# MEASURING AND FACILITATING MEDICAL STUDENTS' WARD ROUND SCRIPTS


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Esther Beltermann, M.A.

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Erstgutachter: Prof. Dr. Ingo Kollar

Zweitgutachter: Prof. Dr. Martin Fischer

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*'...the past is in fact the best predictor for the future.'*

(F. Dochy, 1992)

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# Zusammenfassung

Die Stationsvisite ist eine zentrale alltägliche Aufgabe von klinisch tätigen Ärzten und Ärztinnen. Sie stellt eine komplexe soziale Situation dar, die verschiedenste Anforderungen an Ärzte und Ärztinnen stellt, zum Beispiel akkurate Diagnose- und Entscheidungsfindungsprozesse, das Erfüllen zum Teil konträrer Erwartungen und das Leiten des (interprofessionellen) Visitenteams (Norgaard, Ringsted, & Dolmans, 2004). Darüber hinaus ist die Visite durch permanente Veränderungen gekennzeichnet, die sich sowohl in der Teamzusammensetzung, als auch in Zielen widerspiegeln (Herring, Caldwell, & Jackson, 2011).

Stationsvisiten verfolgen zwei Ziele: einerseits dienen sie der Patientenversorgung, welche medizinische, soziale und administrative Tätigkeiten beinhaltet (Norgaard et al., 2004; Walton, & Steinert, 2010). Andererseits stellen sie einen Ort der Lehre sowohl für Studierende, als auch approbierte Ärzte und Ärztinnen dar (AlMutar, AlTourah, Sadeq, Karim & Marwan, 2013) und umfassen lehr- und lernbezogene Tätigkeiten, die optimaler Weise in der Konstruktion von neuem Wissen bezüglich medizinischer Inhalte und der Art und Weise, wie Visiten durchgeführt werden, resultieren.

Trotz der Bedeutsamkeit der Visite wurde diese bisher in medizinischen Curricula vernachlässigt. Forschungsergebnisse (Nikendei, Kraus, Schrauth, Briems, & Jünger, 2008; Norgaard et al., 2004) legen nahe, dass sowohl Studierende, als auch junge Ärzte und Ärztinnen Schwierigkeiten haben, die Stationsvisite zu verstehen und diese angemessen durchzuführen.

Das Ziel dieser Arbeit liegt daher darin, Visiten aus einer kognitiven Perspektive zu betrachten und das Verstehen von Visiten zunächst zu messen und, in einem zweiten Schritt, zu fördern. Für diesen Zweck wurden zwei Studien durchgeführt. Hierfür wurde Schanks (1999) Skript-Konzept zugrunde gelegt, das sich auf Wissensstrukturen und Erwartungen bezüglich sozialer Situationen bezieht.

In Studie 1 wurden Interviews mit $N = 50$ Medizinstudierenden und Ärzten und Ärztinnen unterschiedlicher professioneller Erfahrung durchgeführt. Die Struktur-Lege-Technik (Scheele, & Groeben, 1988), die die Abbildung zugrunde liegender subjektiver Theorien ermöglicht, wurde genutzt, um das Visitenverstehen der

Interviewten zu externalisieren und grafisch darzustellen. Zudem ermöglichte diese Technik durch einen Konsens zwischen Interviewer und Interviewee die Validierung der abgebildeten Visitenstruktur direkt in der Interviewsituation. Die resultierenden Visitenstrukturen wurden unter Rückgriff auf Erkenntnisse der Expertiseforschung (Nievelstein, van Gog, Boshuizen, & Prins, 2008; Schmidt, & Boshuizen, 1993; Schmidt, & Rikers, 2007) analysiert.

Zur Klassifizierung der gewonnenen Daten wurden die in der Script Theory of Guidance (Fischer, Kollar, Stegmann, & Wecker, 2013) identifizierten Skriptkomponenten *Szenen*, *Skriptlets* und *Rollen* verwendet. Die Szenen-Komponente, die Wissen über typische Phasen einer Situation umfasst, wurde genutzt, um die individuelle Erwartung an einen typischen Visitenablauf zu erfassen. Die Analyse der Skriptlet-Komponente, die sich auf Wissen zu typischen Aktivitäten einer Situation bezieht, erfolgte auf zwei Ebenen: einerseits hinsichtlich des Inhalts der genannten Aktivitäten und deren Bezug zu einem der Visitenziele (Patientenversorgung beziehungsweise das Schaffen von Lehr-Lern-Gelegenheiten (Walton, & Steinert, 2010; Norgaard et al., 2004)), andererseits im Hinblick auf das zugrunde liegende kognitive Potential, welches die Aktivitäten für die Initiierung von Prozessen der Wissenskonstruktion haben (Chi, 2009).

Die Ergebnisse machten deutlich, dass die Visitenskripts von Studierenden und Ärzten und Ärztinnen auf einer strukturellen Ebene eine hohe Ähnlichkeit aufweisen, was früheren Erkenntnissen der Expertiseforschung widerspricht (Nievelstein et al., 2008; van de Weil, Boshuizen, & Schmidt, 2000). Die Analyse der Szenen- und Skriptlet-Komponente zeigte jedoch, dass Studierende defizitäre Erwartungen an den typischen Ablauf einer Visite aufwiesen und einen hohen Anteil an Aktivitäten nannten, die nicht mit den Visitenzielen in Verbindung gebracht werden konnten, was für Defizite in ihrem strategischen Wissen spricht (Eteläpelto, 2000). Dass Experten hingegen Aktivitäten als typisch ansahen, die beide Ziele der Visite wiederspiegeln, spricht für ihr umfassendes Verstehen der Bedeutsamkeit der Visite (Frank, 2005). Darüber hinaus zeigte sich auch, dass Studierende die Visite nicht als Ort der Wissenskonstruktion verstehen und diese, sowie insbesondere ihre eigene Rolle, mit einem hohen Anteil an passiven Tätigkeiten (z.B. dabei sein, daneben stehen) verbanden, während erfahrenere Personen die Visite als einen Ort des Austausches und Wissensgenerierung erachteten.

Auf diesen Erkenntnissen basierend, wurde für die zweite Studie eine instruktionale Intervention entwickelt, in deren Fokus die Frage stand, inwieweit fallbasiertes Lernen mit Video ergänzt durch Reflexionsprompts in der Lage ist, die bewusste Entwicklung von Visitenskripts zu fördern und die Erwartungen von Medizinstudierenden an eine typische Stationsvisite zu verbessern.

Hierzu wurde eine Studie mit $N$ = 184 Medizinstudierenden des klinischen Studienabschnitts am Klinikum der Universität München durchgeführt. Ein 2x2-faktorielles Design mit den Faktoren *Reflexionsprompts zur Förderung des Verstehens des Visitenablaufs* und *Reflexionsprompts zur Förderung der Identifikation von Lerngelegenheiten* wurde hierfür genutzt. Die Studierenden wurden zufällig jeweils einer der vier Experimentalbedingungen zugeteilt.

Im Verlauf der Intervention schauten die Studierenden vier Videos von typischen Visitensituationen aus der Inneren Medizin an, die einer klaren Struktur folgten und Lehr-Lern-Möglichkeiten beinhalteten. Die Videos wurden an definierten Stellen unterbrochen und die Studierenden aufgefordert, den Visitenablauf beziehungsweise Lehr-Lern-Gelegenheiten zu reflektieren (Interventionsgruppen) oder sich Notizen zu machen (Kontrollgruppe).

Die Visitenskripts der Studierenden wurden sowohl vor als auch nach der Teilnahme an der Intervention mit einer papierbasierten Version der Struktur-Lege-Technik (Scheele, & Groeben, 1988) erfasst. Die gewonnenen Strukturen wurden analog der ersten Studie hinsichtlich der Erwartungen an die Visitensequenz sowie die Visitentätigkeiten unter Berücksichtigung von Inhalt (Norgaard et al., 2004; Walton, & Steinert, 2010) und dem Potential zur Wissenskonstruktion (Chi, 2009) analysiert.

Die Ergebnisse zeigten, dass die Teilnahme an der Intervention zu einer leichten Veränderung individueller Erwartungen an typische Visitensituationen führte. Deskriptive Vergleiche zwischen Visiten-Skripts zwischen Pre- und Posttest zeigten keine signifikanten Unterschiede in der Anzahl identifizierter Schlüsselszenen, inhaltlichen Aktivitäten und dem Potential zur Wissenskonstruktion der genannten Aktivitäten.

Die Ergebnisse der weiterführenden Analysen blieben hinter theoretischen Erwartungen zurück: Der Einsatz von Prompts zur Identifikation von Prompts hatte

keinen Einfluss auf die Lernprozesse in der individuellen Lernphase oder auf die Identifikation von Lehr-Lern-Gelegenheiten und den Anteil von Aktivitäten mit hohem Potential zur Wissenskonstruktion. Der Einsatz von Prompts zur Reflexion des Visitenablaufs resultierte in einem signifikant geringeren Anteil an genannten lehr-lern-bezogenen Aktivitäten. Ein Effekt dieser Prompts auf die Identifikation von Schlüsselszenen wurde nicht festgestellt.

Die zusätzlich durchgeführten partiellen Korrelationen zur Untersuchung des Zusammenhangs zwischen Ergebnissen aus der individuellen Lernphase und Ergebnissen im Posttest zeigten einen signifikanten negativen Zusammenhang zwischen den Scores von erkannten Lerngelegenheiten im Verlauf des Bearbeitens der Lernumgebung und dem Anteil interaktiver Lernaktivitäten in individuellen Visiten-Skripts für Studierende, die Prompts zur Reflexion des Visitenablaufs erhielten. Ein positiver signifikanter Zusammenhang zwischen identifizierten Lerngelegenheiten und dem Anteil konstruktiver Tätigkeiten wurde für Studierende identifiziert, die Prompts zur Reflexion von Lerngelegenheiten erhielten. Ein Zusammenhang der individuellen Lernphase und den erkannten Schlüsselszenen wurde nicht gefunden.

Während fallbasiertes Lernen insgesamt als hilfreicher Ansatz erachtet wurde, Studierenden die Reflexion mehrerer Visiten in der inneren Medizin zu ermöglichen, konnten die eingesetzten Prompts nicht systematisch zur Entwicklung von Visiten-Skripts beitragen.

Die geringen Unterschiede im individuellen Lernen zwischen den Teilnehmern der unterschiedlichen Experimentalgruppen lassen sich einerseits durch Charakteristika der Lernumgebung und insbesondere durch die verwendeten sehr spezifischen instruktionalen Prompts begründen. Andererseits ist anzunehmen, dass eine vergleichsweise kurze einmalige Intervention individuelle Visitenskripts nicht grundlegend verändern kann, da deren Entwicklung insbesondere auf vielfältigen Erfahrungen mit Visitensituationen und anderen ähnlichen Lernsituationen basiert. Die Förderung von Skripts sollte also über einen längeren Zeitraum und auch unter Berücksichtigung unterschiedlicher instruktionaler Ansätze sowohl auf kognitiver als auch auf Handlungsebene erfolgen. Zudem sollten follow-up Tests zur Messung von nachhaltigem beziehungsweise verzögertem Lernen in späteren Studien angewendet werden, um die Stabilität von Skripts beziehungsweise verzögerte Lernprozesse zu

erfassen. Die im Rahmen dieser Dissertation gewonnenen Erkenntnisse bieten hierfür einen Anknüpfungspunkt.

Insgesamt stellen die Ergebnisse der beiden durchgeführten Studien einen Beitrag für die Skriptforschung dar, indem sie, von einer kognitiven Perspektive ausgehend, die Messung und Förderung von situationsspezifischen Skripts am Beispiel der Stationsvisite in den Vordergrund stellt. Insbesondere identifizierte diese Arbeit die Struktur-Lege-Technik (Scheele, & Groeben, 1988) als eine geeignete Möglichkeit zur Messung von Skripts. Zudem zeigte sich, dass Skriptkonfigurationen durch Reflexion initiiert werden können. Inwieweit diese Konfigurationen jedoch durch das eingesetzte fallbasierte Lernen unter Verwendung von Reflexionsprompts ursächlich war, konnte im Rahmen dieser Dissertation nicht aufgeklärt werden.

# Kurzzusammenfassung

Die Stationsvisite ist eine zentrale Tätigkeit im Stationsalltag von Ärzten und Ärztinnen. Forschungsergebnisse zeigt jedoch auf, dass medizinische Curricula Studierende nicht ausreichend auf diese Tätigkeit vorbereiten und Studierende sowie junge Ärzte und Ärztinnen Schwierigkeiten berichteten, Stationsvisiten zu verstehen und durchzuführen. Von einer kognitiven Perspektive ausgehend wurde im Rahmen von zwei Studien zunächst das Visitenverständnis von Studierenden unter Rückgriff auf Schanks (1999) Skriptkonzept untersucht und mit dem von erfahreneren Personen vergleichen. Während die Skripts auf einer strukturellen Ebene eine hohe Ähnlichkeit aufwiesen, zeigten sich auf inhaltlicher Ebene defizitäre Erwartungen der Studierenden an den Ablauf einer Visite: Studierende verstanden die körperliche Untersuchung kaum als typische Szene einer Visite und beschrieben die Visite mit einem hohen Anteil an visitenunspezifischen Aktivitäten. Auch zeigte sich, dass Studierende die Visite nicht als Ort der Wissenskonstruktion verstehen und die Visite sowie ihre eigene Rolle mit einem hohen Anteil an Aktivitäten beschreiben, die nicht zur Wissensgenerierung beitragen.

Auf Basis der identifizierten Unterschiede wurde eine fallbasierte Instruktion mit Videos und unter Verwendung von zwei Arten von Reflexionsprompts durchgeführt. Es konnte gezeigt werden, dass die Instruktion zu einer leichten Veränderung in individuellen Visitenskripts beitrug. Während die zweite Studie Hinweise darauf gibt, dass fallbasiertes Lernen mit Video hilfreich zur Förderung der Reflexion on Visiten ist, konnte die Analyse der Lernergebnisse keinen eindeutigen Effekt der verwendeten Prompts ausmachen.

# Abstract

Ward rounds represent a daily routine of physicians in hospitals. Prior research however stressed that medical curricula fail to prepare future physicians adequately for this task and both medical students and young physicians reported difficulties in understanding and conducting them properly. Coming from a cognitive perspective and referring to Schanks script concept (1999), this thesis first investigated how medical students' ward round scripts differed from those of more experienced individuals. Analysis revealed that, on a structural level, scripts showed a high similarity. Analysis of the scene component showed that medical students do not regard physical examination as a typical scene of the ward round. When considering the scriptlet component, it became apparent that, contrary to more experienced individuals, medical students described ward rounds by a high amount of activities that do not contribute to ward round goals. Moreover, they understand ward rounds as such and their own role as a rather passive encounter in which little knowledge generation takes place.

In a second step, building on the identified discrepancies, a case-based learning environment with video and instructional support through reflection prompts was implemented for medical students. Results demonstrated that participation in the learning environment resulted in a slight reconfiguration of students' ward rounds scripts. Even though no differences could be clearly attributed to the used prompts, the study indicates the relevance of case-based learning with videos for conscious script reconfiguration.

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# Chapter 1: Problem statement

Ward rounds represent a daily practice of physicians in hospitals all over the world. They constitute complex situations that require not only accurate decision-making, distributing responsibilities and fulfilling different needs at the same time (Norgaard et al., 2004) but are also characterized by permanent changes, e.g. in team composition (Herring et al., 2011). Rounds mainly serve two purposes: first, they aim at providing patients with high-quality medical treatment which includes the execution of medical (e.g. physical examination), social (e.g. communication with patients), and administrative (e.g. documentation) activities (Norgaard et al., 2004). Second, they serve as educational encounters for physicians and students (AlMutar et al., 2013), and are characterized by teaching and learning activities resulting in the construction of knowledge about both medical content (e.g. patients' diseases) and about the way rounds are typically conducted.

Even though ward rounds represent a daily routine of physicians, prior research pointed out that medical curriculum failed to prepare students adequately for this future task (Nikendei et al., 2008; Norgaard et al., 2004). As a consequence, students as well as young physicians were reported to show difficulties in understanding and conducting ward rounds properly.

Therefore, this thesis aims at contributing to understanding and reducing these deficits. Coming from a cognitive perspective and referring to the script concept (Schank, 1999) which refers to knowledge structures of particular situations that guide both understanding of and behaving in a situation, this thesis encompasses two studies each following one clear research question.

Study 1 aims at mapping medical students' ward round scripts and contrasting them to those of more experienced individuals. Study 2 targets at enhancing medical students' ward round scripts through participation in a computer-supported case-based learning environment using two types of reflection prompts with respect to increasing individuals' understanding of the ward round process and to fostering students' awareness of the role of ward rounds for processes of knowledge construction. The studies are driven by the questions: (1) How do medical students'

ward round scripts differ from those of more experienced individuals? (2) How does participation in a computer-supported case-based learning environment with video using instructional reflection prompts contribute to the development of medical students' ward round scripts?

The following four chapters will provide an overview on literature and findings from previous research relevant to understand the context of this thesis and the conducted studies. Chapter 2 characterizes ward rounds as valuable encounter for treating patients on the one hand and medical education on the other hand. An emphasis is put on characteristics of ward rounds and the role of knowledge construction on the ward round referring to Chi's (2009) framework of overt learning activities. Chapter 3 introduces script theory as the underlying concept to organize individuals' understanding of situation specific knowledge (Fischer et al., 2013; Schank, 1999). Furthermore, approaches to measuring scripts are illustrated. Chapter 4 summarizes insights from expertise research that are used to describe the acquisition and structure of knowledge in the course of professional development. Opportunities for instructional support, particularly the relevance of case-based learning with video and reflection prompts are outlined in Chapter 5 before Chapter 6 outlines the research questions of this thesis. Chapter 7 describes the first study of this thesis that aims at identifying expertise-related differences in individuals' ward round scripts and Chapter 8 outlines the second study which, building on the insights from the first study, targets the development of medical students' ward round scripts through reflection prompts in a case-based learning environment. Chapter 9 finally summarizes and discusses both studies and deduces implications for research and teaching practice.

# Chapter 2: Ward rounds as encounter for treatment and medical education

Ward rounds constitute a crucial aspect of physicians' daily routine in a hospital and are essential for patient care. They usually are the only time in a day when patients, physicians, nurses and other relevant professions get together to discuss and plan the treatment with each individual patient of a ward (Weber, Stöckli, Nübling, & Langewitz, 2007). One main goal of ward rounds thus is to provide patients with high quality medical treatment (Liénard, 2010; Norgaard et al., 2004). In their analysis of ward round processes, Priest, Bereknyei, Hooper and Braddock (2010) found that 47 to 55% of the ward round are spent for providing care to the patient. Walton and Steinert (2010) classified three areas of tasks that are relevant for providing treatment to patients: medical, social, and administrative activities.

Ward rounds however are not only an encounter for treating patients. Since physicians are also teachers and responsible for contributing to professional development of both medical students and fellow physicians (Frank, 2005), the second aim of ward rounds is to provide an educational encounter (AlMutar et al., 2013). According to Priest et al. (2010) 22 to 29% of the ward round are spent on teaching and learning activities. Teaching at the bedside is a valuable component in medical education (AlMutar et al., 2013; Grant, Marsden, & King, 1989) that involves students in patient care already at an early stage of professional development. While learning in a situated and meaningful way (Billett, 2001; Lave, & Wenger, 1991), students may acquire clinically relevant knowledge in an environment that reflects the complexity and authenticity of real world situations students will face in their future role as physicians.

Surprisingly, both medical education and research have failed in valuing the relevance of ward rounds and it stays unclear what goes on in the ward round and what it achieves. While prior studies emphasized that especially medical students and junior physicians fail in understanding and performing ward rounds properly (Nikendei et al., 2008; Norgaard et al., 2004), there is a need to illuminate the perspectives regarding ward round structure and responsibilities of those individuals typically involved in ward rounds. To tackle this issue, this thesis aims at providing

insights in the ward round understanding of medical professionals at different stages of expertise and at fostering individuals' understanding of typical rounds.

Literature suggests that ward rounds can be delineated through several aspects: process, duration, participants, and activities. The next sections provide an overview on these aspects. Due to the potential that ward rounds provide for knowledge construction processes, an emphasis is put on this facet in the last section of this chapter.

## 2.1 CHARACTERISTICS OF THE WARD ROUND: GOALS AND ACTIVITIES, PROCESS, PARTICIPANTS, DURATION

Prior studies indicated a high heterogeneity of the ward round process (Stanley, 1998; Weber, & Langewitz, 2011) and pointed to a need to structure ward rounds for efficiency and to increase the rounds' efficiency and educational potential (Priest, Bereknyei et al., 2010). Literature suggests that ward rounds vary in process, participants and duration as outlined in this section.

*Process of the ward round.* Literature differentiates four likely possibilities for the ward round process: (1) ward round only (teaching or business), (2) pre-ward round meeting followed by the actual ward round, (3) ward round followed-up by a post-ward round meeting, and (4) pre-ward round meeting, ward round, followed up by a post-ward round meeting (Stanley, 1998). Pre-round meetings or sit-down rounds before seeing the patients usually serve as preparation and are located in the doctors' or nurses' room, while the actual ward round aims at seeing each patient of a ward. Additionally, before and after seeing the patients, the ward round team usually discusses the patient in front of his or her room to both recall the patient's history and results of previous examinations beforehand and to discuss decisions made with the patient afterwards. Post-round meetings again take place in the doctors' or nurses' room (Castiglioni, Shewchuk, Willett, Heudebert, & Centor, 2008).

Norgaard et al. (2004) provide a more prescriptive model of the phases of a typical ward round. According to them, pre-ward rounds aim at preparing and determining ward round participants. Moreover, patients can be discussed and organizational issues (e.g., capacity of the ward, discharges, and new patients) can be

addressed. The actual ward round can be separated into three parts: (1) the pre-discussion of a patient in front of the patient's room, (2) the consultation of the patient at the bedside, and (3) a debriefing in front of the patient's room. The pre-discussion (1) consists of a patient presentation including a short review of patient's history, previous treatment, the assessment of new test results and the need to adjust medication outside the patient's room. This is followed by the effective consultation (2) of a patient at the bedside which includes an interaction of physicians, nurses and the patient, a brief history taking and a focused examination of the patient to evaluate the course of disease. Further treatment and discharge are negotiated and planned with the patient. Decisions do not only consider evidence based medicine, but also the social situation of the patient and his or her priorities, options for after-care as well as ethical considerations and physicians' economic thinking (Herring et al., 2010). Finally, patient's agreement with treatment plan is assessed and patient's questions and uncertainties are clarified. The consultation is followed by a debriefing (3) in which the ward round team summarizes their impression of the patient and the treatment plans before attending the next patient of the ward. Once all patients have been consulted, the after-round takes place. It serves to sum up and evaluate the ward round with all professionals involved in the ward round. Moreover, timelines for specific tasks are defined and duties are arranged. Teaching and learning potentially occur at any stage of the ward round process (Priest et al., 2010; Stanley, 1988).

Weber and Langewitz (2011) defined a similar ward round sequence as standard routine for rounds in their hospital. It is, however, unknown how and to what extent the defined procedure reflects the actual professional practice. Prior studies (Priest et al., 2010; Stanley, 1998; Weber et al. 2007) indicate that ideal ward rounds are hard to find and ward rounds are characterized by wide variations in structure and practice of ward round deliveries. Figure 1 provides an illustration of a prototypical ward round process including the pre- and post-round and the actual round consisting of a pre-discussion in front of patient's room, consultation of the patient and the debriefing after seeing the patient in front of the room.

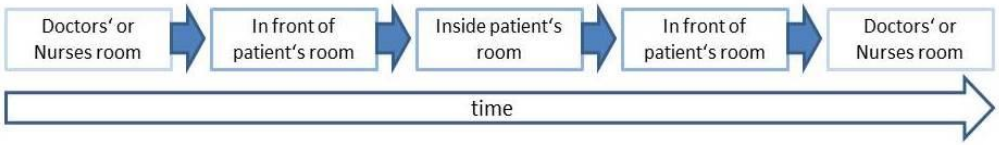


*Figure 1*: Prototypical ward round process based on Norgaard et al. (2004) and Weber and Langewitz (2011).

