection is a metacognitive process triggered by experience and characterised by three sub-processes: Awareness of self and the situation; critical analysis and understanding of self and the situation; development of new perspectives to inform future actions (Atkins and Murphy 1993; Boud *et al.* 1985; Sandars 2009, Koole *et al.* 2011). Reflection on professional experiences is considered to be an attribute that allows health care practitioners to cope with demanding and complex professional situations (Schön 1983; Epstein and Hundert 2002; Robertson 2005; Kjaer *et al.* 2006). Accordingly, the ability to reflect is identified in many guidelines as an important learning outcome for physicians in training (GMC 2009; NFU 2009; SDMCG 2007). It is proposed that reflection gives a comprehensive view of contextual factors that affect clinical decisions, helps practitioners identify gaps in personal knowledge, and gives direction to their personal development (Schön 1983; Boud *et al.* 1985; Lockyer *et al.* 2004; Plack and Greenberg 2005). Unreflective practitioners have been reported to perpetuate routine behaviours and not open them to discussion, have narrow perspectives on their practice, find it difficult to identify learning goals and accept feedback, and find it difficult to adapt their practice (Schön 1983; Evans *et al.* 2002; Plack and Greenberg 2005). Accordingly, systematic reflection is seen as essential for continuing professional development and lifelong learning (Robertson 2005; Evans *et al.* 2002). Despite this recognition, however, there is a lack of empirical evidence proving it is indeed effective (Atkins and Murphy 1993; Mann *et al.* 2009).

In the past decade, evidence has been published showing a link between personal attributes and the ability to reflect. Mamede and Schmidt (2004) found a negative correlation between reflective practice and a physician's age and working experience, which they attributed to older and more experienced physicians being more likely to find situations routine and use automatic reasoning based on recognition and instant retrieval of similar situations. Boenink *et al.* (2004) assessed reflection by means of written answers to vignettes. Undergraduate medical students who were female, had previous health care work experience, and who were aiming for careers in general practice tended to have higher reflection scores. The authors concluded that the ability to reflect is trait-like but affected by learning processes. Their self-report questionnaire developed by Sobral *et al.* (2000) showed a relation between reflection and the perceived meaningfulness of learning, which is a marker of the depth of learning. Qualitative studies by Sargeant *et al.* (2008, 2009) showed that reflection helps learners accept feedback and use it in their future clinical practice. We found only one study that demonstrated a direct link between reflection and performance. Sobral *et al.* (2001) reported undergraduate students' scores on a reflection-in-learning scale were significantly, but weakly, correlated with grade point averages, which they used as an indicator of academic achievement.

Given the paucity of evidence linking reflection to student performance, we set out to investigate the effect of reflection on the ability to solve clinical problems. Previous studies found clinical problem-solving to be determined by generalisable competence in consultation skills, such as history taking, communication and physical examination and content related competence directed by knowledge (Mattick *et al.* 2008; Wimmers and Fung 2008). To acknowledge these factors and investigate their interaction with reflection we included the latter two as independent variables in a study, which set out to answer the question: What effect does reflection add to the knowledge and consultation skills on students' case solving? (Figure 1)

**Figure 1: Conceptual research framework**



## Methods

### *Participants*

At Ghent University undergraduate medical students follow a seven year integrated contextual curriculum, comprising patient centred, student centred, community orientated, problem based and evidence based education (Van der Veken *et al.* 2009). The first two and a half years focus on the healthy and normal body and continue in a second cycle of two and a half years to address the body systems from a clinical perspective. Year six comprises rotational clerkships and year seven is a transitional year to postgraduate education. In the present study data was collected among students in the second cycle during year 2008-2009 (n=362).

### *Method/Instruments*

In line with the conceptual research framework, data were collected on the four variables shown in Figure 1- the quality of case solving, reflection skills, level of knowledge and level of mastery of consultation skills. The variables "case-solving" and "reflection" were measured by presenting each student with two interactive video-cases, which confronted participants with authentic clinical problems in a standardised assessment context (de Leng *et al.* 2007). They showed a simulated patient consulting a physician with a new clinical problem. Scenes were filmed from the physician's perspective, to make the cases as realistic as possible. All consultations had the same structure: 1) reason for encounter; 2) history; 3) physical examination; 4) explanation of diagnosis, advice and treatment planning; and 5) closing the consultation. Each consultation was interrupted six times with a question (e.g. "What would you ask?", "What physical examinations would you suggest?", "Explain the diagnosis to the patient?") against an otherwise blank screen. To mirror real-life consultations where there is limited time to think, a countdown timer showed students how long they had left to respond.

Quality of case solving: Students' case-solving was measured by comparing their answers with a list of expected ones. Case scripts and evaluation forms were authored by the same two skills lab teachers to ensure coherent scoring. To test inter-rater reliability, three assessors (the skills lab teachers and SK) independently scored 30 student reactions per case. A Krippendorff's alpha coefficient (Hayes and Krippendorff 2007) above 0.97 for each case showed that inter-rater reliability was high so the remaining answers were single-rated. Respondents' total score over the two cases was then the variable 'quality of case solving'.

**Reflection skills:** Immediately after solving the video-cases, students were asked to reflect on the video-cases and their reactions to the six questions they had been asked. Because the structure of reflective comments varies so much between people (Boud *et al.* 1985; Moon 1999), six questions were used to structure their responses into six reflection skills related to the three main elements of reflection: awareness; understanding; and future action (Table 1). Reflection skills were scored using the 6-item Student Assessment of Reflection Scoring rubric (StARS®), which has been demonstrated as a valid instrument for reflection in undergraduate medical students at Ghent University (Koole *et al.* 2012). StARS® provides assessors with quality definitions for all items (Popham 1997; Andrade 2000), which are scored on 0-5 scales. All items together form an overall reflection score. All reflections were assessed by SK, who computed the variable ‘reflection skills’ - the aggregate of overall reflection scores on both cases.

**Table 1: The referred reflection skills related to the three key elements in the 6 questions to structure student reflections.**

Element of reflection	Reflection skills
<b>Awareness of the experience</b>	<p><b>1:</b> The ability to describe an experience adequately.</p> <p><b>2:</b> The ability to identify essential elements and describe own thoughts and feelings.</p>
<b>Understanding the experience</b>	<p><b>3:</b> The ability to pose searching questions.</p> <p><b>4:</b> The ability to answer searching questions and being aware of the relevant frames of reference.</p>
<b>Impact on future actions</b>	<p><b>5:</b> The ability to draw conclusions.</p> <p><b>6:</b> The ability to describe concrete learning goals and plans for future action.</p>

**Level of knowledge:** Knowledge was measured by performance in the Dutch inter-university progress test, which assesses knowledge across all medical disciplines at the level of exit from the undergraduate curriculum (van der Vleuten *et al.* 2004), during the same academic year as case solving and reflection were assessed. The progress test is a valid and reliable indicator of knowledge acquisition for undergraduate medical students in the Netherlands (Albano *et al.* 1996). It has also been validated in the context of undergraduate medical curriculum at Ghent University (Van der Veken *et al.* 2009).

**Mastery level of consultation skills:** Consultation skills are taught in a continuing strand - clinical, technical and communication skills – that runs through years 4-6 of our medical programme. Consultation skills, communication skills, and technical skills are examined using multiple tests: Clinical skills are assessed with and without simulated patients by four experienced physicians in a four station objective structured clinical examination; communication skills are assessed by two communication experts in a specific consultation setting with simulated patients; and technical skills are assessed by a written test of rational prescribing and a computer test of ordering and interpreting medical imaging. Scores from those examinations are combined into a single score, representing the generic skills needed to perform a consultation. To identify the mastery level of consultation skills at the same point in a student’s trajectory as the other variable included in this study, the single course scores of the years 2008-2009 were used for analysis.

## Analysis

Stepwise multiple linear regression analysis was used to determine the predictive value of reflection scores, knowledge, and consultation skills on video-case solving, which was the dependent variable. The stepwise regression procedure aimed to produce a parsimonious model, explaining the dependent variable by including or excluding predictor variables stepwise. The contribution of each variable to the model, its significance level, and the variance explained by the whole model are reported. All statistical analyses were performed using SPSS 17.0 (SPSS Inc, Chicago, IL, USA) with a pre-set significance level of  $p \leq 0.05$ .

## Results

Two hundred and seventy students (75% of the total student population) had data on case solving, reflection, knowledge, and consultation skill scores and were therefore eligible to be included in the analysis. Missing data were caused by timetable clashes, illness, and other factors which were unlikely to have a systematic effect on the findings. Table 2 shows descriptive statistics for all variables included in the analysis.

**Table 2: Descriptive statistics of all variables (highest possible score) in the multiple linear regression analysis; Mean, Standard deviation (SD), Minimum (Min) and Maximum (Max)**

Variables	Mean	SD	Min	Max
Dependent				
Case solving score (20)	10.0	2.3	4.3	15.6
Independent				
Knowledge score (100)	35.0	8.3	6.3	62.9
Consultation skill score (20)	13.7	2.1	0.0	17.0
Reflection score (60)	38.6	7.5	16.0	54.0

There were only weak correlations (Pearson  $r < 0.30$ ) between the independent variables, confirming they were distinct constructs. Multiple linear regression analysis resulted in a significant model (Anova  $F(3,269) = 11.00$  and  $p < 0.001$ ) with an adjusted R square of 0.10. The model and its coefficients are described in Table 3.

**Table 3: The Beta values (B), Standard Error (SE B) and the Standardised Beta ( $\beta$ ) of all coefficients in the linear regression analysis model, based on all students**

Coefficient	B	SE B	$\beta$
Constant	3.94	1.10	
Knowledge score	0.04	0.02	0.16*
Consultation skill score	0.17	0.07	0.15*
Reflection score	0.06	0.02	0.19**

Note: \*  $p \leq 0.05$ , \*\*  $p \leq 0.01$

## Discussion

Medical students' ability to reflect was a significant, albeit weak, predictor of the quality of their case solving after allowing for the effects of knowledge and consultation skills. That is in line with findings of Sobral (2001) demonstrating a significant but weak correlation ( $r = 0.21$ ,  $p = 0.003$ ) between undergraduate medical students' scores on a reflection-in-learning scale and academic achievement. He explained this relationship by the underlying metacognitive skills of reflection, which also affect academic achievement through learning. A similar explanation can also be applied to the present study. Reflection includes the ability to relive an experience, analyse it critically, and come up with conclusions after careful exploration of alternatives (Plack and Greenberg 2005; Mamede and Schmidt 2004; Korthagen and Vasalos 2005). Using such skills might have helped students with high reflection scores understand the case content more profoundly and give more carefully considered answers, which resulted in higher case solving scores.

Our results demonstrate that case solving both triggers and is affected by reflection. This relationship, however, is not as circular as it might appear. At its heart lies a distinction between content and process of reflection. Whereas the content of reflection is context specific and influenced by its triggering experience and learners' unique frame of reference, the process of reflection has a more generic character (Bourner 2003, Mezirow and Associates 2000). In the present study, case solving as a triggering experience is related to the content of reflection. The effect of reflection on case-solving that we found, however, refers to the process of reflection, which is driven by more generic reflective skills.

Focus on those generic skills makes it possible to assess reflections while recognising the uniqueness of both learner's frame of reference and the context in which their reflection was initiated (Koole *et al.* 2011). It also provides a counter-argument to the argument that our results can be accounted for by having measured reflection skills and the quality of case-solving in the same context whilst knowledge and consultation skills were assessed in a different context. The focus on process skills made the influence of context less important.