*Duration of the ward round.* In addition to being seen in the description of the ward round process, the aforementioned variations can also be seen in the duration of ward rounds. Ward rounds are reported to last between 90 and 420 minutes for the whole ward (Claridge, 2011; Herring et al., 2011; Tariq, Motiwala, Ali, Riaz, Awan, & Akhter, 2010). When considering the time spent for the round of a single patient, Weber and colleagues (2007) identified an average duration of 12 minutes (range: 3 to 15 minutes) while both Herring and colleagues (2011) found ward rounds to last 12 minutes per patient on average (range: 8 to 24 minutes). Tariq et al. (2010) identified a comparable duration but added that ideally, ward rounds should last at least 14 minutes per patient.

*Ward round participants.* While Herring and colleagues (2010) describe the ward round team as consisting of one to six persons, Tariq and colleagues (2010) mention that the team size may vary between four and 20 persons with an average of eight participants. Due to rotations, shift work and medical curricula team size and composition of the ward round team are ever changing (O'Hare, 2008). Patients, senior physicians, residents and nurses are regarded as individuals typically participating in ward rounds (Amin, Grewcock, Andrews, & Halligan, 2012; O'Hare, 2008; Priest et al., 2010; Tariq et al., 2010; Weber, & Langewitz, 2011). Medical students at different stages in medical education are regarded as frequently present ward round participants (Amin et al., 2012; Herring et al., 2011; Priest et al., 2010; Weinholz, 1991). Depending on the core area of the ward and its patients, relatives (O'Hare, 2008) and individuals of other professions such as pharmacists (Weinholz, 1991), nutritionists and social workers (Priest et al., 2010) may attend the rounds as well. Interprofessional practice on the rounds facilitates opportunities to incorporate different perspectives in the planning of treatment and collaborative clinical

reasoning that incorporate both physicians' and nurses' perspective (Reeves, Rice, Conn, Miller, Kenaszchuck, & Zwarenstein, 2009).

*Ward round activities.* As aforementioned, ward rounds serve two main goals: (1) providing excellent care to patients, (2) providing an educational encounter for medical students and physicians.

Walton and Steinert (2010) distinguished three core areas for activities that are linked to providing care to patients: medical, social, and administrative.

Medical activities refer to aspects directly linked to the treatment of a patient through technical operations or communication directed to medical issues. Presenting a patient including his or her medical history, reviewing charts and assessing new results are relevant for evaluating the success of treatment (O'Hare, 2008). These activities are usually characterized by collaborative clinical reasoning with all members of the ward round team and result in a decision that reflects the perspectives of the representatives of the professional groups involved (Priest et al., 2010). This collaborative approach allows the opportunity to define and prioritize goals, refine diagnosis (O'Hare, 2008) and plan evidence-based treatment that accounts for a patient's social and emotional situation (Edwards, Jones, Higgs, Trede, & Jensen, 2004; Weber et al., 2007). Additional medical activities include physical examination, taking a blood sample (Tariq et al., 2010) and triadic communication between physicians, nurses, and patients that aim at exchanging medically relevant information (Weber et al., 2007).

In contrast, the social category encompasses those interactive tasks that do not mainly serve treatment but to also establishing a trustful atmosphere between the patient and the ward round team as well as within the ward round team. A trustful relationship is important for patients to express fears and ask questions (Weber et al., 2007). Active listening (Priest et al., 2010), referring to the social and emotional situation of a patient as well as his or her expectations and priorities (Weber et al., 2007), showing empathy, maintaining a professional attitude, structuring communication and using comprehensive words (Tariq et al., 2010; Weber et al., 2007) are beneficial for rendering this comfortable atmosphere. Also communication between the ward round professionals is important for facilitating efficient ward rounds. This not only includes respectful behavior towards the participants of different professions and acknowledging the value of interprofessionality for

successful treatment of the patient, but also leading valuable conversations (O'Hare, 2008; Weber, & Langewitz, 2011).

In addition to medical and social activities, *administrative* activities are also inevitable for conducting ward rounds efficiently. This category of activities corresponds to organizational aspects emerging in the course of the ward round and encompasses activities such as defining and organizing the ward round team, distributing tasks and responsibilities and documenting gained information (Amin et al., 2012; Herring, et al., 2011). Moreover, analyzing costs and dealing with disruptions (e.g. telephone) are important administrative components (O'Hare, 2008).

As ward rounds also provide a valuable educational encounter for medical students and physicians, successful ward rounds should also include teaching and learning activities that facilitate meeting the educational goals of ward rounds. For example, experienced physicians can make thought processes explicit for students while performing treatment, demonstrate key physical skills at the bedside (Castiglioni et al., 2008) and teach evidence-based medicine (Tariq et al., 2010). Furthermore, physicians may convey medical knowledge and support younger colleagues and medical students in applying theoretical knowledge (Tariq et al., 2010). Asking and allowing questions and providing valuable feedback may increase learning success (Claridge, 2011). Ward rounds provide a vast potential for teaching medical ethics and patient management (Tariq et al., 2010).

In general, teaching and learning should be encouraged in every hospital and be reflected in the hospital's philosophy, especially at university hospitals that are strongly involved in medical education. However, the educational potential of ward rounds is often neglected (AlMutar et al., 2013; Claridge, 2011; O'Hare, 2008; Priest et al., 2010) and prior studies point to both a lack in students' basic competencies for performing ward rounds successfully (Krautter, Koehl-Hackert, Nagelmann, Jünger, Norcini, Tekian, & Nikendei, 2014; Nikendei et al., 2008) and to students' desire to acquire more relevant knowledge (Clardige, 2011). Steep hierarchies (Stanley, 1988), a high number of participants (Herring et al., 2011), constantly changing teams (Ramani, Orlander, & Barber, 2003; Stanley, 1988), long rounds (Clardige, 2011) as well as teacher-related aspects such as the feeling of being not adequately skilled (Kroenke, Simmons, Copley, & Smith, 1990; Ramani et al., 2003) and a lack in

attaching importance to education are given as possible explanations (Hoellein, Feddock, Wilson, Griffith, Rudy, & Caudill, 2007).

In contrast, several attempts have been made to account for the significance of ward rounds as educational encounters and to systematically use them for teaching and learning. While some countries have implemented teaching rounds (Hoellein, et al., 2007; Irby, & Wilkerson, 2008), other universities have introduced instructional formats using simulation-based training (Melo Prado, Hannois Falbo, Rodrigues Falbo, & Natal Figueiroa, 2011; Nikendei et al., 2008; Ponzer, 2004) or structured supervision on the ward (Krautter et al., 2014). These instructions put a main emphasis on imparting technical knowledge or separate aspects important for the ward round (e.g. blood withdrawal, interpreting EKG findings; Krautter et al., 2014; Nikendei et al., 2008), but lack conveying holistic knowledge about the ward round including the ward round process and typical tasks performed by the particular participants of the round team.

Educational opportunities in the course of the ward round can be created through systematic planning and preparation of the ward round and desensitizing for the impact of hierarchies and team-related aspects. Besides, engaging both students and physicians actively in the ward round, facilitates the opportunity to take advantage of educational opportunities. The next section gives an outline on possibilities for knowledge construction on the ward round.

## 2.2 KNOWLEDGE CONSTRUCTION ON THE WARD ROUND – REFERRING TO THE FRAMEWORK OF OVERT LEARNING ACTIVITIES

It has been widely acknowledged that aside from the teacher, learning goals and the learning environment, active involvement of the learner is another key factor for learning (Billett, 2001; Erstad, Armstrong, Callahan, & Keller, 1997; Niemi, & Vainiomaki, 1999; Wagenaar, Scherpbier, Boshuizen, & Van der Vleuten, 2003). Active involvement can be reflected in accomplishing practice relevant issues independently or under supervision, perceiving opportunities to asking questions, and receiving valuable feedback result in the use of deep-learning strategies, gains in professional knowledge and skills, and an increase in both personal growth and motivation (Clardige, 2011; McLeod, 1986; Wagenaar et al., 2003). However,

students are rarely involved in ward rounds (Hoellein et al., 2007). Consequently the full benefit of this potential learning encounter is not realized. In their comparative study, Melo Prado and colleagues (2011) investigated how medical students differed in their learning success when participating in an activating ward round training and a traditional training. They found that the active methodology referring to self-directed learning proved more effective than traditional learning methods in terms of understanding the significance of medical knowledge and responsibilities of different professionals involved in the ward round. This finding suggests using student-centered instructional approaches that facilitate students' engagement and consequent active learning on the ward.

Engagement may be operationalized through an affective, behavioral, and cognitive dimension (Archambault, Janosz, Morizot, & Pagani, 2009; Fredricks, Blumenfeld, & Paris, 2004). While affective engagement considers individuals' perception and feelings towards components of the learning environment, behavioral engagement refers to participation in educational activities while adhering to regulations. Finally, cognitive engagement alludes to individuals' psychological involvement with the learning material and the effort spent on a task. Besides, this dimension encompasses the learners' desire to grasp and accomplish complex problems which clearly is linked to learners' affects. In particular, the cognitive dimension attracts attention in education and is subject of research. If teachers succeed in engaging their students actively, learners are likely to engage in sustained and meaningful ways of learning both in interactions and in engaging with learning material (Michaels, O'Connor, & Resnick, 2008; Walshaw, & Anthony, 2008).

The significance of active learning is widely acknowledged and research supports for more student-centred instructional approaches (e.g. Cornelius-White, 2007; Walshaw, & Anthony, 2008), also in medical education. However, effective components and characteristics of learning methods as well as their impact on learning still remain unclear and still some questions are not answered in terms of the effectiveness of different learning methods (e.g. Kirschner, Sweller, & Clark, 2006; Osman, 2008; Prince, 2004; Walshaw, & Anthony). Based on this lack of both a sound knowledge base and a comprehensive framework that classifies active learning methods and their impact on learning, Chi (2009) developed a framework that differentiates several modes of observable learning activities. Adapted from the

original classification of active versus passive learning, three modes of active learning were differentiated: interactive, constructive, active. Each mode corresponds to a set of underlying cognitive processes. Some processes are more likely than others to result in knowledge construction (Menekse, Stump, Krause, & Chi, 2013). In her review of empirical studies, Chi (2009) detected that all types of active learning result in better learning outcomes than passive learning activities, assuming that interactive activities are more valuable than constructive, active, and passive activities (interactive > constructive > active > passive).

While this framework clearly provides a manageable classification for distinguishing observable - or so called overt - learning activities (such as creating concept maps) in terms of the knowledge construction they are likely to evoke, it does not fully take into account underlying cognitive interactions with learning material or content, such as video, as these activities can be hardly observed. Chi (2009) only puts little emphasis on the possibility that, despite showing methods associated with high levels of cognitive engagement, students show limited effort in engaging with learning material or collaborate only on a superficial level resulting in only little knowledge construction.

**Interactive activities** correspond to activities by an individual in which it engages with one or more other individuals, e.g. peers, teachers, in knowledge construction processes through interaction of joint contribution to the solution of a problem. In interactive activities, (learning) partners are used as a resource and contributions build on each other and are further developed. Feedback, prompting and asking questions are characteristic for interactive activities both in the classroom and the ward round. Interactions usually occur naturally in the course of collaborative clinical reasoning or when consulting a patient. However, interactions can also be prompted through specific instructional aids (Weinberger, Ertl, Fischer, & Mandl, 2005). This kind of activities is assumed to positively impact learning (Lipowsky, Rakoczy, Pauli, Reusser, & Klieme, 2007; Michaels et al., 2008), learners' active engagement (Pauli, Drollinger-Vetter, Hugener, & Lipowsky, 2008) and students' motivation and interest (Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). As they force learners to question learning material and develop knowledge in an interactive or joint process that includes transactive contributions each building on

each other (Teasley, 1997) interactive activities are assumed to result in the deepest cognitive processes and highest learning outcomes (Menekse et al., 2013).

**Constructive activities** refer to students' activities that generate knowledge going beyond information given in learning material or instruction. Opposed to interactive activities, these sorts of activities are employed individually and results in knowledge construction, a re-organization of knowledge and an update or accommodation of prior knowledge though. Constructive activities are characterized by one essential feature: they result in constructing meaning going beyond a given content. For the ward round context, contrasting information from different sources, generating self-explanations, explaining aspects aloud can be considered typical constructive activities.

**Active activities** encompass activities that activate students' prior knowledge relevant for a particular context or problem. These activities usually require physical activity that can be observed (Chi, 2009). This dimension emphasizes activities that guide individual's attention to a particular information e.g. through underlining crucial information of a text or writing down notes in the words of the instructor. These actions activate or retrieve related knowledge and result in encoding or storing new information, as well as in strengthening prior knowledge and compensate for missing information. According to Chi, students who engage in observable active activities outperform students who do not engage in overt learning activities even though passive students also receive relevant information. Taking notes, auscultating the patient and measuring blood pressure are exemplary active activities occurring in the course of the ward round.

**Passive activities** usually refer to observable passivity of a learner. Learning does not evoke overt manipulation of learning material but occurs through listening to an instructor and observing relevant activities and/or lectures (Menekse et al., 2013). Information is stored directly without connecting it overtly with prior knowledge. Observing attending physicians, paying attention and listening to interactions with the patients are characteristic passive activities in the course of the ward round.

As previously mentioned, this framework represents a manageable classification for learning activities with respect to the knowledge construction these activities are likely to evoke. However, it also bears some limitations. First, Chi

(2009) only puts little emphasis on the relevance of underlying cognitions of non-observable (so called) passive learning activities. It is likely that students who engage in these kinds of activities, such as observing video, digest observed information, e.g. through connecting it with prior knowledge and experience and thus show a high level of cognitive activity. Second, it renders possible that, despite showing methods associated with high levels of cognitive engagement, students show limited (cognitive) effort in engaging with learning material or only collaborate on a superficial level which results in only little knowledge construction.

Taking these limitations into account, Chi's framework is promising for classifying overt learning activities and assessing their effectiveness for learning. Chi expects that different modes of activities impact learning: while passive activities are assumed to have the least effect, the effectiveness of activities increases from passive to interactive: passive < active < constructive < interactive. Activities of the same mode are hypothesized to result in comparable learning success.

In two studies, the group around Menekse (2013) found that interactive and constructive learning activities proved more effective than active and passive activities and thus confirmed Chi's assumptions. Consequently, increasing the number of constructive and interactive activities is desired to increase students' learning.

Transferring these insights to the ward round, increasing interactions between the various ward round participants and especially the medical student is an obvious consequence when aiming to facilitate students' learning. For instance, the leading physician could involve medical students in the process of collaborative clinical reasoning. Physician's attitude towards the extent to which a ward round should not only serve the purpose of providing clinical care to the patient, but also to provide a learning environment for medical students, will thus be reflected in the amount of activities of different modes (Hoellein et al., 2007; Melo Prado et al., 2011). Physicians who understand ward rounds as educational encounters are assumed to employ a greater amount of constructive and interactive activities than physicians who lack involving students in the ward round (AlMutar et al., 2013). This lack of involvement, requires students themselves to bring themselves into the ward round process.

Using the ICAP framework, ward round participants' perception of the potential that ward round activities provide for knowledge construction can be assessed.

## 2.3 CHAPTER SUMMARY

Ward rounds represent a complex task in physicians' daily routine in a hospital. They require a set of different competencies to accomplish the ward round successfully and deal with the ever changing ward round characteristics. Ward rounds serve two goals: providing treatment to patients and to educate of medical students and physicians. Providing excellent treatment to patients refers to activities of medical, social and administrative content and encompasses both evidence-based medicine and patients' priorities. The educational purpose of ward rounds relates to the selection and execution of teaching and learning activities. While active engagement of students is judged as beneficial for learning outcomes, it rarely takes place (AlMutar et al., 2013). Consequently, involving students in the ward round is a desired aim to increase students' learning on the round. Chi's classification of different modes of learning activities as introduced in this chapter serves a helpful tool for both understanding the learning potential of ward round activities and to planning instructions that support students' domain knowledge in understanding the potential ward round activities provide for learning.

As little is known about how ward round participants understand ward rounds, individuals' understanding about the ward round process will be investigated. An emphasis will be put on the content of activities (medical, social, administrative, teaching and learning) and the perceived potential for knowledge construction (interactive, constructive, active, passive). Individuals' understanding of ward rounds will be conceptualized referring to the script theory as introduced in the next chapter.

# Chapter 3: Conceptualizing ward round expectations referring to the script concept

The previous chapter provided a broad overview on ward rounds and their potential for both treatment and medical education. Ward round activities were therefore conceptualized through their content and the potential for knowledge construction they provide (Chi, 2009; Chi, & Wiley, 2014).

The first section provides an overview on the role of scripts for organizing situation specific knowledge. An emphasis is put on the conceptualization of scripts, the script components and the adaptability of scripts. The second section refers to approaches to measure scripts. The structure formation technique (Scheele, & Groeben, 1988) which represents a good means to map individuals' scripts is outlined.

## 3.1 SCRIPTS AS ORGANIZER FOR SITUATION SPECIFIC KNOWLEDGE

The question, how individuals know which behavior would be appropriate in a given situation (Schank, & Abelson, 1977) was the starting point of script research. In the last 30 years, script research investigated several crucial questions to answer Schank's and Abelson's questions. After a short overview on how the script concept is conceptualized, script components are illustrated. The final section of this sub-chapter refers to the adaptability of scripts across similar situations.

### 3.1.1 Conceptualization of the script concept

A script refers to a cognitive schema which covers information about everyday situations and appropriate actions within them (Schank, 1999; Schank, & Abelson, 1977). The expectations of situations refer to a stereotypical sequence of actions that are typical for a specific situation. These expectations are not expected to undergo many changes. As scripts are acquired through repeated exposure with a certain kind

of situations and highly depend on experience, all actions have been carried out so frequently that acting in the situation decreasingly requires conscious thinking.

Besides the "restaurant visit" which represents the most common example of an internal script (Schank, & Abelson, 1977), a visit at a hairdresser could be described by a script: by having been to the hairdresser many times, one has internalized that one typically arranges an appointment at least a couple of days beforehand. On the day of the appointment, one knows to first check in before discussing the hair cut with the hairdresser. Afterwards, the hair would be washed and cut before drying and trimming the cut. One has also learnt that it is a social rule to pay, and, that it is common to tip the hairdresser. The "going to the hairdresser" script is generated through several visits at the hairdresser and individuals develop an expectation of likely and unlikely events for this situation. The script is activated every time one decides to get his or her hair cut and guides understanding and behavior through the visit at the hairdresser. Due to the script, the mental effort within this specific situation is low – which simplifies reaching one's goals and decreases the conscious awareness of a sequence of a given situation (Kolodner, 2007).

### 3.1.2 Script components

One crucial question in script research considered the identification and description of script components. Previously, Aebli (1980, 1983) pointed to four components that a script would comprise of: activity (behavior that is shown by one or more individuals), object (e.g. learning materials), actor (e.g. students and teacher) and a result (e.g. learning goals). However, this classification did not provide further information on the sequence of an event.

Fischer and colleagues (2013) recently argued that scripts can be conceived as consisting of four components that account for the physical and time setting: *play*, *scene, scriptlet*, and *roles*. The *play* component refers to knowledge about the overall situation a person is currently facing, such as the visit at the hairdresser or the ward round. This component organizes knowledge about the different phases of the situation and leads to expectations of a particular chronological order of them.

The *scene* component comprises knowledge about the phases of a play, including information regarding the physical setting and time frames. Moreover, it

connects several scriptlets that occur within a given setting. In the case of the ward round, an individual may expect a sequence of the following scenes: chart consultation, communication with the patient, treatment planning, sharing experiences within the ward round team. The *scriptlet* component encompasses knowledge about the activities that are typically performed in a scene, e.g. asking patient questions, checking vital signs, demonstrating an examination for students. The scriptlet component characterizes a scene in such a sense that it leads to expectations of activities typical for a scene and thus makes a scene specific for a context (Kellermann, Brotzmann, Lim, & Kitao, 1989). Kollar, Fischer and Heese (2006) stated that scriptlets may vary in their complexity and may contain very basic sub-scriptlets which could be labelled as operations. While examination of the patient would be a scriptlet, prorating a pressure sleeve would be a smaller unit of this examination and be labelled as an operation.

As scriptlets to not only target knowledge about activities executed by only one person but may be subject of a group of individuals, the *role* component was introduced to account for expectations about individuals that are typically involved in a situations and perform aforementioned scriptlets. For the ward round, physicians, medical students, nurses and patients are likely roles.

All individuals that are involved in ward rounds have their own ward round script that gets activated by situational characteristics. Its components can be flexibly combined considering situational features and goals each one has in that situation (Kintsch, 1998; Schank, 1999). While scripts develop in the course of professional experience, one would assume that expectations of ward rounds differ between ward round participants who have a different amount of experience with ward rounds. Physicians for example who have participated in quite a few rounds and are increasingly responsible in conducting them themselves, are assumed to have configured and reconfigured a respective ward round script that is likely to be confirm with actual ward round performance and to be easily adapted to slight changes of a situation. Students in contrast who only participated in ward rounds several times or not at all had only limited chances to configure a ward round script. When confronted with a ward round, this role is likely to activate a script of a situation similar to a ward round or a fragmented script he or she acquired during the limited ward round experience. This script is unlikely to understand the situation and

to behave appropriately. In the course of medical education and clerkships on wards, students configure an increasingly comprehensive ward round script reflecting likely and unlikely events. The next section describes how this acquisition process may occur.

### 3.1.3 Script acquisition and adaptability of scripts

Early approaches of script research (Schank, & Abelson, 1977) assumed that scripts were stable and could not be transferred to similar situations. This assumption would have led to the existence of a high number of scripts for similar situations (e.g. one script for the visit of an exquisite restaurant, another script for an average budget restaurant) and thus to a high cognitive burden. More recent approaches (Fischer et al., 2013; Kolodner, 1997; Kolodner, 2007; Schank, 1999) describe scripts as rather flexible knowledge structure that allow an adaption to both similar situations (e.g. having one restaurant script that can be adapted to different types of restaurants, or for the sake of this study, conducting a ward round in different fields of medicine) and a flexible change between script components.

This permanent modification through transfer and adaption is assumed to save more cognitive resources than permanent and complete reorganization of knowledge (Kolodner, 2007; Schank, 1999). This shift took into account individuals' goals (Fischer et al., 2013) and that memory, experience, understanding and learning could not be regarded in isolation but all shape each other (Schank, 1999).

In their Script Theory of Guidance, Fischer et al. (2013) developed three principles that account for changes in scripts of which two are promising for this thesis to understand how scripts develop and adapt in the early years of professional experience. Through participation in initially unfamiliar situations such as ward rounds, an individual starts to establish a new script configuration that bases on already available components known from similar situations (e.g., history taking, physical examination). Repeated application of this elementary script in a relevant encounter such as the ward round, results in the development of more and more higher-level components that organize the script around a likely sequence of events. While this *script induction principle* targets the initial development of a script, the *script configuration principle* refers to a not appropriate script which is likely to

undergo changes to result in adequate understanding and acting in a particular situation. Through cumulative experience and being confronted with unexpected changes in the course of a situation, reconfiguration is needed. As a consequence, likely and unlikely events are increasingly incorporated into the available script.

Basing on these comprehensive scripts that account for divergent situational features, individuals are able to adapt to sudden changes of a situation and to understand situations and act within them adequately.

While this Script Theory of Guidance as introduced by Fischer et al. (2013) clearly provides a sound theoretical frame for understanding script development, it lacks explanations on the underlying cognitive processes that result in the aforementioned script development. Configuration and reconfiguration of scripts is mainly attributed to failures in acting within or insufficient understanding of a situation. The role of conscious metacognitive processes such as reflection however has been neglected so far and requires attention in future research.

## 3.2 APPROACHES TO MEASURING SCRIPTS

The script theory and the components play, scene, scriptlet and role as identified by the Script Theory of Guidance (Fischer et al., 2013) feature a promising approach for mapping individuals' ward round understanding considering knowledge about the overall situation (play), phases (scenes), performed activities (scriptlets) and individuals typically participating in this situation (roles).

To assess how medical students' ward rounds scripts differ from those of more experienced individuals, a method was needed that allowed mapping ward round scripts in a feasible and valid way. Several attempts were made to measure individuals' scripts in different contexts such as classroom research (Baumert et al., 1997; Blömeke, Eichler, & Müller, 2003; Pauli, & Reusser, 2003; Seidel, Rimmele, & Prenzel, 2003), social (Kellermann, et al., 1989; Pryor, & Merluzzi, 1985) and developmental psychology (Fivush, 1984).