Although the predictive effect of reflection, knowledge and consultation skills on the quality of case solving was statistically significant, the model only explained 10% of the total variance. From previous studies we would have expect the levels of knowledge and consultation skills to account for more variance than was demonstrated here (Mattick *et al.* 2008; Wimmers and Fung 2008). First, this inconsistency with earlier studies may be explained by the different methods used to assess case solving. Opposed to answering questions in video-cases, referenced studies used objective structured clinical examinations (OSCE) derived formats as clinical performance examinations (CPX) and Integrated Structured Clinical Exams (ISCE). These methods required practical knowledge and executive skills and are called performance assessment *in vitro* whereas video-based approach in the present study exemplified a clinical context based test where students had to demonstrate theoretical knowledge by means of writing skills (Wass *et al.* 2001).

Second, the specific indicators of knowledge and consultation skills may also have played a role. The Dutch inter-university progress test is designed to test a greater breadth of knowledge than was needed to solve the questions in the video-cases (Van der Veken *et al.* 2009). The scores students received in the course 'clinical, technical and communicative skills', used as variable for consultation skills, also included competence in radiology and pharmacology next to consultation and

communication skills. Whilst these broader aspects of competence were not included in previous studies, they were clearly relevant to the diagnostic and treatment planning aspects of the video-cases. The modest total of variance explained by our regression model suggests the set of three predictors in the model was incomplete. Factors such as case difficulty, the time of testing, and test environment were similar for all students; personal factors, however, could make cases more or less difficult for individual students and contribute to variance in the scores. Desmedt (2008) identified motivation, beliefs, and self-efficacy as relevant factors, alongside gender, personality, intelligence and learning style. Future research could address limitations of the current study by developing a more comprehensive model to describe case-solving. It could also test the generalisability of our findings to a workplace context and from case scores to clinical practice.

## **Conclusion**

Undergraduate medical students' reflection had a small but significant effect on the quality of case solving. This empirical finding suggests that helping students develop their ability to reflect might be beneficial and it would therefore be worth testing the effect of reflection skills training on clinical competence.

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## **General discussion**

## General discussion

### Background

The current perspective on health care professions is advocating social accountable practitioners actively engaging themselves in continuous professional development in order to maintain a high standard of care. In line with this view on professional practice, the ability to reflect has been increasingly acknowledged as an important attribute for a health care practitioner and introduced as an outcome of health sciences education. Although this focus on reflection has led to a vast amount of literature, empirical evidence demonstrating the effects of reflection on professional performance and learning remains scarce. Lack of an agreed method to assess reflection is a particular obstacle confounding further progress.

This dissertation, entitled “**Assessment of reflection in undergraduate health sciences education**”, aims to contribute in resolving this unsatisfactory situation by investigating how reflection can be assessed in undergraduate health sciences education, and was guided by five research questions.

RQ 1: What are the main barriers to reflection assessment?

RQ 2: How can assessment account for the diversity of situations that trigger student reflections in undergraduate health sciences education?

RQ 3: Is it possible to develop a strategy to overcome the barriers to reflection assessment?

RQ 4: How can assessment methods of reflection be implemented in undergraduate health sciences education?

RQ 5: What is the effect of reflection on student performance in undergraduate health sciences education?

These research questions were investigated by five projects, described in chapters 1-5. The next paragraphs will discuss the main findings of this dissertation, practical implications, strengths and limitations of conducted research and suggestions for future research.

### Main findings

#### ***RQ1: What are the main barriers to reflection assessment?***

Literature review in **chapter 1**, identified the nature of reflection as an important confounding factor for assessment. First, reflections are unique to a person in a certain situation which complicates comparison of reflections in assessment procedures. Second, reflection as a metacognitive process, prevents direct observation by a third person. Hence assessment methods have to rely on interpretative descriptions provided by the reflecting person, which cannot be verified.

In search for solutions it was suggested to discriminate between the subjective content of reflection and the generic underlying process (Bourner 2003). Targeting this process, allows assessors to evaluate which elements of the reflection process have been addressed without having to judge their unique meaning to the reflecting person. This approach was adopted in this dissertation.

In response to the inconsistent definitions of reflection in literature, a model of common elements was developed, based on the leading theories and models about reflection, to clearly define this process of reflection. This model identified six indicators: 1) the ability to describe an event/situation comprehensively, 2) the ability to identify essential elements and to describe own thoughts and feelings, 3) the ability to ask searching questions, 4) the ability to answer searching questions and being aware of the used frames of references, 5) the ability to draw conclusions, and 6) the ability to describe concrete learning goals and plans for future action.

As a method to verify the interpretative descriptions assessors have to rely on during evaluation, it was suggested to provide them with information about the triggering situation of the reflection. This creates an objective frame in which descriptions can be evaluated. In search for a feasible method to provide assessors with such a frame, patient cases were investigated to stimulate critical thinking (**chapter 2**) and based on this finding video-cases were introduced as a strategy to offer students a standardised proxy to real-life experiences (**chapter 3**).

Other identified barriers include a lack of standards to determine an adequate level of reflection and the many other factors that influence the reflection process (**chapter 1**). These factors comprise internal aspects such as motivation, beliefs, expected outcome, understanding and external aspects such as supervision, the nature of reflection exercises and the learning environment.

### ***RQ2: How can assessment account for the diversity of situations that trigger student reflections in undergraduate health sciences education?***

In search for a feasible method to 'visualise' situations that trigger reflection, written patient cases were investigated as a trigger for critical thinking in online group discussions in undergraduate dental students (**chapter 2**). Results demonstrated that both students and supervisors perceived the use of cases (patients in their clinical context, related to a specific course content) as an effective method to stimulate adequate clinical reasoning. Furthermore, students experienced the use of cases in combination with peer discussions as an instructive method and supervisors labelled the content of those case discussions as valuable.

Based on their ability to create a rich and challenging context, patient cases were adopted as an approach to standardise triggering situations for reflection in undergraduate medical student (**chapter 3**). The challenging context provided by these cases is ideal to stimulate reflections (Schön 1983, 1987). As de Leng *et al.* (2007) reported the superiority of video-cases to simulate an authentic clinical environment, written cases (**chapter 2**) were replaced by video-cases. The used video-cases displayed a (simulated) patient consulting a physician with a problem. To facilitate students to feel the clinical situation from within, the video-cases were filmed from the perspective of the physician, and cases were made interactive by introducing questions stimulating clinical reasoning. Results demonstrated this standardised approach triggered a diversity of reflections.