### 3.2.1 Methods used in developmental and social psychology, and classroom research

Developmental psychology addresses the question how understanding of the environment changes in the course of human development and how information is processed and encoded (Anderson, 1996; Anderson, Matessa, & Lebiere, 1997; Eysenck, & Keane, 2000) while social psychology places an emphasis on how individuals understand and act in social interactions (Aronson, Wilson, & Akert, 2008). Both branches of psychology referred to script theory in attempting to reconstruct individuals' mental representations of the environment while classroom research used this concept to explain similarities in the individuals' behavior.

Identifying patterns in pre-school students' understanding of a school day was the focus of Fivush's (1984) interview study. During the four interviews that she performed with each child, she aimed at investigating whether or not students differ in the way of recalling general and specific events of the day in school. She therefore analyzed pronouns (e.g. teachers, students), tempus (e.g. past, present), the level of abstraction of children's language (e.g. degree of complexity) and the sequence of activities (including their number and quality) reported by each child. She calculated frequencies of events and the percentage of agreement between students' answers.

She found that individuals at higher ages reported a higher number of activities and used a higher linguistic abstraction level. She concluded that children's mental representations became more elaborated and increasingly resembled with growing age. However, she also reported that students showed difficulties in accessing general information of days in school (e.g., typical events in a day) and pointed to a need for a method that eases the access of information.

While her study rather focused on the understanding of typical events in a school day, Pryor and Merluzzi (1985) as well as Kellermann et al. (1989) were rather interested in understanding patterns in social interactions and underlying cognitive scripts. Pryor and Merluzzi put an emphasis on reconstructing a script for the situations "getting a date" and "the first date". For this purpose, they performed four sub-studies with expert and novice daters. Group allocation based on the number of different people participants had dated in the last six months. In study 1, 50 individuals were asked to freely generate about 20 typical actions and events that typically occur when (i) a male asks a female out for the first time and (ii) on a first

date. Frequencies of specific events and agreement between individuals were calculated. The most common actions were used for study 2 in which another 50 individuals were asked to rate how typical and necessary each action would be for the two situations. The most typical and necessary actions were used for the development of two case scenarios for study 3. This third study aimed at examining individuals' understanding of the hierarchical organization of scripts, i.e. whether or not scenes could be identified. Therefore, 20 individuals were asked to divide the story into several natural parts. "Getting a date" finally encompassed four parts, while "first date" comprised five parts. Each of the parts could be linked to a sub-goal of the script and contained several actions typical for a particular part. Finally, study 4 aimed at testing whether dating experts were able to use shared knowledge about a situation more sufficiently. 200 individuals were asked to group index cards (that contained the scene names) into an appropriate order as fast as possible. Authors calculated a Spearman rank order correlation between the given order and that grouped by each individual. Correlation was significant indicating a high similarity for daters of both groups of experience. Time-on-task was slightly higher for novice daters but did not differ significantly between groups. Along with Fivush (1984), Pryor and Merluzzi (1985) highlighted that all individuals might have perceived difficulties in accessing their prior knowledge on dating during the reported studies. Further, the authors indicated that availability of a script increases construction or retrieval of information from memory. Finally, they concluded that it would be necessary to extract factors that facilitate scripts to being able to support novices in acquiring scripts. Applying insights from expertise research was named as one approach.

To investigate cognitive structures and corresponding behavior regarding typical informal conversations and to finally extract a "conversation MOP" including its scenes was the approach of Kellermann and colleagues (1989). They therefore referred to Schank's script approach. Participants of this study were asked to note at least 20 verbal activities that typically occur in the course of a first conversation between two persons. Each action was to be noted in one line that was labelled with "act 1", "act 2", "act N" which was meant to ease sequencing. Noted activities were coded and summarized into higher categories. Authors ranked all categories basing on the relative position within the string and related them to actual conversational

behavior. They identified a high resemblance within the noted information, and a high similarity between information noted on cards and activities shown in real initial conversations. Authors could thus show that behavior may be guided and comprehended by underlying cognitive structures such as the "conversation MOP". However, they pointed to the need to couple scenes with goals to provide deeper insights on the individuals' intentions in a given situation. While these studies explicitly referred to the script approach in reconstructing mental representations of a given situation, classroom research rather used the script concept for explaining similarities experienced in several studies in the context of classroom research.

Aiming at describing similarities and differences in mathematics and sciences instruction, the Third International Mathematics and Sciences Study (TIMSS; Baumert et al., 1997; Stigler, & Hiebert, 1997) videotaped teachers from various countries (e.g. Germany, Japan, and United States). Analysis revealed a surprisingly high amount of similarities in structure and content of lessons across different countries. Similarly, in later studies, Seidel and her colleagues from the Institute for Pedagogy in the Sciences (IPN; 2003) found that lessons from teachers across Germany had a high resemblance; while Pauli and Reusser (2003; 2006) found a resemblance between lessons from Germany and Switzerland. It was reasoned that teachers potentially possess a shared classroom script that guides their behavior and consequently lead to the observed conformity in the respective video studies.

Having encountered similar findings, Blömeke and her colleagues (2003) aimed to identify teachers' classroom scripts from both a cognitive and a behavioral perspective. They therefore aimed to conduct an interview study to account for teachers' underlying understanding of the course of a lesson and their intentional behavior, and a video study addressing the actual behavior of a teacher shown in the classroom. While this approach is very beneficial in connecting both functions of a script, it bears some theoretical and methodological challenges: on the one hand, indicators are required that allow for comparisons between video and interview data. On the other hand, lessons are very complex and differences between the underlying understanding and actual behavior can easily occur due to complexity, e.g. through sudden changes in students' behavior. Prior studies on planning lessons (Borko, & Livingston, 1989) already found that despite sophisticated planning, reality in the classroom leads so significant changes in the course of a lesson, especially when

teachers only have limited professional experience. Despite these constraints, Blömeke and her colleagues emphasized the need to identify teachers' mental representations of lessons to develop instructional interventions and teaching material that support especially unexperienced teachers in developing sufficient professional routines.

The reported studies share the aim of identifying similarities in individuals' understanding of frequently perceived situations. While Fivush (1984), Pryor and Merluzzi (1985) and Kellermann et al. (1989) put an emphasis on providing insight into individuals' knowledge about a specific situation, Blömeke et al. (2003) aimed at using gained knowledge to explicitly support individuals with a smaller amount of professional experience to succeed in their professional routine. While studies referred to more or less sophisticated methods (e.g. index cards, video studies, short stories) to capture scripts, they were all faced by the challenge to sufficiently trigger individuals' experience with a situation while also considering the sequential and chronological dimension of a complex script. They indicated the need for a method that allowed the externalization also of implicit knowledge and pointed to the necessity to validate gained data to ensure informative value.

The structure formation technique as reviewed in the next paragraph is one such method that strives for capturing individuals' subjective theories and reaches validity through consensus.

### 3.2.2 Insights from the Program "Subjective Theories"

The program "Subjektive Theorien" (Groeben, Wahl, Schlee, & Scheele, 1988) aimed at revealing individuals' theories about concepts from their everyday life. These theories are mental representations of (psychological) concepts which comprise (at least implicit) argumentative links between the parts of a concept. The links characterize causal and temporal relationships between the parts and thus, this technique holds a high potential in reconstructing and integrating individuals' subjective theories (Mandl, & Huber, 1983). In referring to sequential knowledge about a situation and distinguishing components that belong to a particular situation, the concepts of subjective theories and scripts resemble. Against scripts, subjective theories do not necessarily refer and apply to behavior. Thus, both concepts do not refer to the same construct.

To capture subjective theories, usually interviews are performed. Each interviewee participates in two sessions. As interviews aim to comprehend mental representations, questions address interviewee's grasp of a concept (e.g. "death", "causes and consequences of pollution"). Examples and counter questions serve to test individual's clearness of reasoning and to condense his or her subjective theory. The interview ends when satisfying saturation is achieved. In the mean time between session one and two, the interviewer extracts essential concepts and definitions mentioned by the interviewee to map individual's theory as comprehensive as possible. Color-coded cards are used to illustrate and connect statements made by the interviewee. A range of symbols characterizes the relationships between the concepts. A list of these symbols is provided to the interviewee so that he/she gets familiar with their meaning before the second interview session. The second session takes place several days later and aims at reconstructing the subjective theories referring to the gained structure. The structure is presented to the interviewee and validation and acceptance of the structure are gained through consensual dialogue between the interviewee and researcher. In case of complex theories or complicated issues, a third session may be scheduled to validate the interviewee's subjective theory as shown in the structure.

While validity is regarded to be high for this technique through consensus between interviewee and researcher, it is unclear to what extent subjective theories guide individual's behavior indicating issues in external validity. Also, test criteria like objectivity and reliability cannot be easily transferred to this interview approach. As this technique explicitly relies on determining individual's subjective theories about a concept through dialogue, objectivity in the sense of independence from the researcher can surely not be reached. Regarding these issues, Scheele, & Groeben (1988) point to the "emergentic" view of this research approach: objectivity emerges from the subjectivity of both interviewee and researcher which is reflected in the consensus between them. Similarly, reliability is equally difficult to assess: it has to be kept in mind that subjective theories highly depend on individual's experiences and personal values - which are not stable and updated permanently (Groeben et al., 1988). Thus, even though the program seeks to identify preferably stable theories, shortcomings in terms of reliability are accepted.

Since its introduction, the structure formation technique was successfully applied in different contexts to comprehend individuals' subjective theories. Schemann (1995) strived for describing and assessing domain-specific knowledge structures in the arts, while Geise and Westhofen (2006) applied this technique to individual consumer behavior. With their study, they intended to identify subjective theories about causes and effects of spontaneous shopping. Oehme (2007) questioned reasons for truancy in students at risk to identify opportunities to support these youth on an individual and/or contextual level. Each study referred to the structure formation technique but adapted it to the respective target group: Geise and Westhofen (2006) modified their procedure in terms of complexity and reduced the number of interview sessions, while Oehme (2007) had to simplify her method both in terms of content and duration for students. Students were not capable of focusing on the questions long enough, neither were they able to cope with the complex rules as stated in the method's manual. Moreover, students were not willing to participate in more than one session. Oehme mentioned that questioning underlying concepts would also make students feel insecure. She thus abstained from the original proceeding of having two sessions and tried to make the one session as comfortable as possible for the students, accepting a decrease in objectivity and reliability.

Since this technique provides the potential to map individuals' underlying understanding of concepts or situations by accounting for chronological and physical characteristics, and by referring to everyday life situations, this technique will be applied in this thesis. To account for limited time that physicians have besides their usual work on the ward, the technique will also be adapted for the thesis' purpose. The adaption will be introduced in the method section (Chapter 7.3).

## 3.3 CHAPTER SUMMARY

Scripts refer to mental structures that cover knowledge about situations that individuals experience frequently and which are part of their everyday life. They guide both understanding of and acting in a given situation, leading to a decrease in experienced mental effort. Fischer et al. (2013) identified the four script components play, scene, scriptlet and role that render characterization of a situation. Scripts can

be activated by situation specific cues which induce eliciting the appropriate (sequence of) script components.

As opposed to earlier approaches, scripts are assumed to be flexible in a sense that reconfigurations can occur when a script turns out to be insufficient for understanding and acting in situations. So far, script research did not consider the role of metacognition for script development and (re-)configurations of scripts are mainly attributed to failures in understanding situations and insufficient behavior within a situation.

While prior attempts to measuring scripts encountered theoretical and/or methodological constraints/ limitations, especially in considering the sequential and temporal dimension of a complex script, the structure formation technique represents a usable means for capturing ward round scripts. To assess how individuals differ in their ward round scripts considering the amount of professional experience they have, expert-novice comparisons are used. The next chapter thus reviews insights from expertise research and implications for this thesis.

# Chapter 4: Insights from expertise research for differences in individuals' ward round scripts

This thesis refers to expert-novice comparisons - one of the basic strategies in expertise research - to map differences in individuals' ward round scripts. As aforementioned, scripts develop through experience with a particular situation. Consequently, ward round scripts highly depend on the amount of professional experience a person has. While senior physicians have conducted ward rounds on a rather daily basis for several years, they are likely to have comprehensive ward round scripts while medical students' scripts are expected to be characterized by incompleteness due to students' limited exposure to ward round situations.

Over the past 30 years, expertise was extensively investigated and results provide fruitful insights on how individuals organize and use knowledge. Each period of expertise research considered core themes (Alexander, Murphy, & Kulikowich, 2009): while initial studies placed an emphasis on the question of how individuals, internalize, store and apply knowledge, subsequent studies assessed individuals' knowledge and related strategies for problem solving in different domains such as chess (Gruber, 1990) and physics (Chi, Feltovich, & Glaser, 1981). Based on these results, stage models describing expertise development evolved (e.g. Dreyfus, & Dreyfus, 1980; Alexander, 2003). The current strand of expertise research examines how knowledge develops over time in longitudinal studies and how the development is shaped by affective factors (e.g. emotions). There has been a shift in domains that have been investigated: while prior research addressed comparable simple situations such as chess (Chase, & Simon, 1973) and physics (Chi et al., 1981), current research is increasingly dedicated to complex and ill-structured domains such as medicine and concerned with the questions of how expertise develops in the course of professional practice (Boshuizen, & Schmidt, 1992; Rikers, Schmidt, Boshuizen, Linssen, Wesseling, & Paas, 2002) and which instruction can support individuals in the development of expertise (Alexander et al., 2009).

The next sections review how expertise is conceptualized through stage models and critically reflect the models' benefit for describing expertise development. Further, findings from prior studies that investigated discrepancies between experts and novices and their way of organizing and using knowledge for problem solving are illustrated and crucial insights are summarized. As the question of how individuals differ in the organization of task specific clinical knowledge is of pivotal interest in this study, clinical experience is characterized pertaining to its components biomedical knowledge and clinical practice.

## 4.1 DISPLAYING EXPERTISE DEVELOPMENT THROUGH STAGE MODELS

The expert-performance approach is based on the definition of reproducible superior performance in tasks that represent a domain (e.g. ward rounds). Ericsson, Krampe and Tesch-Römer (1993) indicate that this superior experience emerges from extended periods of deliberate practice which result in adaptions in cognition, motion, physiology and neurons. Deliberate practice is bound to individuals' intrinsic motivation to repeatedly engage in directed action towards a particular goal: succeed in performing a particular task. However, Gruber, Jansen, Marienhagen and Altenmüller (2010) allude that this process is not considered enjoyable.

Stage models (Alexander, 2003; 2009; Dreyfus, & Dreyfus, 1980) map the development towards expertise starting from the novice stage. Dreyfus and Dreyfus' (1980) model of expertise development assumes expertise as an accumulation of knowledge and skills relevant for coping with a task. This development can be classified through five stages: *novice*, *advanced beginner*, *competence*, *proficient* and *expertise*. While the first stage is characterized by the acquisition of formalized and rule-based knowledge, in the progress from stage to stage, deliberate practice enables individuals to continuously obtain a more holistic understanding of professional practice. Moreover, intuition becomes increasingly important and decision-making occurs rather unconsciously which results in difficulties for experts to externalize their implicit or so called tacit knowledge (Gruber, Mandl, & Renkl, 2000; Kinchin & Cabot, 2010; McLeod, Meagher, Steinert, Schuwirth, & McLeod, 2004).

A more current model that describes expertise development independently from a particular domain is the *Model of Domain Learning (MDL)* (Alexander, 2003; Alexander et al., 2009). This model considers cognitive and affective factors and accounts for the interaction between subject-matter knowledge and affective aspects relevant for expertise development. Expertise is described through three stages: *acclimation, competence* and *proficiency*. Similar to the aforementioned model, the first stage is characterized by a fragmented base of domain knowledge. Deep-level strategies, such as elaboration, are rarely used and individuals fail in distinguishing between relevant and not-relevant information (Alexander, Jetton, Kulikowich, & Woehler, 1994). A shift in knowledge organization as reflected in a better connections of knowledge, a better recognition of relevant information and the use of deep-level characterizes the next stage of competence. Individuals in the last stage obtain well-developed and -linked knowledge, and show superior strategies to generating new domain knowledge and to solving unfamiliar and complex problems through the use of deep-level strategies and a broad knowledge about a domain. Interest is seen as highly relevant for this stage and the relationship between interest and knowledge becomes increasingly obvious: interest is assumed to be the origin for individuals' engagement with a task and the acquisition of knowledge going beyond that of the earlier competence phase (Alexander, 2009).

Both models have gained empirical support from studies performed in various domains and with different target groups and provided valuable insights into the development of expertise in a particular domain. However, there has been an ongoing debate concerning how individuals progress through the stages of the illustrated models. While expertise development often is described as a gradual development towards expertise (e.g. Roth, & Roychoudhury, 1993), other studies point to intermediate effects (Gruber et al., 2010; Rikers, Schmidt, & Boshuizen, 2000; Schmidt, & Boshuizen, 1993). These effects possibly emerge from a shift in knowledge organization and lead to inferior performance as compared to both novices and experts (Schmidt, & Rikers, 2007). Prior research (Breckwoldt, Svensson, Lingemann, & Gruber, 2014; Schmidt, & Rikers, 2007) suggests that the integration of new strategies and knowledge is followed by a deterioration of performance. Consequently, routines, procedures and knowledge organization - which were applied successfully before new learning - may be called into question

and thus lead to uncertainty and a decrease in the application of knowledge. Professional development and training consequently may lead to detrimental effects that can be noticed in so-called U-shaped developments emerging from the integration of new information or skills in the already existing knowledge base (Breckwoldt, et al., 2014; Gruber, 2001; Mandl, Gruber, Renkl, 1994). In addition to intermediate effects, prior studies allude that not every learner achieves the stage of expertise but stagnates or even decreases in performance (Ericsson, 2006). This so-called arrested development occurs when a certain level of performance is achieved and routine tasks can be solved sufficiently. At this stage, cognitive processes are automatized and thus deprived of deliberate modification. To counteract automation, top experts are capable of practicing deliberately to improve in performance.

Both, intermediate effects and arrested development question models that understand expertise as continuously improving performance. These models are reviewed as insufficient as they do not provide criteria for distinguishing differences in performance between groups through specific knowledge and skills (Dall'Alba, & Sandberg, 2006). These models also do not account for differences within expertise groups (Sandberg, 2000) which implies the necessity to develop more comprehensive models that account for differences both between and within groups.

Despite the aforementioned limitations, stage models provide a valuable way for mapping expertise development through clear group allocation and facilitate comparisons. This thesis combines both Dreyfus and Dreyfus' (1980) model of expertise development with Alexander's (2003) Model of Domain Learning.

In contrast to recent studies on expertise, this thesis refers to individuals' medical experience (as measured in years since the onset of medical studies) and their function (e.g. medical student, resident, senior physician) as criteria for classification. With that, stages are not assumed to make specific assumptions on the availability of a specific skill or knowledge but to account for medical experience. It is assumed that the amount of medical experience and practice promotes attaining a higher stage of expertise and consequently a shift in knowledge organization. It is assumed that individuals' ward round scripts differ with respect to expertise (Kolodner, 2007).

The next sections provide an overview of recent findings from expertise research. An emphasis is put on illustrating how knowledge organization and the

usage of knowledge for problem solving develop in the course of expertise development.

## 4.2 IMPLICATIONS FROM EXPERTISE RESEARCH ON KNOWLEDGE ORGANIZATION AND APPLICATION

As mentioned previously, early approaches in expertise research addressed the question of how individuals internalize, store and apply knowledge (Alexander et al., 2009). These approaches describe how knowledge organization and application change in the course of expertise.

In his theory on Adaptive Control of Thought, Anderson (1983; 1996; Anderson et al., 1997) described learning as the composition of a cognitive architecture. As previously illustrated for the stage models, also Anderson understood novices' knowledge to be fragmented. According to him, this group of individuals mainly acquires and uses declarative rule-based knowledge for problem solving. In the process of expertise development, individuals' knowledge becomes more and more holistic and processing speed improves. Practice becomes more and more important and turns knowledge and procedures in a complete automation of procedures. Beyond, knowledge is organized around chunks which comprise of constraints and consequences of particular situations (Anderson et al., 1997). The remaining knowledge structure is hierarchical in nature and encompasses procedural and implicit knowledge relevant for solving problems efficiently (Anderson et al., 1997; Schmidt, & Boshuizen, 1993; Schmidt, & Rikers, 2007).

Various studies that examined expertise-related differences in different domains such as design (Eteläpeltö, 2000), teacher education (Berliner, 1987; Berliner, 2001; Hammerness, Darling-Hammond, Bransford, Berliner, & Cochran-Smith, McDonald, & Zeichner, 2005), law (Nievelstein et al., 2008), medicine (Schmidt, & Rikers, 2007; Van de Wiel et al., 2000), and nursing (Benner, Tanner, & Chesla, 2009) agreed that characteristics in experts' knowledge organization allow them to identify domain relevant patterns more easily, quickly and accurately. Experts' interpretations of situations consist of explanations and conclusions (Berliner, 1987; Schmidt, & Boshuizen, 1993). In contrast, novices stick to detailed descriptions of observed information, rely on every day and textbook knowledge, and

tend to focus on dispensable aspects which is regarded as being the result of their rather randomly and less systematically organized knowledge (Berliner, 1987; Berliner, 2001; Gruber, 1995; Nievelstein et al., 2008; Schmidt, & Boshuizen, 1993).

Due to their stable and comprehensive cognitive schemata and heuristic strategies, experts are not only superior in professional vision, but also in problem solving (Alexander, Murphy, & Woods, 1996; Nievelstein et al., 2008; Reimann, & Chi, 1989). Experts were found to show more qualitative and principle-based knowledge and employ top-down searches while referring to abstract principles (Chi, 2011). In that, they are capable to flexibly adapt search strategies (Nievelstein et al., 2008) and their cognitive processing strategy as well as their behavior to specific goals in a situation (Eteläpelto, 2000) while novices lack these abilities. It is not surprising that experts were found to come to better solutions (Chi et al., 1981) and to be superior in monitoring and reflecting their own performance while being able to identify and correct mistakes (van Merrienboer, 2013).

Nievelstein and her colleagues (2008) furthermore contrasted expertise-related differences both between and within expertise groups. They could show that experts shared an ontological understanding which was reflected in homogeneity in knowledge organization and reasoning strategies. In contrast the knowledge between novices was found to be characterized by heterogeneity.

## 4.3 THE DEVELOPMENT OF CLINICAL EXPERTISE AND ITS ROLE FOR WARD ROUND UNDERSTANDING

While expertise is typically regarded as being domain specific, available studies indicate that individuals from various domains traverse a comparable development from novice to expert and that assimilable patterns in problem solving can be found and adapted across different domains (e.g. Nievelstein et al., 2008; Gruber et al., 2010).

Medicine is regarded as an ill-structured domain in which knowledge is not stable but exposed to ever changing new findings in (bio)medical research and consequently in changes in treating diseases (Spiro, 1992). This complexity requires a broad set of skills and knowledge to cope with the manifold challenges. Consequently, there has been growing interest in examining medicine specific

expertise. Haynes, Devereaux and Guyatt (2002) characterize clinical expertise as the ability to combine various perspectives (e.g. medical knowledge, patient's preferences, and evidence-based medicine) to decide on treatment of a patient.

Biomedical knowledge and clinical knowledge thereby are regarded as key aspects of clinical expertise (Schmidt, & Boshuizen, 1993). Biomedical knowledge comprises knowledge about anatomy, scientific principles and pathophysiological processes relevant for understanding the human body and the emergence of diseases. Medical students acquire this knowledge in the course of their studies and use it as a reference when solving problems. Clinical knowledge in contrast builds on this knowledge but is linked to symptoms, possible treatments and effects of diseases. In the course of professional development, physicians develop an understanding of likely and unlikely conditions for diseases and store this knowledge in their memory. These emerging clusters are called "illness scripts" which encompass highly aggregated knowledge about diseases and facilitate knowledge organization and diagnostic processes. They are activated through situational characteristics and decrease mental effort. At that stage of professional experience, biomedical knowledge is only used when referring to illness scripts is not successful (Boshuizen et al., 1995; Rikers, Loyens, & Schmidt, 2004; van de Wiel et al., 2000). Students, in contrast, typically collect data and formulate likely hypothesis (Elsteine, & Schwarz, 2002).

Participation in professional activities such as the ward rounds is assumed to contribute to the development of illness scripts and to shape individuals' conception of professional practice and role understanding (Dall'Alba, 2004). While medical students' understanding of a physician is quite rigid and mainly refers to providing care to patients, a rather multifaceted view emerges in the course of professional development. This not only considers ethical implications but may also refer to further responsibilities of a physician such as teaching medical students and younger colleagues. Medical curricula should account for the manifold tasks of physicians and provide students with opportunities to reflect on underlying goals, their role understanding and the manifold responsibilities of a physician.