***RQ3: Is it possible to develop a strategy to overcome the barriers to reflection assessment?***

The proposed method to assess reflection, described in **chapter 3**, was based on the findings in previous research projects, respectively the reflection model (**chapter 1**), the understanding to focus assessment on the process of reflection (**chapter 1**) and the value of patient cases to provide students with a standardised challenging experience to reflect on (**chapters 1 and 2**). Key elements in the strategy to assess reflection were the introduction of video-cases and the development of the Student Assessment of Reflection Scoring rubric (StARS®). To attune student reflections to the indicators identified by the reflection model (and used in StARS®), reflection guiding questions were posed. Results demonstrated the feasibility of this method in a population of 270 undergraduate medical students, with acceptable psychometric properties (distribution of scores, intra- and inter-rater reliability and case-specificity).

Using a rubric to score reflections had an additional advantage. In a scoring rubric each scoring possibility is defined in detail. This has been shown to be beneficial for the reliability of the instrument, but it will also allow to provide students with specific feedback on the development of their reflection skills. This detailed description of the indicators in StARS® facilitates the understanding of reflection in both learners and assessors.

In **chapter 4** the value of the used model of common elements in reflection was investigated to assess reflections on real life experiences in a portfolio-based approach in undergraduate dental education. It proved to be feasible to introduce our concept of reflection in the course and to apply our frame of assessment in it.

***RQ4: How can assessment methods of reflection be implemented in undergraduate health sciences education?***

The research projects in this dissertation have contributed to a better insight in how to introduce reflection in educational settings. In **chapter 1** the importance of a clear definition of reflection was identified. At present, many definitions, models and theories with diverse focusses are used to describe reflection. A common frame of reference for all involved stakeholders (students, teachers, assessors, supervisors) is an important factor, because it prevents miscommunication and interpretation caused by the use of different perspectives on reflection. Furthermore, a common and clear view of reflection is also beneficial for the development of goals for reflective education, for the choice of an educational approach, for the provision of feedback, the specification of a method of assessment and the interpretation of the results of the assessment.

Real life experiences are considered to be a key element in reflection (Kolb and Kolb 2005; Korthagen and Vasalos 2005). In **chapter 4**, student reflections triggered by real life experiences were studied. Professional contexts and educational contexts, however, do not always correspond as patient-centeredness and learner-centeredness may be conflicting (Eriksen *et al.* 2008). Alternatively to real life experiences the usability of cases was demonstrated to create a standardised situation to trigger reflection (**chapters 2 and 3**). Both approaches proved to be valuable for assessing reflection in educational environments.

Upon asking students to reflect, it has been debated what approach to be used to prompt reflections (Aronson 2011). A structured approach can facilitate learners to reflect more deeply and purposeful by directing them to consider certain important aspects (Wald *et al.* 2009). Furthermore a structured approach can be used to stimulate learners to formulate their reflections in an accessible format to match the assessment. Proponents of the unstructured approach to reflection, however, raise the consideration that this structuring strategy may lead to mindless “recipe” reflections without connection to outcome and context (Boud and Walker 1998). In research projects in this dissertation both approaches were used. A structured approach was used by introducing guiding questions to target student reflections towards the assessment indicators (**chapter 3**). This approach proved to result in reflection scores with acceptable psychometric properties. These scores identified students’ performances on the six indicators of the process of reflection, which may provide a framework for feedback, usable for students in learning how to reflect. A less structured approach was used upon introducing reflection to undergraduate dental students in portfolio-based education (**chapter 4**). Students could ground their reflections on their own chosen experiences from a given real life context and did not have to address guiding questions in their reflective writings. They were informed about the used definition of reflection and the applied criteria (based on this definition) for assessment. This approach proved to be feasible in undergraduate dental education and may propose the strategy to deal with the previous mentioned concerns, including a “free write” approach for students followed by structured analysis (Aronson 2011).

To score reflection, two assessment methods have been used in this dissertation. First a scoring grid, based on the indicators identified in chapter 1, was developed to assess reflective writings by undergraduate dental students (**chapter 4**). This method proved feasible and corresponded with other described methods of assessment (Wong *et al.* 1995; Boenink *et al.* 2004; Boyd 2008). Nevertheless, more and more the focus on scoring is shifting towards rubrics to assess reflection (Wald *et al.* 2012). Second a rubric (StARS®) was used to assess reflection as defined in chapter 1 (**chapter 3**). This instrument proved to be feasible in the context of undergraduate medical education and provides scores with acceptable psychometric properties.

***RQ5: What is the effect of reflection on student performance in undergraduate health sciences education?***

This dissertation investigated the influence of reflection on other course related competences in a portfolio-based educational approach in undergraduate dental students (**chapter 4**) and on clinical case-solving in undergraduate medical students (**chapter 5**). Both research project had similar results as reflection demonstrated to be a small but significant predictor for the investigated variables of student performance. These findings are in line with the assumption of reflection as an important attribute for health care professionals and students. The small effect sizes, however, indicate the effect of reflection on performance to be subtle and influenced by many factors in a complex (educational and/or professional) environment.