While a large body of research investigated expertise-related differences in solving medical problems, there has been little research on clinically relevant professional practice such as ward rounds. Several questions have not been addressed

so far: how do individuals at different stages in professional development understand ward rounds and how do they perceive the participating roles? Further, it is unclear whether or not there are expertise-related differences in individuals' understanding and, if so how these discrepancies can be overcome.

## 4.4 CHAPTER SUMMARY

Expertise research found that individuals at different stages of professional experience differ in their knowledge organization and in the way they apply knowledge in professional practice. Experts are characterized by hierarchically organized and encapsulated knowledge reflecting their rich professional experience and resulting in superior performance. Novices in contrast refer to declarative biomedical knowledge when addressing problems and are reported to experience difficulties in mastering medical tasks. Moreover, experts understand their role as more multifaceted than novices. It however remains unclear how individuals at different stages of expertise understand ward rounds and the role of ward round participants. It is also unclear how expected discrepancies can be overcome through instructions. The next chapter thus provides an overview on instructional approaches that can be used for the design of a learning environment that facilitates script development

# Chapter 5: Instructional support for the development of ward round scripts

The development of ward round scripts provides opportunities to gain experience with multiple ward round situations that reflect the authenticity and complexity of individuals' future work routine as physicians. To foster medical students' script development regarding the function of understanding ward rounds properly, an approach was needed that provides students with multiple opportunities and stimulates them to reflect on observed ward rounds to reconfigure their respective ward round scripts.

Case-based learning appears to be a feasible approach to train medical students to increase their understanding of typical ward rounds and to initiate reflections. As case-based learning alone does not enable all learners to benefit from this kind of instruction, scaffolding students was found to be effective (Gräsel, & Mandl, 1999; Kirschner et al., 2006). The next sections provide an overview on case-based learning with an emphasis on learning with videos, and on reflection prompts that are used as instructional scaffold for fostering individual learning.

## 5.1 FOSTERING INDIVIDUAL'S WARD ROUND SCRIPTS THROUGH CASE-BASED LEARNING WITH VIDEO

Case-based learning (CBL) has been applied in various domains such as business education, law (Mersetz, 1996) and teacher education (Kleinfeld, 1992). It can be linked to case-based reasoning which refers to a model from cognitive psychology that addresses an individual's construction of schemata. Learning occurs through exploring and solving cases in light of prior knowledge that is used in and adjusted to a new context (Bennett, 2012; Kolodner, 1993; 1997; Riesbeck, & Schank, 1989). Repeated exposure to similar but different problems results in the internalization of situational knowledge as well as in the development of prototypical rules and procedures which finally result in the development of scripts about a situation (Kolodner, 1997; 2007; Schank, 1999).

CBL is effective for both learning ill- and well-structured problems that students face regularly in their future professional routine (Jonassen, & Hernandez-Serrano, 2002; Papadopoulous, Demedriadis, Stamelos, & Tsoukalas, 2011). Ill-structured problems (e.g. treating a patient with ambiguous symptoms) especially pose challenges to students as they are complex in nature and are characterized by vague and less-defined goals (Voss, Wolfe, Lawrence, & Eagle, 1991). However, these authentic ill-structured problems provide valuable learning encounters for students. Acknowledging this advantage, the usage of authentic cases that represent the complexity of reality is characteristic for this approach (Savery, & Duffy, 1995). These cases provide a high potential for fostering cognitive abilities and analytical problem solving (Lundeberg, Levin, & Harrington, 1999) and require the reflection, analysis of situation-specific characteristics of problem solving as well as decision making (Zumbach, Haider, & Mandl, 2008). As these kinds of problems have no right or wrong but often more than one possible solution or no solution at all (Butler, & Thomas, 1999), learners are required to consider multiple perspectives and/or to decide between different options for problem solving (Dochy, Segers, Van den Bossche, & Gijbels, 2003). Due to the high similarity between learning encounters and reality, the transfer of knowledge to real world situations is alleviated (Barnett, & Ceci, 2002; Bastiaens, & Martens, 2000) while the likelihood to acquire tacit knowledge is decreased (Collins, 2011; Gruber, Mandl, & Renkl, 2000).

To increase authenticity, there has been a growing interest in using video for case-based learning. Anchored Instruction for example referred to video adventures that embedded problems in exciting stories to stimulate students' interest and motivation to apply knowledge and solve particular problems (Cognition and Technology Group at Vanderbilt, 1992; Collins, Brown, & Newman, 1989). Similarly, theories like Social Learning Theory (Bandura, 1977) and Cognitive Apprenticeship (Collins et al., 1989) found that observing other individuals while dealing with a task enhanced learning.

Building on these insights, videos were increasingly implemented in professional training. Especially teacher education refers to video as valuable tool for fostering a learners' professional knowledge (e.g. Borko, Jacobs, Eiteljorg, & Pittman, 2008; Reusser, 2005; Sherin, 2007; Sherin, & van Es, 2009; Tochon, 2007). It is especially acknowledged that video illustrates the full complexity of professional

practice instead of focusing on only single features of a situation. That way, video allows a high vividness and approximation to reality (Borko et al., 2008; Brophy, 2004). As aforementioned, observation is a crucial aspect in learning with video.

Learning occurs through reflection of observed features of the video which enables learners to develop different perspectives and to become aware of underlying cognitions (Reusser, 2005). Learners are thus enabled to acquire transferable knowledge and connect theory and practice (Osman, 2008). When discussing about observed professional practice, video serves a shared reference and contributes to the development of a common language (Borko et al., 2008; Krammer, & Reusser, 2005). Moreover, engaging with video results in both a deeper understanding of (Borko et al., 2008; Sherin, & van Es, 2009) and a shift in individual's attention towards single aspects of a particular situation (Sherin, 2007) as compared to traditional methods in teacher professional education. However, video-based learning does not only foster learning but also positively affects the motivation of learners to engage with case material (Dochy et al., 2003; Renkl, Mandl, & Gruber, 1996; Scheiter, Gerjets, Huk, Imhof, & Kammerer, 2009).

Despite the potential of this learning approach, there are several challenges that need to be considered when using video. Video often illustrates situations that are - as compared to reality - of low complexity to foster students to notice relevant information while not overwhelming them. However, there is a risk that simplification leads to false conceptions of a situation (Feltovich, Coulson, & Feltovich, 1996). Moreover, using video bears the danger that observed situations already appear well-known to students and only cognitive effort seems necessary to acquire relevant knowledge (Salomon, 1984). Consequently, instructors may be faced by the challenge to foster skills that appear general in nature or even self-evident at first sight. Shifting learners' attention to these crucial aspects thus is necessary to stimulate deeper elaboration of case material (Bjork, & Bjork, 2011). It moreover seems plausible to use several authentic cases of different complexity. Also, Kolodner (1993) earlier recommended making use of several different cases to facilitate the development of cognitive schemata (or scripts) about a situation.

Alternatively, authentic case material might result in a high complexity and ambiguity of video. This might be overwhelming or distracting for learners (Sherin, 2004). Moreover, individuals may perceive cognitive overload (Sherin, 2004;

Sweller, 2010). Prior experimental studies found that especially novices with little prior knowledge struggle in solving a case or a problem by themselves, or when observing and reflecting professional practice (Berliner, 1987; van Merriënboer, 2013). While novices tend to focus on superficial features of a particular situation, experts are able to use observed information for explanations and predictions. In his studies, Berliner (1987) found that experts were able to differentiate between relevant and non-relevant information. Moreover, their reflections were found be on a more abstract level and to take into account several interpretations for observed behavior. Beyond that, experts were found to apply theoretical knowledge (e.g. on classroom management) when interpreting observed professional practice (Berliner, 1991; Borko, & Livingston, 1989; van Es, & Sherin, 2009). In contrast, novices' reflections were found to be less integrated but rather judgmental (Berliner, 1991; Hammerness et al., 2002) (for a more detailed overview on expertise-related differences in individual's cognition, see Chapter 4).

It becomes obvious that video will only reach its full potential when the learning environment is well-conceptualized and provides an appropriate frame for learning. Blomberg, Renkl, Sherin, Borko, & Seidel (2013) provide five research-based heuristics for the use of video: first, they point to the necessity of specific learning goals and learning activities aligned to these goals to provide the best possible conditions for learning e.g., to avoid cognitive overload. Prior research has identified several learning goals that can be successfully reached through video-based instruction. Goals that are particularly linked to observations, such as the ability to notice significant situational features, are promising. In contrast, aspects that are inferred by video (e.g. self-regulation, motivation) or cannot easily be observed in a single video (e.g. longitudinal changes) should not be made the target of an instruction. Second, Blomberg et al. (2013) recommend embedding video in an appropriate instructional setting by referring to a learning design such as case-based learning, as well as instructional strategies (e.g. prompts) that serve as a support for learners. Third, they point to the significance of choosing suitable video material that goes in line with the identified learning goals. There are several options for video material and choices to be made: own vs. external video, best vs. typical practice, familiar vs. unfamiliar situations, correct vs. erroneous examples (Blomberg, et al., 2013, Hoppe-Seyler, Gartmeier, Möller, Bauer, Wiesbeck, & Karsten, 2014; Töpper,

Zupanic, Karsten, Gartmeier, & Fischer, 2010). Moreover, Hoppe-Seyler and colleagues (2014) add that ensuring appropriate use of technical language (e.g. medical jargon) and behavior representative for a profession is important for increasing authenticity of video. The fourth heuristic of Blomberg et al. (2013) addressed the limitations of video. While video provides a high potential for illustrating the full complexity of professional practice, it may represent behavior not typical or relevant for practice. Moreover, technical decisions (e.g. focus and angle of the camera, editing) may bias observations. As a last point, they allude to the need of developing appropriate measurements that apply for learning goals and activities. For video-based learning, reflection tasks were identified as one appropriate measurement of learning success (see also Santagata, Gallimore, & Stigler, 2005).

Considering these heuristics when designing a learning environment contributes to students' learning. Particularly, the design of the environment, and in the case of this thesis, the choice of case-based learning with video as instructional approach, facilitates the acquisition of knowledge regarding the typical course of a ward round as reflected in a reconfiguration of individuals' ward round scripts, and the acquisition of domain-specific knowledge (Choi, & Lee, 2009; Fischer et al., 2013; Kolodner, 2007).

As aforementioned, instructional support is a crucial aspect to enhance learning, which is why the next section provides a more detailed overview on the significance of prompts for scaffolding students' learning with cases.

## 5.2 SCAFFOLDING STUDENTS' LEARNING IN CASE-BASED LEARNING WITH VIDEOS THROUGH PROMPTS

While merely presenting information through video usually does not support learners' understanding of a (complex) situation as learners mainly show passive learning activities (Chi, 2009), intentional instructional support should be provided to elicit processes of knowledge building (Blomberg, Sherin, Renkl, Glogger, & Seidel, 2014; Scardamalia, & Bereiter, 1994). Scaffolding has been used in numerous studies and is one way to enable students to recognize relevant aspects of a particular situation and thus solve tasks or achieve learning goals that individuals would not be able to reach without instructional support (Quintana et al., 2004; Wood, Bruner, &

Ross, 1976). Scaffolds can be characterized as temporary support in which elements of the learning material are adapted by a teacher, a peer or technology (Wood et al., 1976). Thus, learners carry out those tasks within their reach and are enabled to bridge the gap between their current knowledge and abilities and a desired goal (Azevedo, Cromley, Winters, Moos, & Greene, 2005; Davis, 2003; Ge, & Land, 2003; Palinscar, & Brown, 1984; Rosenshine, & Meister, 1992). Prompts are one of the most often applied instructional scaffolds and were found to be an effective means of facilitating problem-solving processes (Ge, & Land, 2003). If well designed, they may lead students to overcome cognitive and metacognitive challenges they are confronted with (Land, 2000) and provide several advantages: First, prompts guide individuals' attention to important situational characteristics and thus increase the identification of relevant information (Bulu, & Pedersen, 2010; King, 1994). In directing learners' attention, explicit instructional guidance decreases cognitive demands and consequently prevents cognitive overload (Schworm, & Renkl, 2007).

Second, prompts support learners in developing solutions by connecting existing knowledge and current information by directing learners' attention to goals and solution constraints (Ge, & Land, 2003; King, & Rosenshine, 1993). Prompts activate prior knowledge on technical knowledge and processes that are already known to learners but would not be applied without an instructional scaffold (Reigeluth, & Stein, 1983). Learners are stimulated to use prior knowledge as an interpretative framework which serves as a filter and allows them to create a repertoire of views. This kind of instructional aid thus contributes to the generation, integration and transformation of knowledge (Gao, Baylor, & Shen, 2005) and facilitates the identification of commonalities and differences of a particular situation. As a result, learners integrate knowledge about a situation and modify the appropriate script. Third, prompts provide a clue as to which strategy might be appropriate for mastering a problem. The point of time of a particular prompt also informs learners when a reaction is necessary (Thillmann, Künsting, Wirth, & Leutner, 2009). This knowledge contributes to the development of strategic knowledge. Fourth, prompts positively affect students' metacognition: Lin and Lehmann (1999) indicate that prompts stimulate the articulation of thoughts and learning processes and thus increase monitoring and evaluation of learning activities.

Prompts especially support learners to provide justifications for solutions and increasing the awareness of underlying patterns of a problem (Bulu, & Pedersen, 2010; Lee, & Songer, 2004; Lin, & Lehmann, 1999). Thereby, prompts are non-directive in a way that they activate self-regulation and do not constitute a strict external regulation but leave students the opportunity to follow their own thoughts (Bannert, 2006).

Despite the benefits that prompts provide, van Merrienboer (2013) indicated that they might be too specific in nature and potentially distract students from basic principles of a situation and hinder learning. Also, Azevedo, and Jacobson (2008) stressed that the content, the point of time and the type of scaffolds need to be clarified and synchronized with learning goals to efficiently implement prompts in learning environments.

Throughout the literature, prompts are used in many encounters: in multimedia environments, curriculum material, through peers or teachers. The next sections first provide a short overview on the role of reflection prompts for facilitating learning processes in case-based learning with video. Secondly, it outlines two possible reflection prompts that provide the potential to support medical students to overcome their difficulties in understanding ward rounds properly.

### 5.2.1 The role of prompts that stimulate reflection for enhancing case-based learning with video

There exists a high variety in the kind of prompts used to facilitate learning: examples, reminders, questions (Chen, & Bradshaw, 2007) or sentence starters (Davies, 2003).

Especially questions and sentence starters have been used as instructional means to facilitate learners' reflection and were identified to positively affect the quality of students' reflection (Chen, & Bradshaw, 2007; Davies, 2003; Ge, & Land; Land, 2000; Moon, 2004). Due to their potential to direct learners' observation in such a way that they uncover the underlying qualities that made an experience significant, question prompts are a valuable means to foster learning (Davis, & Linn, 2000). Moreover, responding to question prompts facilitates learners in developing their understanding, enables them to embed information and activities in a broader

and more relevant context (Amulya, 2004), and thus increases knowledge integration and construction (Davis, & Linn, 2000; King, 2004; King, & Rosenshine, 1993).

Students in contrast who did not receive question prompts were found to struggle in accomplishing problem solving and showed decreased deliberate effort in identifying relevant information in the problem (Davis, & Linn, 2000). While these advantages underline the significance of question prompts per se, recent studies (e.g. Davis, 2003; Ge, & Land, 2003) emphasized the need to pay attention to the type of question prompt as the type may serve different goals and may hold different impacts on both cognition and metacognition.

In her study, Davis (2003) differentiated generic and directed question prompts and investigated their impact on middle school science students' reflection. While generic prompts requested students to merely stop and think about given information, directed prompts provided hints for reflection. Davis discovered that generic prompts ("Right now we're thinking…") proved more effective than directed prompts ("Pieces of evidence we didn't understand very well included…") as they allowed more space for individual reflection and dealing with a subject. It however remained unclear how and to what extent prior domain knowledge affected this outcome. A study conducted by Bulu, and Pedersen (2010) distinguished between domain-general and domain-specific prompts. While domain-general prompts ("How do you plan to solve this problem?") address the development of concepts and strategies that can be used across different domains, domain-specific prompts ("What does Akona need to survive? Think about the facts including body, food, habitat, dwellings, communication, and technology.") refer to questions that provide cues about relevant content knowledge for solving a problem. In line with prior research (Bell, & Davies, 2000), it was found that domain-general prompts were useful for initiating processes of knowledge integration in general, learners perceived difficulties in solving problems without further domain-specific hints. In contrast, domain-specific prompts contributed to the acquisition of content knowledge as well as students' reflection abilities and particularly and provide explanations and justifications.

Consistent with these insights, the group around Demetriadis (2008) and Papadopoulous (2011) developed a three-stage-process (observe-recall-conclude) consisting of domain-specific questions that initiate reflection processes and

contribute to the development of knowledge schemata. These questions connect both prior knowledge and new information and trigger the processing of learning material which in turn is expected to result in more effective and stable knowledge schemata. In a first step, learners identify context information of the learning environment (observe: "What concrete events imply possible problems during project management?"). They then activate prior knowledge gained in similar situations (recall: "In what other cases do you recall having encountered similar project development problems?"). In a third step, learners are expected to initiate reasoning processes while drawing conclusions in light of the insights from the previous steps (conclude: "What are the useful implications for the successful development of a project?"). Both studies proved the effectiveness of domain-specific questions as demonstrated by the time students spent on task and the quality of their productive cognitive activity (e.g. identifying relevant information; connecting cases). Moreover, prompted students were more efficient in processing, integrating and recalling new information as compared to students who did not receive instructional support. Conversely, non-prompted students were reported to have spent less time on task and to fail in engaging cognitively in a given task. As a results, prompted students outperformed non-prompted students in a post-test that captured students' conceptual knowledge and transfer abilities.

Despite the justification for the use of question prompts to initiate reflection processes, Davis (2003) stressed that directed prompts are likely to be too specific and only refer to single aspects of the overall situation while neglecting basic principles of a situation. Designing prompts that shift students' attention to underlying goals and solution constraints without being too specific thus appears to be a walk on a tightrope (Davis, 2003; Ge, & Land, 2003). Another issue identified in prior research that is not only bound to reflection prompts but to prompts in general refers to learners' prerequisites. Students who differ in the amount of prior domain knowledge may be in need of different instructional support tailored to the various challenges they encounter during their learning processes (Davis, 2003; Kirschner et al., 2006; Moreno, & Valdez, 2007).

So far, neither is known whether the findings on the effectiveness of question prompts that initiate reflection processes can be transferred to other contexts or theoretical constructs like scripts. Bulu and Pedersen (2010) performed their study on

the acquisition of problem-solving skills with middle school students (sixth grade). Learning goals addressed the understanding of the solar system as well as strategies and tools that scientists require for researching it. The studies conducted by Demetriadis et al. (2008) and Papadopoulous et al. (2011) included Computer Science university students in their third (out of four) year of studies who participated in a mandatory laboratory class on Software Project Management.

The aforementioned studies emphasized the role of prompts for initiating reflection processes to impart problem-solving skills. While the efficiency of prompting was proved for their particular context, it remains unclear to what extend the results can be transferred to the facilitation of individuals' scripts about professional practice such as ward rounds.

### 5.2.2 The potential of reflection prompts to increase medical students' ward round scripts with respect to the ward round sequence and engagement of students

Similar to project management which was used as study context by the groups around Demetriadis (2008) and Papadopoulous (2011), also ward rounds constitute an ill-structured environment which requires complex problem-solving skills of learners.

Prior research stressed that medical education does not prepare medical students properly to understand and perform ward rounds: medical students fail to understand both the ward round itself as well as basic duties of the round such as documentation, reaching therapeutic agreement and controlling patients' parameters (Nikendei et al., 2008; Norgaard et al., 2004). From a script perspective, it can be assumed that students' insufficient scripts are the reason for these issues. Medical students thus need to be supported to configure scripts or reconfigure insufficient scripts. These scripts should encompass knowledge on the typical sequence of the ward round process as well as activities that are typically performed by the different individuals involved in the ward round process to contribute to patients care.

Prior studies also pointed out that students fail to understand the educational potential that ward rounds provide and do not participate actively in ward rounds either (AlMutar et al., 2013; Melo Prado et al., 2010). Active involvement of students in ward rounds however is regarded as key element to acquiring knowledge

on the process of the ward round as well as on medical knowledge relevant for treating patients (Melo Prado et al., 2010). Chi (2009) moreover found that activities which require students' active engagement in a situation result in higher levels of knowledge construction.

As outlined before, prompts that initiate reflection processes are regarded as valuable instructional support in case-based learning environments that use ill-structured authentic cases. Moreover, they provide instructional support to enhance students' reflection.

To tackle the aforementioned issues, reflection prompts should be used to direct students' attention to the sequence of the ward round process and to provide students opportunities to configure respective reconfigure their ward round scripts (*sequence reflection prompts*). These scripts should comprehend knowledge about the order of scenes and scriptlets that are conducted be the involved roles.

Reflection prompts should also focus on the educational potential of ward rounds and shift students attention to opportunities for engaging medical students into the ward round process (*engagement reflection prompts*).

Through the use of these types of prompts, induction and/or reconfiguration of ward round scripts can be triggered.

## 5.3 INDIVIDUAL AND CONTEXTUAL FACTORS THAT IMPACT LEARNING WITH PROMPTS

While case-based learning is assumed to positively affect the acquisition of professional knowledge, there are some factors that affect learning processes. As mentioned before, students' prerequisites may interact with the learning environment and the instructional support provided (Davis, 2003; Moreno, & Valdez, 2007).

One such aspect might be students' prior domain knowledge. The importance of students' domain-specific knowledge was emphasized by several authors (Dochy, Segers, & Buehl, 1999; Gruber, & Mandl, 1996; Murphy, & Alexander, 2002) that regarded this kind of knowledge as fundamental to understanding problems and generating solutions. New learning is seen as exceedingly difficult when prior domain knowledge is not available or not used (Dochy et al., 1999; von Glaserfels,

1987). Gruber and Mandl (1996) argued that domain knowledge seems to exceed other influences such as those of cognitive abilities, general problem solving strategies and metacognitive abilities.

In line with these insights from general educational psychology, previous research in the field of case-based learning with prompts (Blomberg et al., 2013; Davis, 2003; Kirschner et al., 2006) suggested that students who differ in the amount of prior domain knowledge may be in need of different instructional support tailored to the challenges they encounter during their learning process (Davis, 2003; Kirschner et al., 2006; Moreno, & Valdez, 2007). Especially novice learners might be overwhelmed by the complexity of authentic cases as they lack a comprehensive base of prior knowledge in which new information can easily be integrated (Heitzmann, 2014; Renkl, 2002; Nievelstein et al., 2008). Moreover, this group of learners was characterized as being particularly vulnerable to cognitive overload (Kalyuga, Ayres, Chandler, & Sweller, 2003; Sherin, 2004).

With regard to script research that assumes that prior experience with a situation influences both understanding of and acting in a situation (Schank, 1999), it can be assumed that individuals' prior practical clinical experience may also have an impact on learning with cases and the amount of instructional support required to tackle perceived challenges. In a recent study on the predictors for medical students' performance in procedural knowledge tasks, Schmidmaier et al. (2013) found a correlation between students' problem solving and the amount of time spent in clinical clerkships. The exposure to real life professional encounters thus was assumed to facilitate the acquisition of procedural knowledge which in turn provides the potential to enhance students' problem solving skills. It however remains an open question whether the amount of clinical experience also fosters individuals' understanding of professional encounters such as ward rounds.

While prior knowledge and clinical experience are surely important factors for predicting learning outcomes, the relevance of affective aspects should not be disregarded. Individual interest is a significant motivational condition for learning processes and is regarded as an important predictor for performance in school and academics (Krapp, 1998). Interest is defined as a „state of engaging or the predisposition to reengage with particular classes, events, or ideas over time" (Hidi, & Renninger, 2006, p. 112) and enables learners to select and prioritize information

according to their personal values. Thereby, learners focus their attention and show an increased cognitive functioning and persistent effort (Tsai et al., 2008). As interest results in deeper processing of information and a higher amount of time spent on a task or problem, the quality of learning increases and learned content can be recalled for a longer duration (Hidi, & Renninger, 2006; Krapp, 1998, 1999; Tsai et al., 2008). These studies were mainly conducted in formal learning settings in school. However, transferability of findings was assumed also to informal learning encounters such as the ward round.