## Practical implications

The role of reflection in health care professionals and students encompasses multiple perspectives ranging from reflecting on clinical experiences to lifelong learning and from the development of reflective education to emotions and reflection. Research projects in this dissertation targeted only a limited area. They demonstrated that student reflection in undergraduate dental and medical education can be assessed. According to assessing reflection in undergraduate health sciences education the following recommendations can be suggested:

1. Clearly define the concept of reflection and verify that all stakeholders (curriculum developers, students, assessors and supervisors) adopt the same definition. This will avoid bias caused by using different concepts of reflection in involved stakeholders. Introduction sessions are ideal for that. Explain at the same time the value of reflection for learning and practice, which method of assessment will be used and what criteria will be applied in the scoring.
2. Based on the adopted definition of reflection, be specific about what level of reflection is expected and identify good and inadequate reflection. At present standards supporting the interpretation of reflection assessment results are scarce. Hence we recommend to inform stakeholders about the used criteria and expectations to support the transparency of assessment and interpretations of results. The use of a scoring rubric like StARS® will facilitate this process.
3. The metacognitive nature of reflection prevents the direct observation of reflection during assessment. Suggested indirect methods include the assessment of described reflections by the reflecting person or to rely on self-assessment methods. Both methods may suffer from bias. In self-assessment methods the inability to adequately introspect will affect both reflections and evaluation results. To facilitate the detection of possible bias in described reflections it is suggested to provide assessors with a perspective on the situation that triggered the reflection.
4. Clinical cases can be used to create a standardised challenging context, as a feasible approach to provide assessors with a perspective on the triggering situation of reflections.
5. Reflections are characterised by their subjective nature. Identical reflections can have different meaning to different reflecting persons. This complicates the assessment of reflection. In response it is suggested to focus on the process of reflection rather than the content. While content is subjectively coloured, process is considered to be a generic frame, guiding persons to reflect.
6. When interpreting results of reflection assessment, consider also individual influencing factors as motivation, beliefs or prior knowledge and structural factors as supervision, provision of stimulating experiences or nature of assessment (summative vs. formal).

The developed methods to assess reflection in undergraduate health sciences education, described in this dissertation have both educational and research applications. In education, assessment is crucial to evaluate whether students have attained the ability to reflect. The proposed methods address the process of reflection through six indicators, which allows assessors to provide students with specific feedback. Students can use this feedback to target specific deficits in their reflection process (eg. looking back on an experience, identifying learning goals, etc.). Furthermore, assessment can be used to identify the efficiency of an educational strategy used to develop the ability to reflect when students are assessed at the beginning and end of a course.

As a strategy to implement reflective education in health sciences curricula, the proposed reflection model in this dissertation can be used to introduce the process of reflection to students. Initial education should focus on learning students how to reflect using the six indicators identified by the model and the proposed methods of assessment, including StARS® to monitor progress and provide feedback. As such, findings in this dissertation provide a blueprint for the building blocks of this first phase. In a second phase, when students have acquired the competence of how to reflect, focus of reflective education could shift towards the content of reflection and its unique meaning to the reflecting person. This content has been labelled as single, double and triple-loop learning based on its focus (Greenwood 1998; Rushmer *et al.* 2004). Single-loop learning is targeting action and instrumental problem-solving, double-loop learning tries to understand the mechanism behind actions and solutions and triple-loop learning is on an even deeper level as it considers also the context and their influence on the understandings in double loop learning.

Assessment of reflection is also crucial for research, which findings will further increase our understandings about reflection and its role in health care practice and education. Results of the proposed assessment method in this dissertation can be used for multiple purposes: eg. to evaluate the relation between students'/practitioners' ability to reflect and other factors as performance, self-efficacy or knowledge retention or in a longitudinal design to investigate the development of reflection and to identify possible influencing factors in this process.

### **Strengths and limitations**

Within the focus of this dissertation, assessment in undergraduate health sciences education, research projects have considered various contexts. First, assessment of reflection was considered in educational and research perspective. This dual purpose approach illustrates the possibility to integrate educational development with research.

Second, reflection was examined in three different contexts within health sciences education, a context of consultation training in undergraduate medical education and courses in periodontics and social dentistry in the undergraduate dental curriculum. Within these contexts a wide variety of educational approaches were involved, including case-based education, portfolio-based education and authentic experiences at local organisations. In all contexts the same concept of reflection was used, suggesting its generic value for health sciences education.

Third, the finding that reflection significantly predicted student performance was demonstrated in two contexts, including a conceptual research framework with knowledge, consultation skills and case-solving in medical students and in relation to course related competences in dental students. The consistency of reflection to predict student performance in different contexts may suggest the relation between reflection and a wider range of student performances, and is in line with the growing consensus on reflection as an attribute for professional practice and education. Nevertheless, conclusions have to be formulated with caution as the effect of reflection on student performance still has to be confirmed in other contexts.

Next to context, in response to the research questions, multiple research methods have been used in the various research projects. Methods include literature review, questionnaires, cross-over design,

retrospective data collection and analytical methods as generalisability and decision studies, inter-rater reliability (Krippendorff's alpha), and multiple and single linear regression analysis. All these individual methods provide specific information contributing to the line of research. When put together, they provide a rich base of results to ground the conclusions in this dissertation.

The individual approach to reflection adopted in this dissertation is not congruent with the perspective on reflection as a process to be developed through social interaction. The influence of social interaction can be described as the opportunity of reflecting persons to analyse their reflective thoughts with the input of others, to verify or adjust their understandings which facilitates effective reflections (Eva and Regehr 2005). Although the proposed reflection model includes the focus on thoughts and feelings of others, the used approach to assessment did not direct learners into social interaction to verify their understandings. Nevertheless, the added value of interaction was acknowledged by students and supervisors when discussing patient cases on online forums. Furthermore, for efficient interaction it is important that involved persons share the same frame of reference. The proposed model of reflection provides such a frame of reference, which can be used to facilitate social interaction and to formulate efficient feedback addressing elements of attention.

Situativity theory considers reflection to be situated in an unique context (Durning and Artino 2011). This context dependability appears to contradict with the process based approach to the assessment advocated in this dissertation. This apparent conflict, however, could be explained from the perspective of knowledge in situativity theory. Knowledge is seen as a tool, which can be possessed without using it (Durning and Artino 2011). By identifying the process of reflection as a tool, the content can be viewed as the result of using this tool in an unique situation, explaining how process and context work together.

Reflections are triggered by unique situations (Boud *et al.* 1985). Interactive video-cases were introduced as a strategy to create a standardised context to facilitate assessment by limiting the variability in triggering situations. This approach proved to result in reflection scores with acceptable ability to discriminate. Although this method is beneficial to assess the process of reflection, the content of generated reflections will have a lesser impact on student learning as they are triggered with less personal and meaningful experiences. In this dissertation also reflections based on real life experiences were assessed. Disadvantage of this approach, however, was the inability of assessors to relate reflections to the situation referred to in the reflection. A potential strategy to deploy these methods is to use a standardised approach to learn students/professionals how to reflect and shift towards real life experiences when content of reflections is the focus of attention as discussed previously.

Findings in this dissertation contribute to the understandings about the assessment of reflection in education and research, however results are limited to the specific context in this dissertation leaving the possibility for (additional) future research wide open.

## Future research

The discrepancy between the emerging attention for reflection as an attribute for health care professionals and students and the uncertainty about the practical implications, provide an interesting but challenging environment for further research. Research related to this dissertation, covered a limited area as it targeted the assessment of reflection in undergraduate health sciences education. Findings and limitations of the executed research projects provide interesting grounds for further investigations.

Focus on the reflection process is a key feature in the suggested strategy to assessment in this dissertation. This process, however, embodies only one element in reflection. The subjectively coloured content of reflection is another, which provides the meaning of reflections to a reflecting person (Bourner 2003). To fully understand reflection, future research could focus on the relation between process and content. Setting up such research, however, will require a strategy to analyse the subjective meaningfulness of reflections.

The proposed conceptual framework to assess reflection provides the opportunity to investigate other interesting aspects of reflection and education. Research described in this doctoral thesis had a cross-sectional character. A longitudinal design (multiple assessments of the same students over a period of time) allows researchers to study the development of the reflection process in students as identified by the six indicators. Furthermore this approach could be used to investigate the effect of educational strategies to foster the development of reflection and to gain an understanding of the influence of authentic experiences in complex learning situations of prolonged duration, like clerkships.

Findings in this dissertation are limited to undergraduate students in educational settings. The ultimate goal of reflection in education is to teach future practitioners to reflect on their experiences in support of their professional development and to provide a high quality of care. To investigate whether the demonstrated effect of reflection on student performance is also valid in professional contexts, future research could focus on confirming the effects of reflection on performance in health care practitioners, reflecting on professional experiences.

Further research about the deeper emotional dimension that drives or obstructs individuals to reflect, is another important building block in the understanding of the complexity of reflection. Boud et al. (1985) stressed the importance of feelings in their theory, acknowledging the presence of positive and obstructing emotions. Better understanding of those inner emotional processes and their influence on actual reflective behaviour, will allow to develop an approach to guide health professionals to cope with their continuous incoming experiences together with the accompanying destabilising emotions, that challenge the balance of their safe, individual or collective world.

The present research addressed reflection from an individual perspective. Reflection in relation to social interaction is a possible next step. Previous research has reported the influence of reflection on the feedback acceptance (Sargeant *et al.* 2008). The opposite relation between feedback as a method of social interaction and reflection remains elusive. Assessment results have been suggested as a source of feedback, but the effectiveness and modalities yet have to be investigated.

Finally, findings have demonstrated the complex relation between reflection and student performances, as case-solving and the acquisition of social dentistry course related competences. It is recommended that future research should be aimed at generalising these results. Furthermore, the unravelling of this complex relation, by identifying intervening additional factors and their interactions, will contribute to the understanding of the relation between reflection and performance.

Fully understanding reflection in health care professionals and in health sciences education is a complex challenge, which Schön (1987) would situate in the swampy lowlands. With no obvious straightforward solutions available, this messy and ill-defined problem requires a creative, non-mainstream strategy and a lot of reflective activity with every small step in the right direction towards the highly rewarding goal of understanding reflection.

## **Conclusion**

The purpose of this dissertation was to increase the understandings about the assessment of reflection in undergraduate health sciences education. First, confounding factors of reflection assessment were identified and discussed. Based on these findings an approach to assessment was developed and validated to finally use this approach to investigate the effect of reflection on performance in undergraduate students. Outcomes of the various study projects include a model of common elements to describe the process of reflection, Student Assessment of Reflection Scoring rubric (StARS®) to evaluate this process of reflection, the use of video-cases to trigger reflections in undergraduate students. These outcomes can be used as an approach for further curriculum development and research. The finding that reflection has a small but significant effect on case-solving in medical students and on social dentistry and oral health promotion course related competences in dental students is in line with the general assumption of reflection as an important attribute for health care professionals and suggests the importance to further integrate reflection in practice and education.

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# Summary

## Summary

Reflection is increasingly considered as an important attribute for health care professionals in the long provision of high quality of care. Consequently, health sciences education has adopted the ability to reflect as a competence to be achieved, based on the premise that reflection can be fostered. Empirical evidence, however, that supports reflection in professional practice and education is scarce, and consensus about how to introduce and assess reflection in practice and education remains elusive. This dissertation aims to develop a valid and reliable method for the **assessment of reflection in undergraduate health sciences education**. A line of research is described in five chapters, each reporting on a research project executed in the period 2007-2011 at Ghent University.

In **chapter 1** four important barriers to the assessment of reflection were identified, 1. Diversity of definitions, 2. Lack of agreed standards to interpret results, 3. The metacognitive nature of reflection which prevents direct observation and 4. The influence of multiple internal and external contextual factors. In search for solutions a comprehensive model based on the common elements in widely quoted models and theories was developed. It describes reflection as *a metacognitive process retrospective to experiences characterised by 1) the awareness of this experience, one's own and others' thoughts and essential aspects in this experience 2) reflective inquiry to analyse the experience within a personal frame of reference and 3) the development of new perspectives to be implemented in future actions*. As an approach to the subjective nature of reflections it was suggested to distinguish between the process and the content when assessing reflection. Whereas the subjective nature of the content of reflections forms a barrier for comparison, the elements in the process are generic. Furthermore the situation that triggered was identified as an important factor in reflections. To aid assessors with interpreting reflections it was proposed to look for a feasible method to provide them with a perspective on the situation that triggered the reflection.