In addition to prior knowledge and experience and individual interest learner's characteristics such as age, gender and educational status influence the kind of participation in learning processes and learning outcomes (Billett, 2001). In their "Dispositional Theory of Thinking", Perkins et al. (1993) emphasized that individual dispositions such as inclinations, sensitivity and abilities impair thinking and learning. Moreover, attitudes towards learning as well as the perception of learning activities and learners' own capacities impact the willingness to participate in learning processes and professional activities (Billett, 2001).

As outlined in chapter 5.1, the design characteristics of the learning environment may also impede learning with prompts. Blomberg et al. (2013) therefore suggested clear learning goals which are represented in learning material and the instructional support used. Based on the Self-Determination-Theory as introduced by Deci and Ryan (2002), it can be assumed that the learning environment and particularly the used prompts may inhibit students' perceived autonomy, competence and relatedness which may be reflected in lower learning outcomes.

## 5.4 CHAPTER SUMMARY

Fostering medical students' ward round scripts requires multiple opportunities to gain experience with ward rounds. Case-based learning with video was identified to be an appropriate instructional approach that refers to complex and authentic professional encounters to facilitate learning. To support students in dealing with the complexity of situations, instructional support was recommended and prompts were chosen as adequate means to direct learners' attention to aspects relevant with a

situation. Specifically reflection prompts were found to be suitable to enhance the conscious development of medical students' scripts and to provide individuals with the opportunity to reflect on crucial aspects. Two kinds of reflection prompts, namely *sequence reflection prompts* that direct students' attention to the sequence of the ward round process, and *engagement reflection prompts* that refer to opportunities how physicians may engage students in the course of the ward round, were introduced to tackle deficits in medical students' ward round understanding and to initiate the reconfiguration of individual's ward round scripts.

# Chapter 6: General research questions

The previous chapters provided an outline on the significance of ward rounds for physicians work routine and medical education. Ward round activities were organized around four categories linked to round specific goals: medical, social, administrative, teaching and learning. As ward rounds represent an encounter for knowledge construction, the ICAP framework was introduced to assess the cognitive engagement induced by observable activities in the course of the ward round.

To conceptualize individuals' ward round understanding, the script concept (Schank, & Abelson, 1977) was introduced. An emphasis was put on the script components scenes, scriptlets and roles and possibilities on the configuration and reconfiguration of scripts (Fischer et al., 2013). The structure formation technique (Scheele, & Groeben, 1988) described a good choice for measuring individuals' ward rounds script as it is regarded as a proper tool for extracting also experts' conceptions of ward rounds (Kinchin, & Cabot, 2010). As professional experience is regarded as a predictor for individuals' performance, insights from expertise research were summarized to illustrate individual differences in the organization and application of knowledge for mastering professional problems from novice to expert.

This thesis encompasses two studies. Study 1 aims at mapping medical students' ward round scripts and contrasting them to those of more experienced individuals. Study 2 targets at enhancing medical students' ward round scripts through participation in a computer-supported case-based learning environment using two types of reflection prompts with respect to increasing individuals' understanding of the ward round process and to fostering students' awareness of the role of ward rounds for processes of knowledge construction. The studies are driven by the following questions:

**General Research Question 1: How do medical students' ward round scripts differ from those of more experienced individuals?**

Building on prior findings of expertise research, one would assume to find differences in ward round scripts between medical students and individuals at higher stages of expertise. These differences would predominantly lie in individuals'

knowledge organization and in the quality of activities that individuals at different expertise stages relate to ward round goals. One would expect experts' scripts to be more comprehensive and to represent activities that are connected with both purposes of ward rounds: treating a patient and educating medical students and fellow physicians (Frank, 2005). Moreover one would expect a higher amount of activities that relate to higher levels of knowledge construction. Representing their low amount of ward round experience, novices' scripts in contrast are expected to be characterized by a comparably higher amount of activities that cannot be tied to one of the ward round goals (Eteläpelto, 2000; Schmidt, & Boshuizen, 1993). Besides, these scripts would comprehend a higher amount of activities that relate to lover levels of knowledge construction. Furthermore, novices are assumed to fail to understand the ward round process properly since they lack professional experience (Schmidt, & Boshuizen, 1993).

Identified differences are intended to be tackled through an instructional intervention. So far, only little is known on how the development of scripts can be promoted through instructions. The second study thus aims at understanding how medical students' script development can be enhanced through an instructional intervention.

**General Research Question 2: How does participation in a computer-supported case-based learning environment with video using instructional reflection prompts contribute to the development of medical students' ward round scripts?**

Case-based learning with video proved an effective approach for learning in ill-structured domains (Papadopoulous et al., 2011) and will be used in the second study to enhance the conscious development of medical students' ward round scripts. Moreover, the usage of question prompts was found to be effective to trigger reflection (Demetriadis et al., 2008). Thus, study 2 uses this type of prompts to enhance medical students' ward round understanding. Particularly, sequence reflection prompts that shift students' attention to the sequence of the ward round and provides them with opportunities for reflection, and engagement reflection prompts that direct students' attention to opportunities to engage medical students in knowledge construction processes in the course of the ward round are used.

The studies conducted in the context of this thesis are outlined in the following chapters. The last chapter discusses insights gained from the studies as well as implications for future research.

# Chapter 7: Study 1 – Identifying expertise-related differences in ward round scripts

## 7.1 CONTEXT

Ward rounds constitute a crucial activity in physicians' daily routine in hospitals. They serve two purposes: first, they aim at providing evidence-based care to patients characterized by medical (e.g. physical examination), social (e.g. patient-physician communication) and administrative (e.g. documentation) activities (Norgaard et al., 2004; Weber et al., 2007). Second, ward rounds serve as educational encounter for both medical students and physicians (AlMutar et al., 2013; Claridge, 2011) and encompass teaching and learning activities with facilitate cognitive engagement and thus result in the construction of knowledge regarding the typical sequence of the round as well as activities representative for ward rounds.

Ward rounds are complex situations which require not only technical knowledge, but also accurate decision making based on evidence-based medicine and patients' priorities, distribution of responsibilities between the members of the ward round team as well as fulfilling manifold affordances (e.g. hospital's economic goals, patients' needs) simultaniously (Castiglioni et al., 2008; Norgaard et al., 2004). In addition, ward rounds are also characterized by permanent changes, e.g. in team composition (Herring et al., 2011).

Individuals' understanding of and behaving in situations can be explained by Schank and Abelson's (1977) script theory. Scripts represent cognitive schemata that contain information about situations and appropriate behavior within them. Repeated exposure to similar situations, such as ward rounds, results in the development of scripts (Schank, 1990). Scripts can be characterized by the four script components play, scenes, scriptets and roles (Fischer et al., 2013). While the play component contains information about the overall situation an individual is facing, the scene component refers to knowledge about the phases of the play. Scenes are tied to both a physical and temporal setting (Kellermann et al., 1989). The scriptlet component covers information about the activities that characterize a scene whereas the role

component accounts for the individuals involved in a situation and scriptlets performed by them.

In the course of professional development, and due to observation of and participation in ward rounds, individuals develop an understanding of participants, phases and scriptlets typical for rounds. Because of their limited ward round experience, medical students are assumed to lack understanding regarding the significance of certain phases for ward rounds as well as the responsibilities of ward round participants as reflected in the scriptlets performed by these participants.

The next section provides an outline of the aim of the first study as well as on the research questions and hypotheses.

## 7.2 AIM OF THE STUDY, SPECIFIC RESEARCH QUESTIONS AND HYPOTHESES

Even though rounds represent a daily routine of physicians, little is known about how medical students understand them, and how professional development contributes to the acquisition of professional expertise regarding the way rounds are typically conducted.

Thus, the aim of this study is to investigate medical students' conception of typical ward rounds and actions within them. A secondary aim is to contrast students' conception with that of more experienced physicians.

### 7.2.1 Expertise-related differences in the nomination of script components (RQ1)

The first question places an emphasis on the script components *scenes*, *scriptlets* and *roles* which are conceived as covering specific knowledge regarding typical ward rounds in internal medicine.

RQ 1: *How do medical students' ward round scripts differ from those of more experienced individuals in terms of the nomination of the script components scenes and scriptlets and roles?*

As outlined in Chapter 4, experts and novices differ in the organization of knowledge. Experts are reported to have encapsulated knowledge which stores information around few key concepts representative for a domain and encompasses information about likely and unlikely events in a particular situation (Nievelstein et al., 2008; Rikers, & Boshuizen, 2000; Rikers, Loyens, & Schmidt, 2004). While

neglecting irrelevant information, experts succeed in recognizing domain relevant patterns (Alexander et al., 1996; Reimann, & Chi, 1989). Novices, in contrast, struggle in recognizing relevant information but stick to detailed descriptions of observed information (Berliner, 1987; Berliner, 2001; Gruber, 1995; Nievelstein et al., 2008; Schmidt, & Boshuizen, 1993).

This study is anticipated to replicate expertise-related differences found in prior studies. It is hypothesized (hypothesis 1.1) that novices mention more scenes than individuals at higher stages of expertise who in contrast organize their ward round knowledge around fewer key concepts. Moreover, it is expected that, due to their difficulties in recognizing domain relevant information, (hypothesis 1.2) novices mention significantly more scriptlets than more experienced individuals. Finally, (hypothesis 1.3) novices are assumed to report more scriptlets of low complexity than individuals at higher expertise stages. As prior research varies in identifying typical ward round participants, the question about typical ward round participants remains explorative.

### 7.2.2 Expertise-related differences in understanding scriptlets' content (RQ2)

As outlined in Chapter 2, ward rounds serve two main goals: first, providing treatment to patients, which is mainly linked to medical, social and administrative activities; second, educating medical containing teaching and learning activities. It is unclear how individuals at different expertise stages understand ward round goals as reflected in activities. Thus, the third research question is:

RQ2: *How do medical students' ward round scripts differ from those of more experienced individuals in terms of scriptlets' content?*

Prior studies (Eteläpelto, 2000; Schmidt, & Rikers, 2007) utilizing expert-novice comparisons found that novices show insufficient strategies when it comes to identifying, interpreting and maintaining situational information. Experts, in contrast, were reported to demonstrate successful strategies. It is assumed that in line with professional development, individuals' scripts undergo a reorganization and are increasingly tied to ward round goals. It therefore is hypothesized (hypothesis 2.1a) that experts have internalized the different roles a physician fulfils (Frank, 2005) and thus possess scripts which are characterized by activities that serve the attainment of

both ward round goals while novices' scripts are more likely to reflect a unifaceted understanding of professional practice (Dall'Alba, 2002) and mainly consist of social activities that are not tied to the goals of the ward round. However, it is also likely that (hypothesis 2.1b) novices who typically are recipients of education as part of their studies recognize teaching and learning activities in the course of ward rounds and emphasize those while more experienced individuals neglect these sorts of activities. Moreover, it is anticipated that (hypothesis 2.2) novices show deficits in identifying situation-relevant information (e.g. Nievelstein et al., 2008) and place an emphasis on activities that are not related to ward round goals.

### 7.2.3 Expertise-related differences in understanding scriptlets' potential for knowledge construction (RQ3)

Representing a daily routine, ward rounds serve a crucial aspect for attaining professional knowledge and provide manifold opportunities to apply it in a meaningful context. Ward rounds facilitate cognitive engagement and knowledge construction for both medical students and physicians of different stages of professional experience. Still, it remains unclear whether and to what extent individuals recognize ward rounds as an encounter for knowledge construction.

RQ 4: *How do medical students' ward round scripts differ from those of more experienced individuals regarding the perceived potential for knowledge construction of scriptlets?*

Knowledge construction is conceptualized through Chi's (2009) ICAP framework. Due to the varying amount of clinical experience, expertise-related differences in scripts are expected with respect to interactive, constructive, active and passive activities.

It would stand to reason that (hypothesis 3.1a) experts understand their responsibility as teachers (Frank, 2005) and regard ward rounds as an educational encounter. Consequently, they would involve students and younger colleagues in the round which would result in a larger amount of constructive and interactive scriptlets. However, research indicates that the educational value of ward rounds often is neglected (AlMutar et al., 2013; Clardige, 2011). It thus is conceivable that (hypothesis 3.1b) experts put an emphasis on providing care to patients and neglect the educational value of ward rounds. He/she would barely include students in the ward round. This would lead to a small amount of constructive and interactive

scriptlets whilst an emphasis would be placed on passive and active scriptlets which barely contribute to knowledge construction.

Converse assumptions can be made for novices' perception of ward rounds' potential for knowledge construction. Since students have a limited understanding of professional practice (Dall'Alba, 2002) it is imaginable that (hypothesis 3.2a) they only recognize the medical goals of ward rounds and fail to engage cognitively. Activities that promote knowledge construction are limited and individuals' scripts are characterized by a high amount of passive activities. It is however possible that (hypothesis 3.2b) students recognize the value of ward rounds for learning. As a consequence, their scripts are assumed to be composed of constructive and interactive scriptlets.

### 7.2.4 Expertise-related differences in understanding the medical roles involved in ward rounds (RQ4)

An emphasis is also put on the question of how individuals at different expertise stages understand the medical roles (medical student in the 3rd and final year, resident, ward physician, senior physician) involved in ward rounds considering the content and potential for knowledge construction of assigned scriptlets.

RQ 4: *How do medical students and individuals at higher stages of expertise understand the involved medical roles of ward rounds?*

Expertise-related differences are assumed in the types of scriptlets assigned to the medical roles. The roles "3rd year medical student" and "resident" will be of particular interest as the student is the target of medical education and is supposed to acquire medical and ward round knowledge, and the resident is the future role of medical students after their graduation.

Considering scriptlets' content, it is hypothesized that (hypothesis 4.1) novices describe their own role as consisting of significantly more non-demanding and social scriptlets than individuals at higher expertise-stages. Also, it is anticipated that (hypothesis 4.2) individuals at higher expertise stages understand the roles "resident", "ward physician" and "senior physician" as mainly characterized by medical, social and administrative scriptlets tied to ward round goals. Due to their lack in understanding strategic goals and related activities, novices, in contrast, are expected to mention significantly fewer scriptlets of these types but to recognize

significantly more non-demanding scriptlets also for these roles (hypothesis 4.3). Due to their involvement in medical education, both novices and experts are expected to attribute significantly more teaching and learning scriptlets to the roles "3rd year medical student", "ward physician" and "senior physician".

Referring to scriptlets' potential for knowledge construction, in line with the presumptions before, (hypothesis 4.4) individuals are assumed to assign predominantly passive scriptlets to the student's role while (hypothesis 4.5) individuals with more professional experience, such as the resident, are characterized by an increasing amount of active, constructive and interactive scriptlets that contribute to knowledge construction.

## 7.3 METHODS

A qualitative-quantitative approach was chosen for identifying expertise-related differences in individuals' understanding of typical ward rounds in internal medicine. Therefore, standardized interviews were performed basing on a simplified version of the structure formation technique (Scheele, & Groeben, 1988) with medical students and physicians all studying or working in internal medicine.

## 7.4 PARTICIPANTS

50 medical students and physicians (25 female, 25 male) with a mean age of 30.58 years (*SD* = 9.68) and *M* = 8.99 years of medical experience (*SD* = 7.90) since their onset of medical studies participated in this study. Individuals represent the typical ward round participants with a medical background. To maximize transferability of results, individuals represent the broad field of internal medicine equally. All participating students were enrolled in medical studies at the University of Munich, while physicians were employed by the University Hospital Munich and worked at one of the two campuses "Innenstadt" and "Großhadern".

Participants were grouped according to both their function (e.g. medical student, ward physician) and their years of medical experience. This resulted in the four stages *novice*, *intermediate*, *advanced intermediate* and *expert*.

Table 1 provides an overview on the number of participants per expertise group, their mean age, amount of medical experience, and gender.

*Table 1*: Sample characteristics.

| **Expertise stage** | ***N*** | **Mean age (*SD*)** | **Years of Medical Experience (*SD*)** | **Male** | **Female** |
|---|---|---|---|---|---|
| Novice | 15 | 24.87 (6.26) | 3.00 (0.00) | 7 | 8 |
| Intermediate | 11 | 26.36 (4.03) | 6.18 (0.60) | 3 | 8 |
| Advanced intermediate | 12 | 29.50 (1.43) | 8.53 (1.20) | 5 | 7 |
| Expert | 12 | 43.55 (10.16) | 19.50 (9.94) | 10 | 2 |
| Total | 50 | 30.58 (9.68) | 8.99 (7.90) | 25 | 25 |

The novice group comprises medical students ($N$ = 15) who were in their third year of medical studies and were involved in the so-called Modul 23 which represents the basic year in internal medicine and surgery at the Medical Faculty of the University of Munich, and have passed their one-week clerkship in internal medicine. While preclinical studies and the first clinical semester ensure a vast amount of biomedical knowledge, the Modul 23 provides students with a first practical experience in their role as future physicians. Due to their limited clinical experience, these students constitute the novice group. The intermediates group includes students ($N$ = 10) in their final year, who studied medicine for at least five years. The so-called practical year comprises three clerkships in internal medicine, surgery and an elective of 16 weeks each. These students are supervised by residents and ward physicians when applying their knowledge on the ward. The practical year ended with the second state examination. The advanced intermediate group comprises residents ($N$ = 13) who possess their approbation as physician and are involved in the everyday care of patients. They usually started their specialist training in a field in internal medicine. The expert group finally includes ward physicians and senior physicians ($N$ = 12) who are responsible for a ward. They are involved in medical education. Supervising students in bedside teachings, tutorials and on the ward are part of their responsibilities.

Participants in the study were recruited personally, through e-mail, telephone and upon the recommendation of other participants in the study. The study was approved by the ethics committee of the University Hospital of the University of Munich (UE No. 067-13). In accordance with the Declaration of Helsinki, participation was voluntary and based on informed consent. No financial compensation was provided for participation.

## 7.5 MEASURES

The study aimed at identifying differences between medical students' ward round scripts and those of individuals at higher expertise stages considering the script components *scenes, scriptlets* and *roles*. As knowledge about processes would not be necessarily conscious (Schank, 1999), an instrument was needed that allowed individuals to make their knowledge explicit. This was especially important for the

expert group: prior research (Kinchin, & Cabot, 2010; McLeod et al. 2004) reported that experts possess a high amount of implicit and tacit knowledge that is used rather unconsciously, but show difficulties in verbalizing this information. Graphical representations like concept maps were found to be a proper tool to allow experts (Kinchin, & Cabot, 2010) and novices (Prinz, 2012) to externalize their knowledge and to demonstrate how they organize their knowledge. The structure formation technique, as presented in Chapter 3.2.2 is another graphical method that especially puts the focus on processes and relationships between aspects.

### 7.5.1 Adjusting the Structure Formation Technique to capture Individuals' Ward Round Scripts

The structure formation technique (Scheele, & Groeben, 1988) is a valuable method to map individuals' understanding of situations and concepts as well as relationships between aspects. The original technique is very complex due to sophisticated definitions and rules (e.g. regarding forms and colors of cards) and requires a great amount of time (e.g. two separate meetings) and preparation by the interviewee. As expect physicians were expected to be not willing and/or capable of spending this high amount of time on this interview, there was a need to simplify the technique both in terms of time and complexity of rules. However, the simplification should not limit the power of this method. Therefore, it was decided to note information provided by the interviewee directly on cards, and the option of sophisticated rules and signs, and validated gained information directly after the interview was abandoned.

### 7.5.2 Pilot Study

The adjustments were tested in a pilot study with $N = 10$ students and physicians representing the target group until the final procedure was established. The first interviews proved the use of color coded cards convenient for both interviewer and interviewee, while the use of arrows highlighting the sequence of mentioned information turned out to be rather time-consuming and thus was abandoned for future interviews. Also, adjustments in the wording were necessary, since the terms "scene", "scriptlets" and "role" could not be easily understood by the participating interviewees. Therefore, they were replaced by "phase", "activity" and "participant".

The first interviews were performed by two interviewers, each one interacting with the interviewee, one noting down interviewees' utterances. This procedure

proved to be resource consuming. As interviews followed a clear and fixed structure, both interviewers did not perceive it difficult to both ask questions and note down utterances. Neither did they feel distracted from interviewees' utterances. To assess reliability of data gained through the interview and to avoid interviewer bias, three audiotapes of interviews performed by one interviewer were used by the other interviewer to reproduce the ward round structure and to compare both structures. As no major differences were found neither in the way interviews were performed nor in utterances noted on cards, both interviewers proceeded in conducting the actual interview study.

### 7.5.3 Procedure

The interviews were performed in confidential one-to-one settings in the office of the project group or in the doctors' room on a given ward. Participants were informed about the goal of the study and the procedure. Interviews were then performed using a standardized interview schedule (see Appendix A). Participants were requested to recall a typical ward round in internal medicine.

The first question addressed the typical participants of ward rounds. The named roles were noted on colored cards, each representing a specific role (e.g. white cards for senior physicians, pink cards for final year students, yellow cards for students, and blue cards for the patient). The second question referred to the phases a ward round typically has (e.g. discussion of patient in front of the room, patient consultation). The third question asked interviewees about the activities that ward round participants would typically perform in each of the mentioned phases. Here, participants were asked to first provide information on the ward round activities of each participant for phase 1 before continuing with phase 2 and so forth until all activities performed by each ward round participants were mentioned for all phases. The resulting structure was validated by the interviewee immediately after the interview (for a concrete example of study data, see Appendix B). The interviewee was given as much time as needed to go through the noted information and to assess whether his/her understanding was mapped appropriately. Changes in terminology and sequence were made when required. This procedure assured 100% validated structures. Interviews were videotaped and photos of the structures were taken for future reference.

### 7.5.4 Questionnaire

After the interviews took place, individuals filled out a short questionnaire on demographics (e.g. age, gender, medical experience, field of work) and questions concerning acceptance of the interview technique (e.g. comprehensibility, conformability) (see Appendix C).

### 7.5.5 Coding Procedures

The resulting structures comprise a broad range of scenes and scriptlets mentioned as typical for ward rounds. In a first step, there was a need to recode terms in favor of comparability and to code activities' content and potential for knowledge construction in a second step.

The coding scheme (see Appendix D) was developed inductive-deductively and based on a review of recent ward round literature (e.g. Herring, et al., 2011; Norgaard, et al., 2004; Priest, et al., 2010; Walton, & Steinert, 2010; Weber, & Langewitz, 2011). Scenes and scriptlets as identified by literature were then extended by those mentioned by the participants. Similar words with the same meaning were summarized in one term. The final coding scheme covers 17 scenes (e.g. chart consultation, discussion in front of the room, communication with patient, physical examination) and 140 scriptlets (e.g. taking notes, discussing findings, sharing opinions, listening). The structures gained during the interviews were transferred to Excel sheets. Scenes and scriptlets were recoded according to the coding scheme to ensure comparability. 20% of data were coded by two independent coders to ensure reliability of codings. Interrater reliability was assessed and proved very satisfactory (96% agreement, Cohens Kappa: 0.85).

In a second step, data were coded in terms of script components (roles, scenes, scriptlets) using a coding scheme (see Appendix E).

Initial coding revealed that individuals organized their ward round knowledge differently. In terms of the scene component, 20 participants named phases that reflected time and space (e.g. in front of patients' room before seeing the patient), four participants mentioned only content-related phases (i.e. communication with patient), while 25 interviewees used both aforementioned kinds of phases. One participant did not mention any phases. There were no expertise-related differences in knowledge organization. Thus, it was decided to determine a new classification of

scenes that would reflect both content, time and space. Five recurring scenes were used for classifying the time-spatial dimension: “Briefing in doctors’ room”, “Discussion in front of patient’s room before seeing the patient”, “Seeing the patient inside patient’s room”, “Debriefing in front of patient’s room after seeing the patient”, “Debriefing in doctors’ room after the round” (*Figure 1*). To ensure a more sophisticated insight into ward rounds14 content scenes that could potentially occur were assigned to the time-spatial dimension (see Appedix F).

In terms of the scriptlet component, initial coding revealed, that individuals mentioned activities at different levels of complexity: one consisting of rather complex activities such as “presenting the patient”, and one consisting of basic activities such as “say ‘hello’ to the patient”. Consequently, the scriptlet component was separated into activities of high and low complexity and this distinction was used for coding of the data. All data were then coded accordingly by one coder and 20% of data were coded by another independent trained coder to ensure interrater reliability which proved to be very satisfying (95.3% agreement, Cohens Kappa: K = 0.89).