In search for a feasible method to visualise the triggering situation, cases were investigated to simulate real practice situations to trigger clinical reasoning in undergraduate dental education (**chapter 2**). Cases have the advantage of offering a safe environment while challenging students with course related clinical problems. Results indicated that both, students and supervisors, acknowledged cases as a valuable instrument of instruction, stimulating rich meaningful discussions and effective clinical case solving. The format of the cases (whole patient case description vs. description of one case element) did not result in different learning outcomes.

Findings of the described study in chapter 2 grounded the development of a scoring method for reflection based on video-cases and the Student Assessment of Reflection Scoring rubric (StARS®) (**chapter 3**). Undergraduate medical students were presented interactive video-cases, displaying a simulated patient consulting a physician with a problem from a physician's perspective, that were interrupted with questions gauging students' thoughts. After having completed the case itself, students were asked to reflect, guided by six questions, directing the students' reflections towards the model described in chapter 1. These reflections were assessed, using StARS®. Analysis identified StARS® scores to demonstrate acceptable psychometric properties concerning the ability to discriminate between students, inter- and intra-rater reliability and case-specificity. It was suggested to use this feasible method for summative assessment and to provide feedback on specific elements in the process of reflection.

In **chapter 4** the implementation of reflection assessment in a portfolio-based undergraduate dental course on oral health promotion and community dentistry is described. In this course the ability to reflect on real life experiences (while executing a oral health promotion project in a local organisation) was a competency to be acquired through portfolio learning. Reflection was defined according to the model in chapter 1 and a scoring grid was developed to match this definition. Linear regression analysis demonstrated that the reflection scores obtained with this method were significantly predicting the scores of the other competences to be acquired in the course.

Finally the relation between reflection and student performance (case-solving) in undergraduate medical education was investigated (**chapter 5**). The case-solving scores (answers to the questions posed during the video-case interruptions) and the StARS<sup>®</sup> scores from chapter 3 were brought together with the main indicators for case solving described in literature including knowledge (progress test score) and consultations skills (score on a consultation course) in a multivariate regression analysis. In a model with knowledge and consultation skills, reflection scores proved to be a small but significant predictor for student case-solving.



# Samenvatting

## Samenvatting

Reflectie wordt in toenemende mate beschouwd als een belangrijke eigenschap voor professionals in de gezondheidszorg voor het levenslang aanbieden van hoog kwalitatieve zorg. Als gevolg wordt de bekwaamheid om te reflecteren door het onderwijs in de gezondheidswetenschappen als een belangrijke te verwerven competentie geïdentificeerd, in de veronderstelling dat reflectie ontwikkeld kan worden. Empirisch bewijs dat de positieve invloed van reflectie op professioneel handelen en onderwijs aantoonbaar is echter schaars en er blijft nog veel onduidelijkheid bestaan over de introductie en beoordeling van reflectie in de praktijk. Dit proefschrift beoogt een valide en betrouwbare methode te ontwikkelen voor de **beoordeling van reflectie bij studenten in de gezondheidswetenschappen**. Het beschrijft een onderzoekslijn in vijf hoofdstukken waarbij elk hoofdstuk een onderzoeksproject weergeeft dat werd uitgevoerd tussen 2007-2011 aan de Universiteit Gent.

In **hoofdstuk 1** worden vier belangrijke barrières om reflectie te beoordelen besproken: 1. diversiteit aan definities, 2. een gebrek aan overeengekomen standaarden om resultaten van evaluaties te beoordelen, 3. reflectie als een metacognitief proces dat directe observatie belet en 4. beïnvloedende interne en externe contextuele factoren. Op zoek naar oplossingen werd een reflectiemodel ontwikkeld, gebaseerd op de gemeenschappelijke elementen van wijdverspreide modellen en theorieën over reflectie. Dit model definieert reflectie als *een metacognitief proces retrospectief aan ervaringen en gekarakteriseerd door 1) het bewustzijn van een ervaring, eigen gedachten en gevoelens, en die van anderen en belangrijke aspecten in een ervaring, 2) Reflectieve vraagstelling om de ervaring in een persoonlijk referentiekader te analyseren en 3) Het ontwikkelen van nieuwe perspectieven als uitgangspunt voor toekomstig handelen*. Als strategie om bij het beoordelen om te gaan met de subjectieve aard van reflecties wordt gesuggereerd om een onderscheid te maken tussen het proces en de inhoud van reflectie. Waar de subjectieve inhoud een belangrijke barrière vormt voor het vergelijken van reflecties, heeft het doorlopen reflectieproces een generieke aard. Verder is de gebeurtenis die aan de grondslag ligt van een reflectie een belangrijke factor. Door deze gebeurtenis zichtbaar te maken voor de beoordelaars, krijgen zij een aanvullend perspectief bij het evalueren van de reflecties. Het zoeken naar zo'n uitvoerbare methode is een belangrijk uitgangspunt van hoofdstuk 2.

Als methode om gebeurtenissen te 'visualiseren' wordt casusgericht onderwijs onderzocht waarbij reële praktijksituaties worden gesimuleerd om een klinisch redeneerproces uit te lokken bij tandheelkunde studenten (**hoofdstuk 2**). Casusgericht onderwijs heeft als voordeel dat het een veilige leeromgeving aanbiedt en studenten kan confronteren met klinische problemen gerelateerd aan het opleidingsonderdeel. De resultaten van deze studie tonen aan dat zowel de studenten als de begeleiders het nut van casussen als instructiemethode inzien, om betekenisvolle discussies te faciliteren met effectieve klinische redenering tot gevolg. De wijze van aanbieden van de casussen (hele casus ten opzichte van één casuelement per week) heeft geen invloed op het leerresultaat.