Afterwards, mentioned scriptlets at both levels of complexity were assessed regarding (i) their content and (ii) their potential for knowledge construction using inductive-deductive coding schemes (Appendices G and H). In terms of content, the categories *medical*, *social*, *administrative and teaching* and *learning* were distinguished. Initial coding revealed that some activities (e.g. open the door, stand around) mentioned by interviewees would not match any of these categories. Therefore the category *non-demanding* which reflected those activities that could not be linked to ward round goals was added. All activities were coded in terms of their content and their potential for knowledge construction. Each 20% were coded by the two independent coders counterbalancing for group membership membership (i.e. expertise group), site (i.e. Innenstadt or Großhadern), field of internal medicine (e.g. cardiology, endocrinology). Interrater reliability was assessed and proved very satisfactory (91.67% agreement for content, Cohens Kappa: $K_{Content}$ = .87; 92.1% agreement for potential for knowledge construction, $K_{Knowledge\ construction}$ = .86). The remaining structures were then coded by one coder for each level of analysis.

### 7.5.6 Statistical analysis

Absolute frequencies of script components (roles, scenes, scriptlets) were counted and the relative positions of the scenes were calculated.

Also, the frequencies for each dimension of scriptlets (content and potential for knowledge construction) and for each mentioned scene and role were calculated. Frequencies were then transferred to SPSS. As absolute frequencies showed a high variance both within and between groups, relative frequencies were calculated to account for varying amounts of the different levels of scriptlets, their content and potential for knowledge construction. Because of the sample sizes for the four groups, non-parametrical tests were performed to identify differences between the subgroups of the total sample. SPSS Version 22.0 was used with a significance level of $p = 0.05$. For group comparisons, Kruskal-Wallis tests were calculated that based on 10000 sampled tables. Mann-Whitney tests were used to follow up a Kruskal-Wallis test. To account for Type 1 errors, Bonferroni correction was applied with a confidence interval of $p = .05$ divided by the number of conducted tests.

## 7.6 RESULTS

The following paragraphs present the results emerging from both quantitative and qualitative analyses of interview data.

### 7.6.1 Preliminary Results

#### 7.6.1.1 Duration of interviews

The interviews took $M$ = 15.89 minutes on average ($SD$ = 6.88) indicating no expertise-related differences ($H(3) = 1.17$, $p = .77$). However, duration highly differed both between and within groups (see Table 2).

*Table 2*: Means, standard deviations and ranges of the duration of interviews (in minutes) between individuals of different expertise groups.

| Expertise group | Duration of interviews (*SD*) | min | max |
|---|---|---|---|
| Novice | 14.99 (5.57) | 7.60 | 28.60 |
| Intermediate | 15.13 (5.46) | 7.90 | 23.50 |
| Advanced Intermediate | 14.75 (6.12) | 6.58 | 26.58 |
| Expert | 18.86 (9.65) | 6.85 | 29.83 |
| Total | 15.89 (6.88) | 7.23 | 27.13 |

#### 7.6.1.2 Acceptance of the interview technique

To assess individuals' acceptance of the interview technique, a short questionnaire was handed to the interviewees. Overall, the acceptance of the interviews was high with a mean of $M$ = 3.65 ($SD$ = .29) on a 4-point-scale (4 = fully agree, 0 = fully disagree). Interviewees agreed on the suitability of the interview method to extract their ward round understanding ($M$ = 3.37, $SD$ = .53) and that the mapped structure represented their conception of a typical ward round ($M$ = 3.64, $SD$ = .56). Moreover, they indicated that participation in the interviews deepened their ward round understanding ($M$ = 3.26, $SD$ = .88). In that, the structure formation technique proved an appropriate method to validly externalize ward round scripts.

### 7.6.2 Analysis of individuals' ward round understanding

#### 7.6.2.1 Expertise-related differences in the nomination of script components (RQ1)

The first research question pointed to expertise-related differences in the mentioned script components *roles, scenes* and *scriptlets.*

*Role component*. Interviewees were asked for typical participants of the ward round team. Prior studies indicated a high variety in the composition of the ward round team. Thus, it was aimed at exploring which roles individuals at different expertise stages regarded as typically attending.

Ward round teams were described as consisting of $M = 3.82$ ($SD = 1.43$) roles. No expertise-related differences could be identified. Residents (38), third year medical students (34), nurses (32), ward physicians (28) and last year medical students (27), senior physicians (14) patients (12) as well as fellow patients (1), relatives (1) nursing students and other professions (1) were indicated as present roles in the course of the ward round. The mentioned roles did not differ significantly between expertise groups with the exception of the role "third year medical student": Novices mentioned their own role significantly more often than individuals at higher stages of expertise ($H(3) = 15.284$, $p < .01$).

*Scene component***.** Interviewees were asked for phases that are typical for ward rounds. As mentioned in section 7.5, initial coding revealed that interviewees organized their ward round knowledge differently. In a first step, scenes were thus recoded according to their time-spatial dimension. In a second step, they were recoded on a content level. Experts were hypothesized to organize their ward round knowledge under fewer scenes than novices would do (hypothesis 1.1).

Individuals organized their ward round knowledge around the five time-spatial scenes "Briefing in doctors'/nurses' room" (as mentioned by 12 interviewees), "Briefing in front of patient's room" (45), "Consultation of the patient in patient's room (50), "Debriefing in front of patient's room" (24), and "Debriefing in doctors'/nurses room" (2). Interviewees referred to a mean of 2.66 ($SD = .75$) time-spatial scenes. No expertise-related differences were found in the number of occurrences of the scenes.

*Table 3*: Frequencies and standard deviations of content scenes mentioned by the different expertise groups.

| Expertise group | Total content scenes (*SD*) | Briefing in doctors'/ nurses' room (*SD*) | Discussion in front of patient's room (*SD*) | Consulta-tion of the patient in patient's room (*SD*) | Debriefing in front of patient's room (*SD*) | Debriefing in doctors'/ nurses' room (*SD*) |
|---|---|---|---|---|---|---|
| Novice | 7.47 (4.05) | .13 (.35) | 1.67 (1.18) | 3.80 (1.21) | 1.47 (1.77) | .33 (1.29) |
| Intermediate | 7.18 (2.92) | .73 (1.56) | 1.82 (.87) | 3.81 (1.47) | .82 (1.40) | .00 (.00) |
| Advanced Intermediate | 7.58 (1.56) | .42 (.67) | 1.58 (.90) | 5.00 (1.71) | .42 (.51) | .00 (.00) |
| Expert | 9.33 (3.47) | .33 (.65) | 1.75 (1.06) | 5.33 (2.93) | 1.58 (1.93) | .33 (1.15) |
| Total | 7.88 (3.22) | .38 (.88) | 1.70 (.99) | 4.46 (1.98) | 1.10 (1.56) | .18 (.90) |

Time-spatial scenes were sub-divided into content scenes. As the scene "communication with the patient" was mentioned both in the beginning and the end of a patient consultation, it was considered twice for analysis ("Communication with patient 1", Communication with patient 2"). Overall, interviewees reported an average of 7.88 (*SD* = 3.22; range: 2-18) scenes spread across the five time-spatial scenes (see *Table 3*). Comparisons regarding the number of occurrences of content scenes did not reveal any significant difference between expertise groups. Consequently, hypothesis 1.1 could not be confirmed. I further contrasted the content scenes mentioned by the different expertise groups. *Table 4* shows scenes that were mentioned by at least 20% of the overall sample (Appendix I provides a detailed overview of all mentioned scenes).

Group comparisons revealed that the nomination of the scene "physical examination" increases with growing expertise ($V$ = 0.41, $p$ = .04). No further significant differences between groups were identified.

In a next step, relative positions of those content scenes that were mentioned by at least 20% of the interviewees were calculated for each expertise group (see *Table 6*). Overall, the different expertise groups showed a high resemblance in the relative positions of content scenes in the course of the ward round. Only the position of the scene "physical examination" differed significantly between groups ($H(3) = 9.87$, $p$ =

.01): intermediates located this scene at a significantly later position than novices ($U$ = -2.619, $p$ = .01).

*Table 4*: Frequencies of content scenes mentioned by the different expertise groups.

| | Expertise group | | | | |
|---|---|---|---|---|---|
| **Content scenes** | **Novice** | **Intermediate** | **Advanced intermediate** | **Expert** | **Total** |
| **Briefing in front of patient's room** | | | | | |
| Chart review | 5 | 5 | 3 | 3 | 16 |
| Patient presentation | 5 | 8 | 7 | 8 | 33 |
| **Consultation of patient in patient's room** | | | | | |
| Discussion of findings | 9 | 3 | 5 | 3 | 20 |
| Treatment planning | 11 | 8 | 8 | 11 | 38 |
| Teaching | 3 | 1 | 2 | 5 | 11 |
| Communication with patient (1) | 15 | 11 | 12 | 12 | 50 |
| Communication with patient (2) | 7 | 7 | 8 | 7 | 29 |
| Physical examination | 6 | 7 | 9 | 11 | 33 |
| **Debriefing in front of patient's room** | | | | | |
| Discussion and reflection of patient | 7 | 3 | 4 | 5 | 19 |

*Note*. This table only includes scenes mentioned by at least 20% of the total sample.

*Table 5*: Relative positions and standard deviations of content scenes as mentioned by the different expertise groups.

| | **Briefing in front of patient's room** | | **Consultation of patient in patient's room** | | | | | | **Debriefing in front of patient's room** |
|---|---|---|---|---|---|---|---|---|---|
| **Expertise Group** | **Chart review (*SD*)** | **Patient presentation (*SD*)** | **Communication with patient (1)(*SD*)** | **Physical examination (*SD*)** | **Discussion of findings (*SD*)** | **Teaching (*SD*)** | **Treatment planning (*SD*)** | **Communication with patient (2)(*SD*)** | **Discussion and reflection of patient (*SD*)** |
| Novice | .13 (.05) | .22 (.13) | .43 (.20) | .60 (.22) | .55 (.15) | .72 (.25) | .68 (.22) | .74 (.21) | .77 (.14) |
| Intermediate | .43 (.17) | .21 (.07) | .52 (.23) | .60 (.15) | .87 (.05) | .73 (.00) | .81 (.19) | .81 (.21) | .83 (.16) |
| Advanced Intermediate | .18 (.06) | .19 (.08) | .44 (.16) | .64 (.17) | .66 (.18) | .71 (.12) | .70 (.25) | .79 (.21) | .97 (.06) |
| Expert | .21 (.11) | .16 (.08) | .38 (.17) | .53 (.13) | .61 (.10) | .53 (.17) | .61 (.18) | .70 (.27) | .91 (.87) |
| Total | .25 (.17) | .20 (.09) | .44 (.19) | .59 (.16) | .62 (.17) | .63 (.19) | .70 (.22) | .76 (.22) | .86 (.13) |

*Scriptlet component*. Further, participants were asked to mention activities that are typically performed by the ward round team while conducting the round. As indicated before, individuals mentioned scriptlets of different complexity. Thus, scriptlets of high and low complexity were differentiated. It was anticipated that - due to their lack in knowledge organization (e.g. Schmidt, & Boshuizen, 1993) - novices mention (i) more scriptlets than individuals at higher levels of expertise (hypothesis 1.2) and when considering the complexity of scriptlets (ii) mention more scriptlets of lower complexity than individuals of lower expertise (hypothesis 1.3).

In total, interviewees reported an average of 30.32 scriptlets (*SD* = 14.02); and mentioned more scriptlets of high complexity than of low complexity (see *Table 6*). While hypothesis 1.2 expected a gradual increase of the amount of scriptlets, results indicate a U-shaped development. Overall, novices and experts mentioned more ward round scriptlets than intermediates and advanced intermediates. A Kruskal-Wallis-Test however did not show a significant difference ($H(3) = 3.45$, $p = .33$). Hypothesis 1.2 thus could not be confirmed.

*Table 6*: Means and standard deviations for the total number of scriptlets, scriptlets of high and low complexity for individuals of different expertise groups.

| **Expertise Group** | **Total number of scriptlets (*SD*)** | **Scriptlets of high complexity (*SD*)** | **Scriptlets of low complexity (*SD*)** |
|---|---|---|---|
| Novice | 31.99 (14.64) | 25.47 (12.03) | 6.52 (5.78) |
| Intermediate | 23.00 (8.76) | 17.64 (9.99) | 5.36 (2.62) |
| Advanced Intermediate | 28.91 (14.71) | 20.58 (11.62) | 8.33 (5.61) |
| Expert | 36.33 (18.18) | 30.25 (16.28) | 6.08 (3.82) |
| Total | 30.32 (14.02) | 23.72 (13.23) | 6.60 (4.74) |

Further analysis was performed to investigate expertise-related differences in terms of scriptlets of high respective low complexity. Novices and experts were found to mention more scriptlets of high complexity than the intermediate groups. This difference however was not significant ($H(3) = 5.74$, $p = .13$). Also, no expertise-related differences could be identified in the number of activities of low

complexity ($H(3) = 1.65$, $p = .64$). Consequently, hypothesis 1.3 that anticipated significantly more scriptlets of low complexity for novices could not be confirmed.

Based on both the analysis of scenes' relative position and transition probabilities, one most likely sequence of the ward round across all expertise groups could be identified: (1) patient presentation, (2) chart review both occurring in the course of the briefing in front of patient' room (3) physical examination, (4) communication with patient, (5) discussion of findings, (6) teaching, (7) treatment planning, all taking place while consulting the patient and (8) discussion and reflection of the patient as part of the debriefing in front of patient's room.

#### 7.6.2.2 Expertise-related differences in understanding scriptlets' content (RQ2)

It was asked how medical students' ward round scripts differ from those of more experienced individuals when considering scriptlets' content. Medical, social, administrative, teaching and learning and non-demanding activities were differentiated. A reorganization in individuals' scripts resulting in a multifaceted understanding of ward rounds was anticipated. Consequently, experts' scripts were hypothesized to be characterized by all types of activities while novices' scripts were assumed to mainly consist of social activities (hypothesis 2.1a). However, it is also likely that novices recognize ward rounds as one part of medical education and thus emphasized these sorts of activities (hypothesis 2.1b). Beyond that, it was assumed that novices show deficits in recognizing ward round relevant information but put an emphasis on activities not related to ward round goals (hypothesis 2.2) as reflected in a high amount of non-demanding activities.

Overall, interviewees perceived ward rounds as mainly medical and social encounters whilst administration and teaching and learning played a minor role (see Figure 2). No expertise-related differences were found in the amount of mentioned medical, social and administrative activities. Teaching and learning-related activities were most frequently reported by experts and novices ($H(3) = 6.62$, $p < .01$). Hypothesis 2.1a applied to experts who mentioned all types of activities but not to students who, contrary to the initial assumption, recognized medical, social and administrative activities like more experienced individuals. Moreover, in line with hypothesis 3.1b novices reported a high amount of teaching and learning activities.

Meeting the initial expectation (hypothesis 3.2), novices also mentioned more non-demanding activities not linked to ward round goals than individuals on higher expertise stages ($H(3) = 9.74$, $p = .02$).

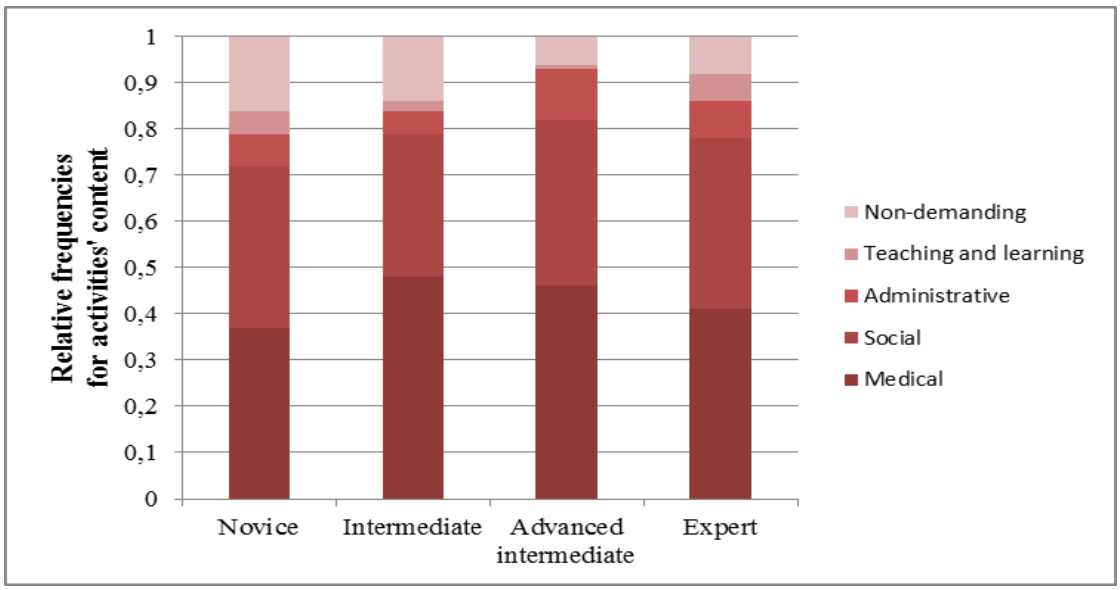


*Figure 2*: Relative frequencies for the content of activities named by the different expertise groups.

#### 7.6.2.3 Expertise-related differences in understanding scriptlets' potential for knowledge construction (RQ3)

As it was unclear whether and to what extent individuals recognize ward round as encounter for knowledge construction, the question aims at identifying how individuals of different expertise stages differ in perceiving scriptlets' potential for knowledge construction considering the four modes interactive, constructive, active and passive. Based on prior findings, a high amount of interactive and passive scriptlets was regarded likely for both experts (hypotheses 3.1a and 3.1b) and novices (hypotheses 3.2a and 3.2b).

Overall, 36% of the mentioned scriptlets were constructive, 33% were active, while 21% were passive and another 10% were interactive (Figure 3). No expertise-related differences could be found in the amount of interactive ($H(3) = 5.30$, $p = .92$) and constructive ($H(3) = 5.19$, $p = .16$) scriptlets. Significant differences were only found for active ($H(3) = 9.71$, $p = .01$) and passive ($H(3) = 18.25$, $p < .01$) scriptlets: advanced intermediates stated significantly more active scriptlets than novices ($U =$

38.00, $p$ = .01); and novices reported significantly more passive scriptlets than intermediates ($U$ = 23.00, $p$ < .01), advanced intermediates ($U$ = 18.50, $p$ < .01) and experts ($U$ = 33.50, $p$ < .01). These results confirm hypotheses 3.1a and 3.2a which anticipated a high amount of higher level scriptlets for experts and an emphasis on passive scriptlets among novices.

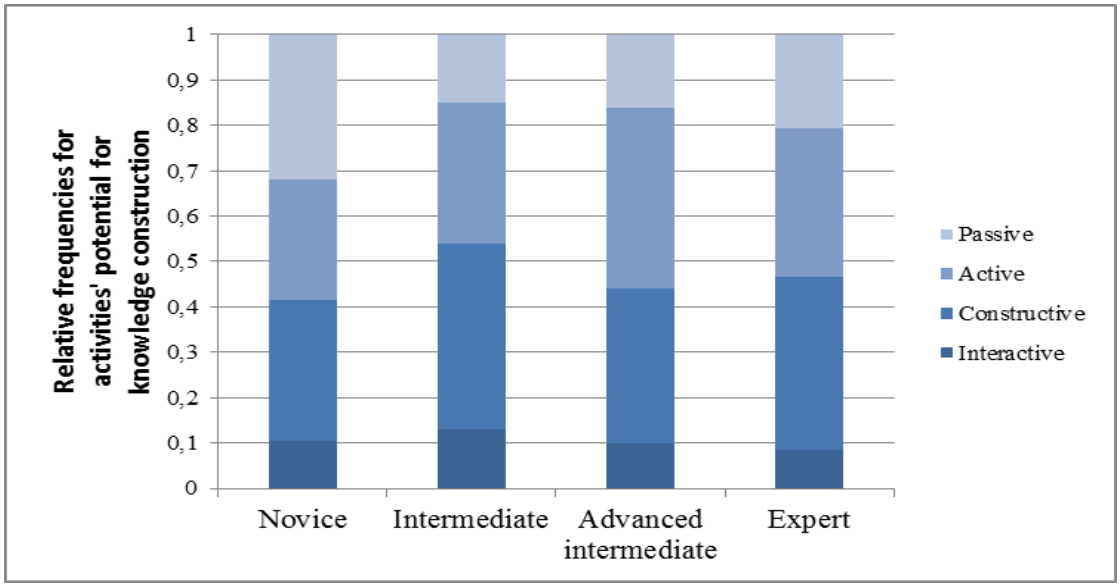


*Figure 3*: Relative frequencies for interactive, constructive, active and passive activities for the different expertise groups.

#### 7.6.2.4 Expertise-related differences in understanding the medical roles involved in ward rounds (RQ4)

It was asked how medical students and individuals at higher stages of expertise understand the medical roles involved in ward rounds and examined the scriptlets assigned to these roles. An emphasis was put on the roles "medical student" and "resident" which are the current and the prospective roles of 3rd year medical students. Scriptlets' content and potential for knowledge construction were considered for analysis. Group comparisons were made accounting for expertise group and medical role.

Scriptlets assigned to third year medical students were mostly social (50%). Also, a high amount of non-demanding scriptlets (17%) were assigned to this role. Interviewees also attributed a high amount of social (23%) scriptlets to this role. Moreover, a comparably small amount of administrative (5%) and teaching and

learning (6%) scriptlets was attached to 3rd year medical students. Kruskal-Wallis tests revealed expertise-related differences in terms of non-demanding ($H(3) = 9.735$, $p = .02$) and medical ($H(3) = 8.76$, $p = .02$) content: in line with the initial assumption (hypothesis 4.1), novices attached significantly more passive scriptlets to their own role than more experienced individuals ($U = 28.00$, $p = .02$). No expertise-related difference between groups was found for social content. In contrast, group comparisons revealed expertise-related differences for scriptlets of medical content ($H(3) = 8.76$, $p = .02$): experts attached significantly more medical scriptlets to the 3rd year student's role compared to novices ($U = 14.50$, $p < .01$), see Figure 4.

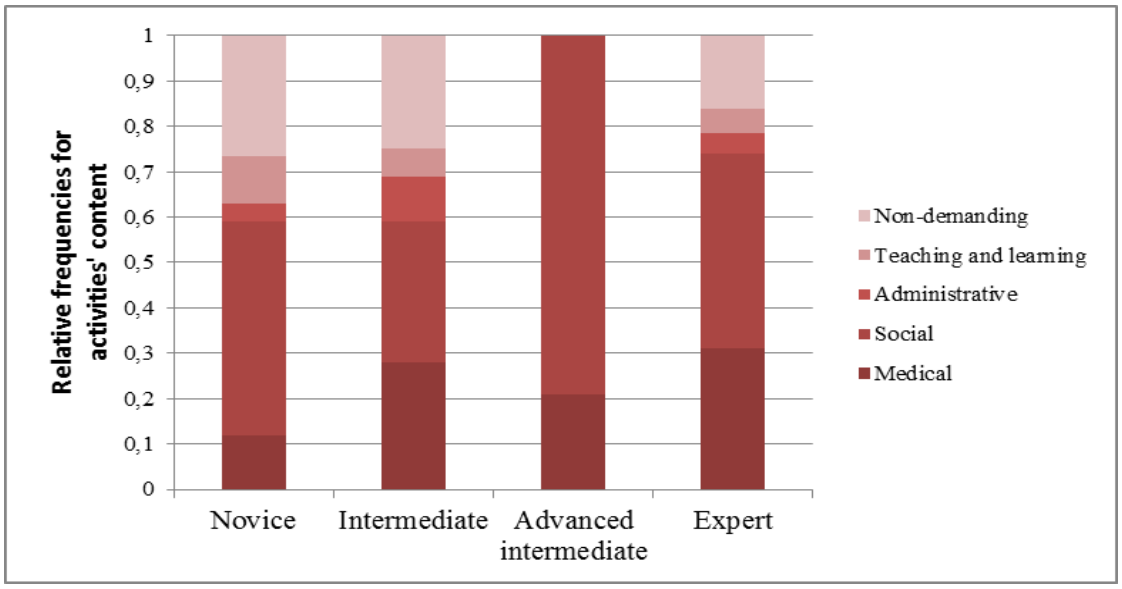


*Figure 4*: Relative frequencies for activities' content as mentioned for the role "medical student, third year" by the different expertise groups.

Considering scriptlets' potential for knowledge construction, the role "3rd year medical student" was characterized by a high amount of passive scriptlets (57%), followed by constructive (20%), active (19%) and a small amount of interactive (3%). Confirming hypothesis 4.4, group comparisons revealed that novices mentioned significant more passive scriptlets than experts ($U = 14.00$, $p < .01$), see Figure 5.

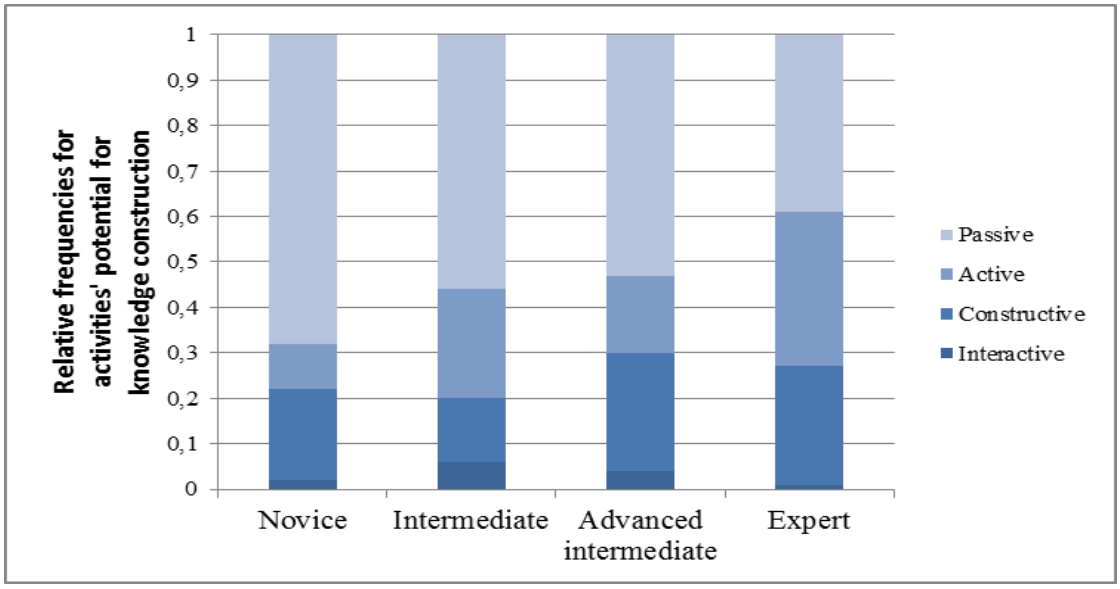


*Figure 5*: Relative frequencies for activities' potential for knowledge construction as mentioned for the role "medical student, third year" by the different expertise groups.

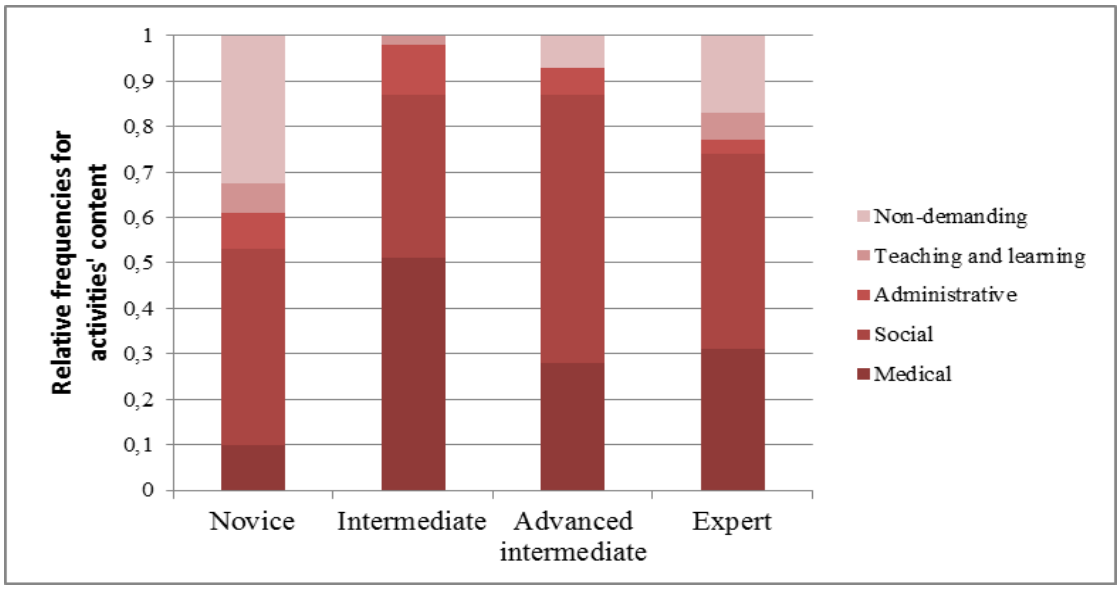


*Figure 6*: Relative frequencies for activities' content as mentioned for the role "medical student, final year" by the different expertise groups.

The role "final year medical student" was characterized by a high amount of medical (46%) and social (31%) scriptlets followed by non-demanding (13%), administrative (8%) and teaching and learning (4%) related scriptlets, see Figure 6. No expertise-related differences were identified for scriptlets' content. Considering

scriptlets' potential for knowledge construction, interviewees demonstrated a high variance in terms of interactive (range: 38 to 59%) and passive (0 to 32%) scriptlets, see Figure 7. Group comparisons revealed that novices regarded this role significantly more passive than experts ($U = 36.50$, $p < .01$).

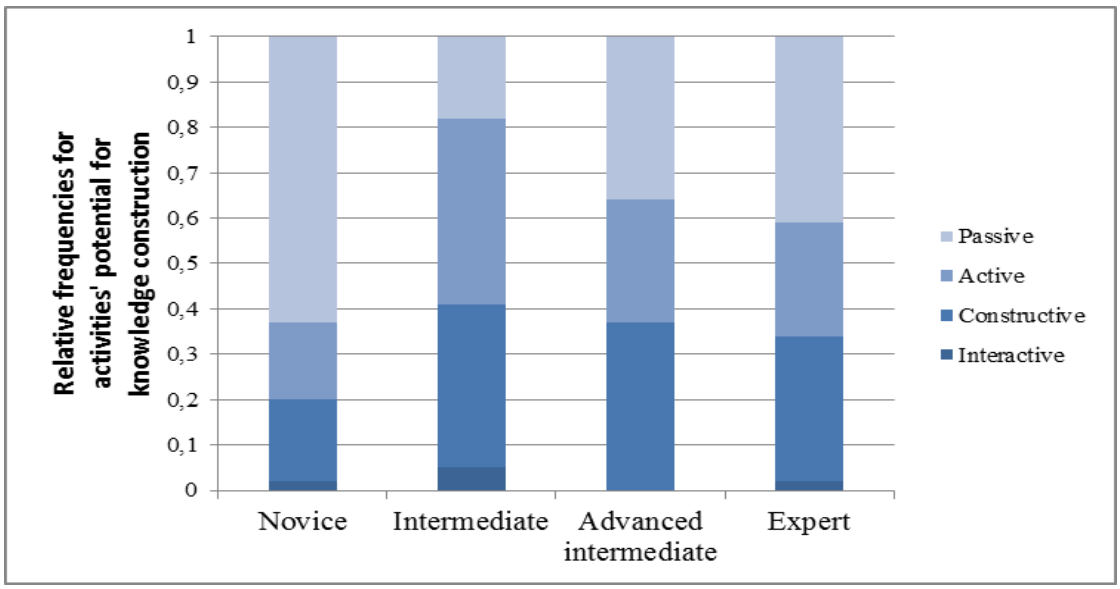


*Figure 7*: Relative frequencies for activities' potential for knowledge construction as mentioned for the role "medical student, final year" by the different expertise groups.

A high amount of medical (50%), social (30%) and administrative (12%) scriptlets was found for the role "resident". Only 5% of scriptlets were assigned to non-demanding and 4% to teaching and learning content, see Figure 8. Contrary to the initial assumption, scriptlets of social, administrative and non-demanding content did not differ across groups. Differences were only found in terms of medical content ($H(3) = 7.98$, $p = .05$): intermediates mentioned significantly more medical scriptlets for the role "resident" than novices ($U = 9.00$, $p = .02$) and advanced intermediates ($U = 13.00$, $p = .01$). Referring to scriptlets' potential, interviewees attributed mainly passive (38%), active (35%) and constructive (35%) and only mentioned few (16%) interactive scriptlets to this role, see Figure 9. No significant differences were found between expertise groups.

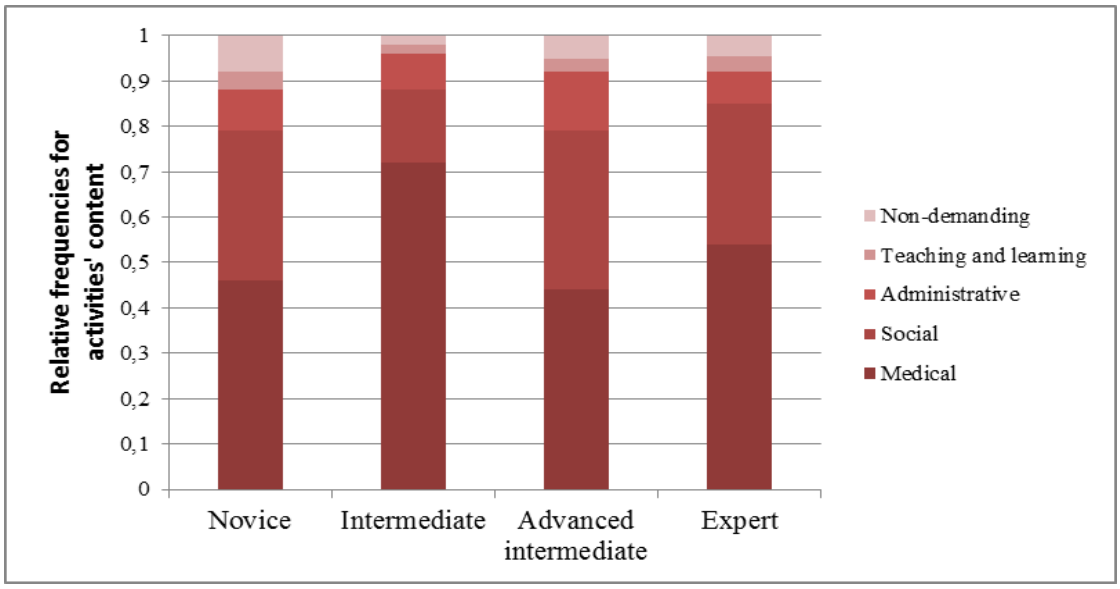


*Figure 8*: Relative frequencies for activities' content as mentioned for the role "resident" by the different expertise groups.

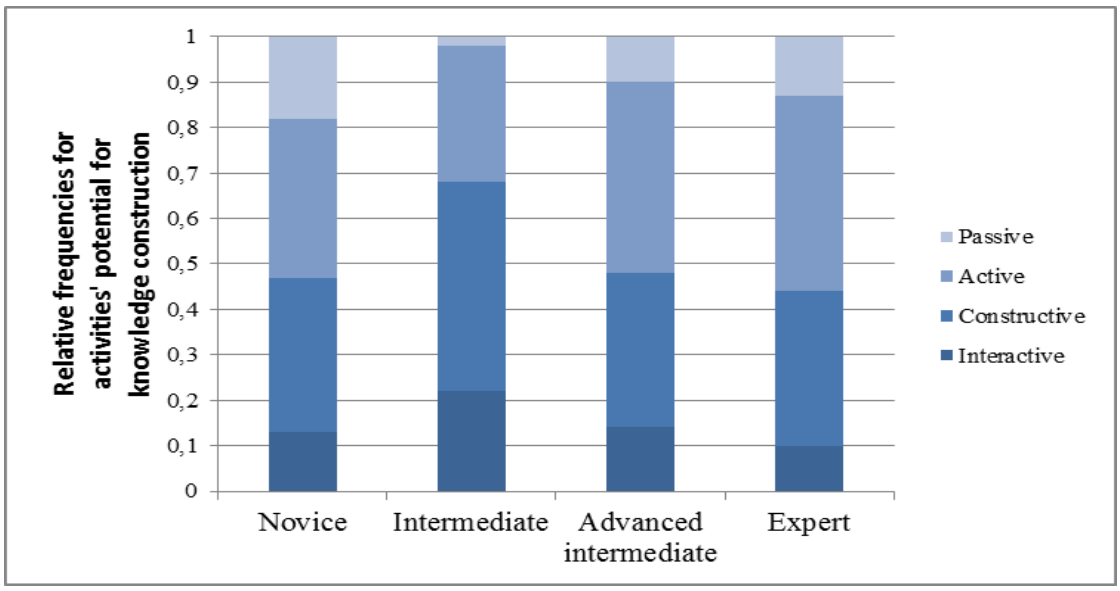


*Figure 9*: Relative frequencies for activities' potential for knowledge construction as mentioned for the role "resident" by the different expertise groups.

The role "ward physician" is characterized by a high amount of medical (51%) and social (32%) activities. Individuals mentioned comparably few administrative (8%), teaching and learning (6%) and non-demanding (4%) scriptlets. Contrary to hypothesis 4.2 no expertise-related differences were detected in terms of medical,

social, administrative and non-demanding scriptlets. However, consistent with hypothesis 4.3 both novices ($U$ = 4.00, $p$ < .01) and experts ($U$ = 12.00, $p$ = .02) recognized significantly more teaching and learning scriptlets for this role than intermediate groups.

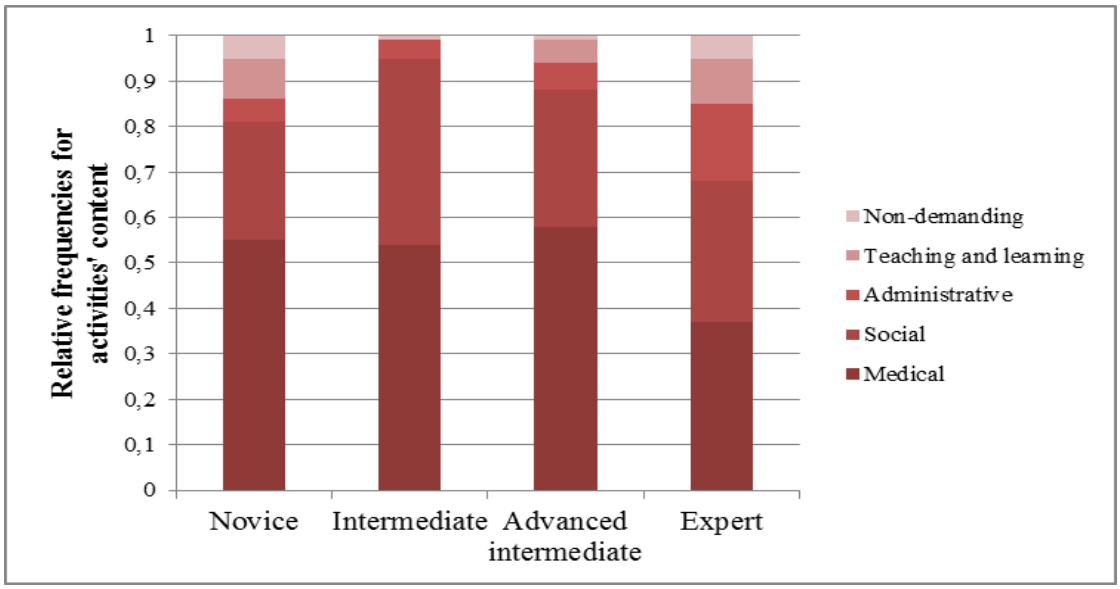


*Figure 10*: Relative frequencies for activities' content as mentioned for the role "ward physician" by the different expertise groups.

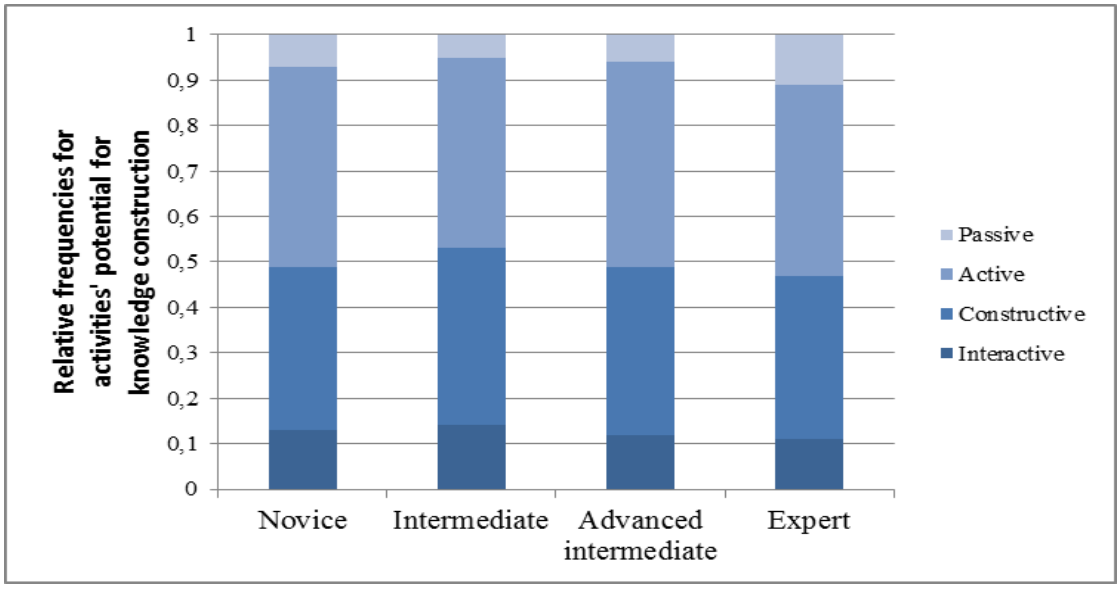


*Figure 11*: Relative frequencies for activities' potential for knowledge construction as mentioned for the role "ward physician" by the different expertise groups.

This role is also marked by a high amount of active (43%) and constructive (37%) scriptlets followed by interactive (13%) and passive (7%) scriptlets. Group comparisons did not indicate expertise-related differences.

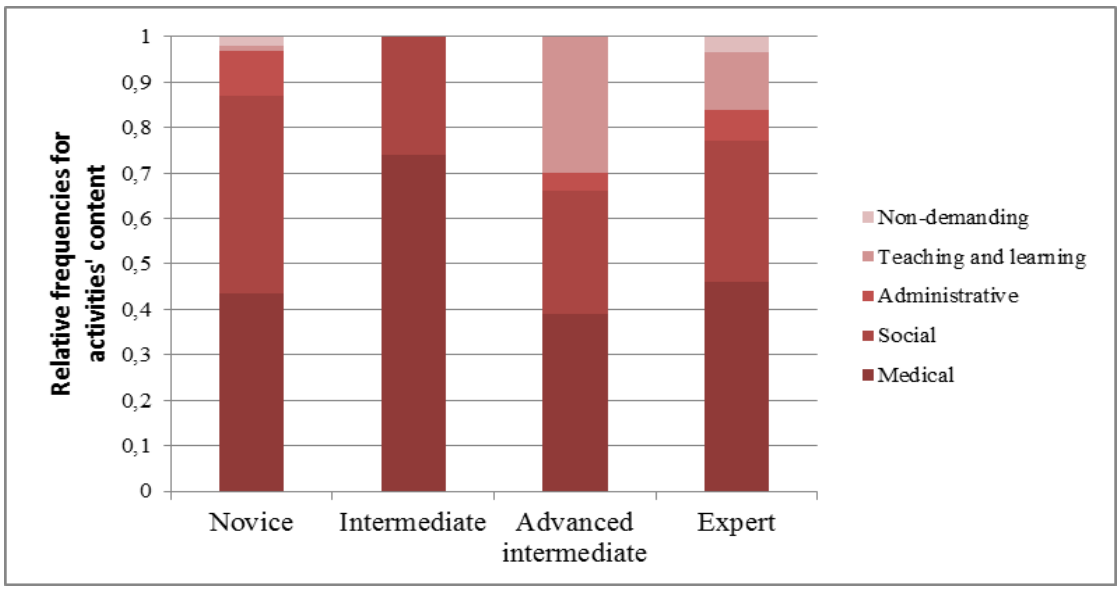


*Figure 12*: Relative frequencies for activities' content as mentioned for the role "senior physician" by the different expertise groups.

Similar to the role "ward physician", the role "senior physician" is attached to mainly medical (51%) and social (32%) scriptlets followed by scriptlets of teaching and learning (11%), administration (5%) and non-demanding (2%) content, see *Figure 12*. Conflicting the initial assumptions (hypotheses 4.1-4.3), no expertise-related differences were determined. The amount of interactive, constructive, active and passive scriptlets resembles those of the role "ward physician", see Figure 13. Group differences were not found for this role.

It became visible that, in line with hypothesis 4.5, roles with a high amount of professional experience (resident, ward physician, senior physician) were attributed to an increasing amount of interactive, constructive and active scriptlets while roles with limited professional experience (medical students in their third or final year) were characterized by a high amount of passive scriptlets.

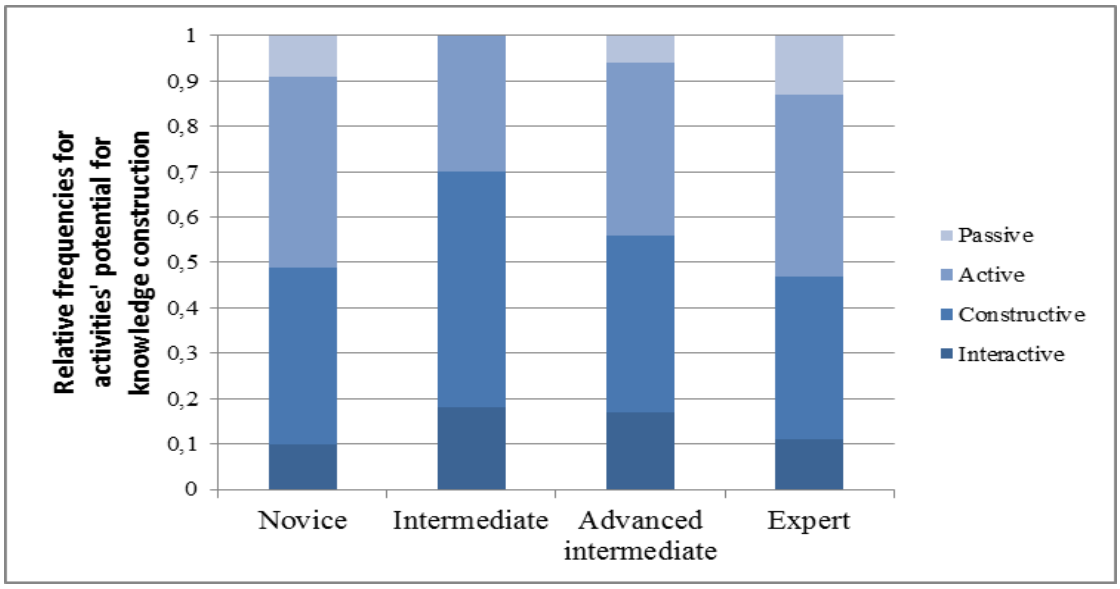


*Figure 13*: Relative frequencies for activities' potential for knowledge construction as mentioned for the role "senior physician" by the different expertise groups.

## 7.7 DISCUSSION

### 7.7.1 Discussion of results

This study aimed at measuring ward round scripts of medical students and physicians at different stages of expertise referring to Schank's (1999) script concept. Therefore, an interview study with $N = 50$ participants was performed referring to the structure formation technique (Scheele, & Groeben, 1988). This technique allowed illustration of underlying ward round scripts already in the course of the interviews. A high acceptance and feasibility of this technique proved this technique a valuable method for capturing individuals' scripts. The Script Theory of Guidance (Fischer et al., 2013) which differentiates between the script components roles, scenes and scriptlets was applied to structure both interviews and data analysis. Thus classification proved a valuable guide for this study. Analysis of both the ward round sequence and mentioned scriptlets was performed. For the last-mentioned component, I differentiated the potential for knowledge construction that mentioned activities provided referring to Chi's (2009; 2011) framework of overt learning activities. Also, the content of activities that represent the ward round goals (1) providing treatment to the patient, and (2) education was differentiated.