De resultaten, beschreven in hoofdstuk 2, zijn ondersteunend geweest voor de ontwikkeling van een beoordelingsmethode voor reflectie, gebaseerd op video-casussen en een rubric voor het beoordelen van studenten reflecties (StARS®). Het onderzoeksproject in **hoofdstuk 3** is gericht op de validiteit en betrouwbaarheid van de methode. Hierbij kregen studenten geneeskunde twee interactieve video-casussen te zien, gefilmd vanuit het standpunt van de arts, waarbij een simulatie

patiënt een arts consulteerde. Elke casus werd meerdere keren onderbroken met een vraag, die peilde naar de gedachten van de student. Direct na de casus werd aan de studenten gevraagd om te reflecteren aan de hand van zes vragen, gebaseerd op het model beschreven in hoofdstuk 1. Reflecties werden beoordeeld via StARS®. De reflectiescores vertoonden acceptabele psychometrische eigenschappen met betrekking tot de mogelijkheid om te discrimineren tussen studenten, inter- en intra-beoordelaars-betrouwbaarheid en casusspecificiteit. Resultaten wijzen op het nut van deze uitvoerbare methode voor summatieve beoordeling en als bron voor feedback over het doorlopen van het reflectieproces.

De studie beschreven in **hoofdstuk 4** handelt over de beoordeling van reflectie via portfolio-gericht leren bij tandheekkunde studenten in het kader van een opleidingsonderdeel over mondgezondheids promotie en maatschappelijke tandheekkunde. Studenten reflecteerden hierbij over 'real life' ervaringen (uitvoeren van een mondgezondheids promotieproject bij een lokale maatschappelijke organisatie), die zij documenteerden in hun portfolio. Reflectie was gedefinieerd volgens het model beschreven in hoofdstuk 1 en werd beoordeeld via een score sjabloon dat aansloot op deze definitie en de beoordeling van de andere te verwerven competenties. Lineaire regressieanalyse demonstreerde de significante voorspellende waarde van de reflectiescores ten opzichte van de overige competenties in het opleidings-onderdeel.

Tot slot is de relatie tussen reflectie en het oplossen van casussen bij geneeskunde studenten onderzocht (**hoofdstuk 5**). Multivariate regressie analyse werd gebruikt om het verband na te gaan tussen de reflectiescores via StARS® (uit hoofdstuk 3) en scores voor het oplossen van casussen (antwoorden op de vragen gesteld tijdens het doorlopen van de videocasus). Verder werden de twee voornaamste indicatoren voor het oplossen van casussen in de literatuur, namelijk kennis (score Nederlandse voortgangstoets) en consultatievaardigheden (score opleidingsonderdeel consultatievaardigheden), als onafhankelijke variabelen meegenomen in de analyse. Resultaten in de studie tonen aan dat rekening houdend met kennis en consultatievaardigheden, de reflectiescore een kleine maar significante voorspellende variabele is voor het oplossen van casussen door studenten geneeskunde.



# Curriculum Vitae and Publications

Sebastiaan (Bas) Koole was born on February 14th 1979 in Vlissingen, the Netherlands. After primary education (Bouwen Ewout school) and two years of secondary education (RSG Scheldemond), he left Vlissingen and the Netherlands behind in 1993, to follow his dream at that moment, to become a professional football player in Belgium (Bruges). After four years of boarding school, he graduated from secondary education (Sint-Lodewijkscollege) and enrolled higher education to study motor rehabilitation and physiotherapy at Ghent University, graduating cum laude in 2001. Subsequently he studied physical education and movement sciences at Ghent University, which he successfully completed in 2004 to graduate summa cum laude. Between 2002 and 2004 he also attended a teachers program to obtain a teachers degree in physical education.

In 2005, Bas Koole joined the Centre for Educational Development at the Faculty of Medicine and Health Sciences (Ghent University) to work on an one-year educational project aimed at developing an electronic portfolio approach to supervise students during their clerkships. This project included three educational programs: master of medicine in family medicine, master in physical education and movement sciences, and master in motor rehabilitation and physiotherapy. Outcomes of this project included 1. the development of an electronic portfolio system, 2. a general framework for supervising clerkships in the involved educational programs, and 3. the organisation of workshops about supervision of students during clerkships.

After this project, Bas Koole continued working for the Centre of Educational Development and in 2006 he initiated a line of research about the assessment of reflection in undergraduate health sciences education which is reported in the present dissertation. During his research he has also been involved in educational development in the Faculty of Medicine and Health Sciences, including the development and support of portfolio learning in multiple educational programs as master in rehabilitation sciences and physiotherapy, dentistry, physical education and movement sciences and specialised medicine; development of an electronic system to stimulate active learning in undergraduate dental students; and the use of videos in undergraduate medical education.

Bas Koole has also been involved in various workgroups. At Ghent University he has co-founded and chaired a multidisciplinary workgroup on innovation in education, which resulted in the organisation of a 'Ghent University day of educational innovation' every two years. Between 2010 and 2011 he also chaired the Netherlands Association for Medical Education PhD-student network, which represents PhD-students in medical education and related health sciences domains, in the Netherlands and Flanders. For his contribution to dental education, he received an early career excellence in dental education award by the association for dental education in Europe in 2012.

His main areas of interest and expertise are reflection, portfolio-learning and e-learning. Since 2005, Bas Koole has reported his experiences and findings in multiple articles, poster presentations, short communications and workshops.

## Publications

### *Publications in this dissertation*

Koole S, Vanobbergen J, De Visschere L, Aper L, Dornan T, Derese A. (2013) The influence of reflection on portfolio learning in undergraduate dental education. *European Journal of Dental Education*, 17(2) part 2 (online issue).

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### *Other publications*

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### *Book chapter*

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### *Short communications*

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Koole S, Aper L, Dornan T, Scherpbier A, Valcke M, Cohen-Schotanus J, Derese A. (2011) The influence of reflection triggered by video-cases on medical students' case-solving. *Presented at AMEE (Association for Medical Education in Europe) Conference, Vienna (AT)*.

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# Dankwoord

## Dankwoord

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