Consistent with prior ward round research (e.g. Herring et al., 2011; O'Hare, 2006), the analysis of the role component revealed a heterogeneity of roles that were recognized as typically participating in rounds. While the roles "ward physician", "resident", "medical student" and "nurse" were mentioned most frequently, the role "patient" was neglected by most interviewees. It is plausible to assume that the interviewees took this role for granted or that they assumed that the interview only referred to the ward round team and thus disregarded this role. Analysis also revealed that novices mentioned their role "medical student" significantly more often than individuals at higher expertise stages. This is not surprising as students have never experienced ward rounds without themselves while individuals at higher expertise would not perceive medical students as typical members of the ward round team.

When examining the scene component, it became evident, that individuals across all expertise stages used three approaches to storing their ward round knowledge. Against prior studies (e.g. Nievelstein et al., 2006), the usage of one approach could not be explained by the amount of individuals' professional

experience. Instead, individual preferences may be the reason for this result. The analysis of the scene component also revealed that ward rounds are regarded as consisting of the three phases "discussion of patient in front of patient's room", "consultation of patient", "debriefing in front of patient's room" that were repeated for each patient. Pre- and post-round in the physicians' or nurses' room were not regarded as typical phases of the ward rounds. One explanation could be that organizing ward round knowledge in these cycles is more simple and economic than additionally considering also aspects that do not directly contribute to seeing and treating single patients. To a great extent, consensus was found regarding the sequence of the ward round scenes. Individuals of all expertise groups recognized eight key scenes indicating a high amount of shared knowledge between individuals at different expertise stages. The only exception is the scene "physical examination". Nomination of this scene increased with growing ward round experience. This result indicates that novices do not yet understand the relevance of focused examinations of the patients in the course of the ward round and lack strategic knowledge (Eteläpelto, 2000). The number of mentioned scenes shows a U-shaped development. Such intermediate effects were also detected in previous studies (e.g. Boshuizen, & Schmidt, 1992; Breckwoldt et al., 2014) and point to a reorganization in knowledge which might be due to professional development and training that result in the integration of new strategies and knowledge but may also lead to a temporary deterioration of performance.

In summary, scripts between individuals of different expertise groups are very similar on a structural level which conflicts with prior assumptions from both expertise and script research that pointed that scripts develop through experience and repeated exposure with a situation (Fischer et al., 2013; Kolodner, 2007; Schank, 1999; Schmidt, & Rikers, 2007; van de Wiel et al., 2000). One would have expected novices' scripts to be rather fragmented while more experienced individuals were assumed to possess scripts characterized by a more abstract knowledge organization (Nievelstein et al., 2008; van de Wiel et al., 2000). One could reason, that - on a scene level - the complexity of ward rounds is rather low. Already a limited number of observations of and participation in ward rounds or watching TV programs (e.g. House, Scrubs) may have led to vicarious learning (Baum, Li, & Usher, 2000; Stegmann, Pilz, Siebeck, & Fischer, 2012) of the typical course of the ward round.

When examining the scriptlets mentioned by interviewees, two levels of complexity were identified: high and low. Contrary to prior studies (Nievelstein et al., 2008) no expertise-related differences were found in the use of either scriptlets of high or low complexity. Already, novices were capable of organizing their ward round knowledge in more abstract terms instead of just describing observable operations. One of the reasons might be that some of the mentioned scriptlets, such as "physical examination", are not ward round specific but are also relevant for other medical encounters (e.g. admission interview, history taking) or imparted in classes of the medical curriculum (e.g. patient-oriented communication; patient presentations). Novices thus may have a respective script that gets activated also in the course of the ward round and enables them to organize their knowledge on a higher level which resembles that of more experienced individuals.

In line with prior assumptions, experts mentioned activities that referred to both ward round goals indicating a multifaceted understanding of ward rounds and responsibilities of physicians (Frank, 2005). Also, novices emphasized activities of teaching and learning content. One may assume that due to their role in medical education, they understand ward rounds as an encounter for education and professional development (Claridge, 2010). Intermediates in contrast mainly mentioned activities tied to providing care to patients. As aforementioned, their growing responsibility for the ward may be the reason. While the activities of the aforementioned groups could be linked to one or both ward round goals, novices put an emphasis on social activities. These activities are not only relevant for ward rounds but also further medical encounters. Their small impact on medical and social activities may be due to their limited strategic or unifaceted understanding and the limited amount of professional experience (Dall'Alba, 2002; 2004; Eteläpelto, 2000). In line with this finding, analysis revealed that novices mentioned significantly more non-demanding activities that could not be linked with any ward round goals (e.g. open the door). Similarly, already Berliner (1987, 2000) and Eteläpelto (2000) previously highlighted that novices show deficits in their professional vision and do not understand the relevance of particular activities. Moreover, novices' deficient professional understanding may be an explanation for this result.

Another level of analysis strived for answering the question as to whether individuals perceive ward rounds as encounter in which knowledge construction

takes place. The high amount of passive activities as mentioned by novices points out that these individuals do not understand ward rounds as relevant for knowledge construction processes. Coupled with their aforementioned emphasis on non-demanding activities, this result implies that novices lack understanding as to the relevance and complexity of ward rounds (Dall'Alba, 2002; Eteläpelto, 2000) but stress those activities that they are familiar with. Professional experience goes in line with a decrease in the amount of passive scriptlets and an increase in activities with a higher value for knowledge construction. It is likely that individuals with a higher amount of professional experience appreciate the collaborative character of ward rounds and understand ward rounds as an opportunity for knowledge construction (Reeves et al., 2009).

The next group of research questions aimed at identifying the types of activities assigned to the medical roles involved in ward rounds. Again, (1) the content of activities and (2) activities' potential for knowledge construction were distinguished. Examination of the medical roles revealed a shared understanding of the roles "resident" and "ward physician" in terms of both content and potential for knowledge construction between the different expertise groups. These roles were recognized as performing activities that are particularly relevant for providing care to patients as reflected in a high amount of medical, social and administrative activities. Constructing knowledge both individually and with the ward round team seems to be essential for this role when it comes to planning and adjusting treatment. Teaching and learning activities were only rarely connected with this role.

In contrast, the role "senior physician" was also understood to be strongly involved in teaching and learning activities. Experts and novices especially placed an emphasis on teaching and learning activities for this role while the intermediate groups did not assign these kinds of activities to the senior physicians' role. When considering the role "medical student, 3rd year", it became apparent that novices linked their own role more strongly with non-demanding activities (e.g. open the door, stand around, look friendly) than individuals at higher expertise stages. Similarly, novices understood their own role as mainly passive and neglected the potential for contributing to processes of knowledge construction. Likewise, novices recognized the final year students' role as mainly passive.

The origin of differences in mentioned ward round scripts should be the subject of further debate. Prior experience with ward rounds is certainly a crucial aspect for script development (Fischer et al., 2013; Kolodner, 2007; Schank, 1999) and guides individuals' understanding of the overall situation as well as that of the roles involved in ward rounds. Further, it explains differences in ward round scripts between individuals at different expertise stages. Experts' ward round scripts appear to be stable and multifaceted since they acknowledge both goals of ward rounds and regard medical students as active participants. Novices' scripts, however, are based on only little professional experience with ward round situations. Their understanding of ward rounds may be a result of prior experience with ward rounds that only place little emphasis on teaching and learning processes. These insufficient and unifaceted scripts may themselves contribute to students' little involvement in ward rounds. As a result, medical students may experience ward rounds as a very passive encounter in which they only "stand around and look friendly" instead of contributing to knowledge construction processes which finally results in lower learning. Besides, individuals' scripts may impact students' active participation in ward rounds. First, ward rounds are very complex both in medical knowledge relevant for solving problems as well as in features of the round such as the ever changing team compositions, interprofessionalism, time pressure, and the necessity to make quick decisions (Liu, Manias, & Gerdtz, 2013; O'Hare, 2008; Weber et al., 2007; Weber & Langewitz, 2011). While some students may recognize opportunities for engaging themselves in ward round processes, steep hierarchies (Stanley, 1998; Walton, & Steinert, 2006) may cause anxiety and hinder students' participation due to fear of negative consequences in case of uncertainty or incorrectly answered questions.

While experts' scripts show that students' active participation is expected and appropriate at different points of the ward round, it should also be desired to empower students to actively engage in ward rounds. This would contribute to both their learning processes and outcomes (Melo Prado et al., 2011) as well as the satisfaction of the ward round team (Hoellein, 2007). Aside, students contribute to patient satisfaction (Lowe, Kerridge, McPhee, & Hart, 2008) when integrated as a proper member of the ward round team (Seiden, Galvan, & Lamm, 2006). Supporting medical students to recognize learning opportunities and to actively

engage in ward rounds thus seems to be an essential need which should be addressed in daily professional practice to enhance learning outcomes. Further, medical students should be supported in identifying information relevant for the ward round so that they are able to shift their attention to important details that directly contribute to ward round goals. Structured training could contribute to medical students' script development and facilitates both their understanding of and behaving in ward rounds. However, in addition to medical students also residents seek support. Their scripts were found to neglect teaching and learning as part of the ward round. This group of medical professionals also needs to be pointed to opportunities to incorporate students in ward rounds efficiently.

### 7.7.2 General discussion

This study provides a sound theoretical frame for ward round research. It particularly referred to script theory and expertise research to illustrate individuals' understanding of the ward round process. The script theory of guidance (Fischer et al., 2013) provided components that rendered classification of ward round processes possible and consequently offered a means to compare individuals' ward round understanding as conceptualized through the script concept (Schank, 1999). Goals of scripts as operationalized by the activities' content and potential for knowledge construction were assessed to obtain a comprehensive understanding. Assuming that the structure formation technique proves a way for measuring individuals' underlying ward round understanding, one can expect that gained data represent typical ward rounds at the local university hospital.

Comparisons of ward round scripts were made by referring to insights from expertise research. Participants were grouped to represent expertise stages that individuals would pass on the way from novice to expert: novice, intermediate, advanced intermediate, expert. An individuals' function at the university hospital as well as their amount of professional experience was used to assign individuals to one of these four stages. It was assumed that a higher amount of professional experience results in higher stages of expertise (Ericsson, 2006). These four stages represent the gradual development of clinical expertise which goes in line with advances in knowledge organization (Schmidt, & Boshuizen, 1993). While prior research on expertise mainly focused on declarative knowledge (e.g. Chi et al., 1991; Ericsson, 2006; Gruber, 1990; Schmidt, & Boshuizen, 1993), this study examined situational

understanding and thus the capability to grasp complex professional situations in a hospital, such as ward rounds. Through mapping the development of ward round scripts across different expertise stages, it was possible to identify how novices' scripts differed from those of more experienced individuals and in which aspects they needed to be supported to finally acquire comprehensive ward round scripts.

With these results, this study adds to research on ward rounds as well as to that of scripts and expertise and provides a substantial contribution to these branches of research. Implications for teaching practice and the advancement for theory and methodology are illustrated in the following sections.

### 7.7.3 Limitations

While this study provides advances in both ward round and script research, this study faces some limitations going back to the applied method, study participants and expertise-related grouping of the sample.

The study was conducted with physicians and medical students who worked or studied at various wards in internal medicine of one institution - namely the university hospital Munich - to capture individuals' ward round understanding. Participants of different professional experience from different fields of internal medicine and both locations of the local university hospital were included to account for subject-related characteristics of ward rounds and to increase generalizability of results while not only illustrating one core area of internal medicine. This study thus provides insight into the typical structure of ward rounds as perceived by physicians and medical students and contributes to answering the question on whether ward rounds are used and understood as educational encounters. While the study detected recurrent patterns of ward rounds which are consistent with other current studies performed in different fields of medicine (Vietz, in prep.; Wölfel, Beltermann, Lottspeich, Vietz, Fischer, & Schmidmaier, 2016.), one has to consider that individuals' ward round scripts certainly are shaped by the culture of a ward and thus differ between the different subjects of internal medicine. Transferability to hospitals that are not directly engaged in medical education such as peripheral hospitals cannot easily be assumed as system-related differences exist. Wölfel and colleagues (2016) for example found that ward rounds performed at peripheral hospitals are usually conducted by only one physician without any student participants. These structural differences in team composition which were already found in prior studies (Claridge,

2011; O'Hare, 2008) are likely to impact ward round scripts and especially scriptlets that are performed by the different members of the ward round team. The study's emphasis on ward rounds conducted at a university hospital that is strongly involved in medical education is also assumed to influence scripts in favor of the educational purpose of ward rounds. This bias may also explain why - against prior research (Herring et al., 2010) - senior physicians who make the expert group especially placed such an emphasis on teaching and learning on the ward. They are all engaged in medical education and hold a position as module representative and limit transferability to other non-university hospitals. Thus their strong emphasis on educational activities is not surprising.

Another limitation related to the sample concerns the sample size. This study included 50 participants spread across four expertise groups. While data saturation was reached and differences between expertise groups were found, deeper analysis of data indicated a need for a higher sample size that would have facilitated more fine grained analysis of mentioned scenes and of role-specific activities. The small sample size and variability of data within groups limited the options for performing sequential analysis of mentioned scenes. Analysis was thus mainly tied to nonparametric statistics and was performed across all groups. Similar difficulties were found for role specific analysis between groups. Due to variances both within and between groups, comparisons were only made for those roles that were reported in a sufficient frequency. Other roles such as nurses and patients could not be included in the analysis. Future studies should include more participants to facilitate deeper analysis of both the scene component and role comparisons.

Analysis of the students' role also indicated that this role is highly dependent on the leading physician and cannot be assumed to act autonomously. Interpretation of the student role thus should always occur in light of this dependency. Possible future instructional interventions should thus not only target medical students but also physicians who are responsible for conducting the rounds and may use different approaches for including medical students in the ward round process.

Expertise theory was used to classify the study sample. Building on prior findings (e.g. Alexander 2003), it was assumed that clinical expertise is dependent on the amount of professional experience and the amount of clinical expertise is reflected in individuals' scripts. Thus, individuals were grouped according to this

criterion which also reflects individuals' function in the hospital. No further criterion such as assessment of ward round performance was used to assess the availability of a specific skill or knowledge. It is likely, that this grouping procedure impacts the results found in this study. Data analysis for example indicated that senior physicians - who make up the expert group - participate in ward rounds on an irregular basis. Per definition, this lack of practical experience indicates that this group of physicians does not practice deliberately anymore which conflicts underlying assumptions from expertise research. Furthermore, as was pointed out in Chapter 4, expertise does not necessarily follow a gradual development. Intermediate effects which also occurred in this study may be due to a shift in individuals' knowledge organization which temporarily results in a deterioration of performance (Breckwoldt et al., 2014; Schmidt, & Rikers, 2007). As the development of expertise and especially deliberate practice is highly dependent on the individuals' motivation, not every individual achieves the stage of expertise even though he or she would be assumed to do so according to the amount of professional experience. Instead, individuals may stagnate or even decrease in a level of performance that is sufficient to conducting ward rounds efficiently (Ericsson, 2006). An external criterion that facilitates the relocation of individuals to expertise groups is required.

Contrary to the initial assumptions, this study did not contribute to the development of a golden standard for ward rounds. A prototypical sequence of the ward round process could be identified. The question of what constitutes a good ward round script on a more sophisticated level remained open. It thus remains unclear, which scripts are most promising for understanding ward rounds properly and to conducting them successfully or which script contributes most to student learning. Based on prior studies (e.g. AlMutar et al., 2013) it can be assumed that scripts that mainly consist of activities bound to one or both ward round goals instead of a high amount of non-demanding activities are more effective for conducting ward rounds properly. Moreover, building on Chi's studies (2009; 2011), it is likely that students who recognize a high amount of interactive activities learn better than students who regard ward rounds as rather passive encounter. Performance evaluation in authentic ward round environments is needed to assess the effectiveness of different scripts in practice. Combining both performance and interview data might provide hints to address these issues. Qualitative content

analysis of verbal protocols (e.g. Mayring, 2005; Wengraf, 2002) that goes beyond the classification of components of ward round scripts may add to the gained results. Possible research questions may target the kind of knowledge used by individuals of different expertise stages for mapping ward rounds (e.g. descriptions vs. explanations; Berliner, 2001) or to assess characteristics of different ward round types.

### 7.7.4 Implications for teaching practice

Ward rounds have been regarded as a valuable teaching and learning encounter. Prior studies (e.g. AlMutar et al., 2013; Claridge, 2011; Ker, Cantillon, & Ambrose, 2009; Nikendei et al., 2007) mainly identified resistances that go back to features of medical educators or the system and suggested improving these aspects to increase learning. In contrast, the reported study put an emphasis on student-related features that hinder learning, such as deficient ward round scripts. The study suggests that students should be supported in (1) increasing their active engagement, (2) identifying information crucial for ward rounds and (3) understanding the structure of the ward round properly. It is especially important to strengthen students' ability to recognize learning opportunities during the course of the ward round in order to enhance clinically relevant knowledge, tie this knowledge to the practically relevant situation (Schmidt, & Rikers, 2007) and, finally, foster students' ability to conduct ward rounds themselves as part of their professional life (e.g. Krautter et al., 2014; Nikendei et al., 2007; Norgaard et al., 2004). As previously mentioned, prior experience with ward rounds may also shape future physicians' behavior and result in ward rounds which are characterized by active engagement of students, interactivity and integration of all participants of the ward round team. This would not only refer to students at different phases of their studies, but also nurses and professionals of other professions and might lead to a decrease in discrepancies reported in prior ward round research (Hill, 2003; Weller, Barrow, & Gasquoine, 2011). Structured training for preparing students could be integrated at an early point into the medical curriculum to allow students to transfer their learning into a practical context such as clerkships (Approbationsordnung für Ärzte, 2002).

Building on the assumption that scripts evolve from repeated exposure with a situation (Fischer et al., 2013; Schank, 1999), students should be provided with multiple opportunities to acquire relevant knowledge and skills for conducting ward

rounds. Structured training as part of their medical studies would be one possibility. One promising approach refers to simulation-based training with the optional use of standardized patients (e.g. Ker, Hesketh, Anderson, & Johnston, 2006; Nikendei et al., 2007; Weller, 2004). Simulation provides an authentic encounter for students to engage in clinical practice without using live patients. Learning is especially fostered by a subsequent debriefing and feedback that initiates reflection processes (Issenberg et al., 1999; McGaghie, Issenberg, Petrusa, & Scalese, 2010). In performing ward rounds themselves, students may acquire ward round scripts and increase their role understanding. Additional instructional support through external scripts (Weinberger et al., 2005) or prompts (e.g. Davis, 2003; Ge, & Land, 2003) provided by the teacher can serve as means of structuring learning and script development. This instructional support should target relevant information or tasks performed by physicians as well as teaching and learning opportunities that different phases of the round provide. Educational questions that are asked in these scenarios may especially prepare medical students for future interrogations by physicians and decrease anxiety.

While simulations provide a vast potential for supporting students, there are more economical approaches for medical faculties with a high number of students. Computer-supported learning is one such option. Teacher education has already made use of computer-supported learning with video to support future teachers in acquiring knowledge about complex professional activities (e.g. Blomberg et al., 2014; Borko et al. 2008; van Es, & Sherin, 2009). Videos of typical ward rounds of varying complexity can be used to discuss observable ward round behavior. The additional use of instructional aids such as prompts serves structured learning and allows shifting their attention to aspects crucial for a situation. This does not only include role specific activities but also information on the scene level. Moreover, video may serve as a role model (Seidel, Stürmer, Blomberg, Kobarg, & Schwindt, 2011), vicarious learning may occur (Stegmann et al., 2012), and students may transfer observed behavior to future ward rounds.

While both simulation- and computer-based learning environments provide opportunities to acquire knowledge and skills without real patients, students should be encouraged to also attend real professional encounters on the ward through compulsory (Ärztliche Approbationsordnung, 2002) or voluntary clerkships. This

could occur both on and off the round. Patient contact outside ward rounds could decrease anxiety and offer students the opportunity to achieve knowledge about individual patient cases in a comfortable atmosphere. Participation in ward rounds could likewise increase their understanding of the ward round processes through embedding patients' history in a broader context. The results indicated that there is a need to also sensitize especially residents to the importance of teaching and learning on the ward. Fostering residents' awareness of ward rounds' potential for medical education is likely to increase student involvement and thus learning outcomes. Workshops could be offered to allow residents to discuss or experience different opportunities to adjust current ward round practice (Gonzalo, Chuang, Huang, & Smith, 2010).

As Melo Prado et al. (2006) recommended, also self-directed learning should be facilitated to attain medical knowledge. By using ward rounds as educational settings, students may gain a more realistic picture of the ward round and their future responsibilities as physicians.

### 7.7.5 Implications for research methodology and theory

Prior studies which aimed at assessing ward round practice used two main approaches. One approach emphasized observations or videos of ward round situations to assess ward round processes (e.g. Herring et al., 2011; Krauss et al., 2014; Liu et al., 2013; Walton, & Steinert, 2010; Weber et al., 2007) while another approach mainly used self-reports to measure individuals' perceptions of ward rounds (e.g. AlMutar et al., 2013; Claridge, 2011; Dahlstrom et al., 2005; Kelly et al., 2007). In contrast to these approaches, this study's origin lies in cognitive psychology and refers to individuals' understanding of typical ward rounds by referring to the script concept (Schank, 1999) which were externalized through an adjusted version of the structure formation technique (Scheele, & Groeben, 1988). The study's procedure allowed the extraction of individuals' underlying cognitions without biasing interviewees through directed questions e.g. on the role of teaching on the round which may have caused effects like social desirability.

The interview technique proved to be a valuable instrument that allowed individuals at different expertise stages to make their understanding of ward round processes explicit. In addition, experts who were reported to struggle in externalizing their (tacit) knowledge (Kinchin, & Cabot, 2010; McLeod et al., 2004) reported no

difficulties in participating in the interview. Graphical representation of the ward round process allowed a consent between both interviewee and interviewer and contributed to an economic analysis of data. However, interviewer effects could not be totally avoided and it is likely that the keywords noted on the cards slightly deviated from the originally mentioned terms. It would have been possible to let the interviewee note down the ward round process in his/her own words or to use a pre-defined set of concepts to let the interviewee arrange the ward round process on his/her own. However, in order to ensure comparability of data, we decided to utilize a standardized procedure organized in a two-dimensional matrix with the script components (Fischer et al., 2013) "roles" as one and "scenes" as the other axis, taking into account bias that could have occurred through forcing participants to follow this procedure. A questionnaire which was provided after the interviews accounted for acceptance of the applied technique. Interviews proved the remaining structure valid and corresponding to their understanding of typical ward rounds. Overall, interviewees also agreed on the feasibility of this technique especially under limited time.

Another possible bias refers to previous ward round experience. Ward round scripts are continuously shaped through exposure to ward rounds. Accordingly, it is possible that ward rounds that were performed in the morning deviated from the usual procedure and impacted interviews. In order to reducing this effect, it was underlined multiple times that interviews refer to patterns of typical ward round situations and not to those that stick most to individuals' memories.

In summary, the adapted structure formation technique does not only provide a valuable technique to map complex subjective theories individuals have, but also scripts. The simplified version was very promising as it did not make rules or signs necessary. In case of more complex concepts, the initial procedure of the technique might be more appropriate. Further studies referring to this adjusted technique are recommended to assess validity and transferability of the gained insights also to other domains.

From a theoretical perspective, the utilization of the script components as identified by the Script Theory of Guidance (Fischer et al., 2013) and Chi's (2009; 2011) framework of overt learning activities are an innovative procedure to capture individuals' understanding of complex situations like ward rounds. The script

components roles, scenes and scriptlets provided a sound basis to structure interviews and to classify ward rounds. Analysis of mentioned scriptlets however revealed, that mentioned scriptlets were characterized by two levels of abstraction that the script theory did not account for: scriptlets of high complexity such as "examining a patient" and scriptlets of lower complexity such as "measuring blood pressure". The results indicated that all individuals put an emphasis on scriptlets of high complexity. Further studies should take into account this differentiation to assess the necessity of adjusting the underlying theoretical framework.

The scriptlet component was further analyzed in terms of (1) content and (2) learning potential that individuals attribute to ward round activities. While prior research (e.g. Walton, & Steinert, 2010) did not utilize a sound theoretical basis for classifying ward round activities, a systematic review of prior research was performed for this thesis and activities were classified according to the content and the ward round goal they contributed to. The resulting dimensions referred to medical, social and administrative activities which are primarily linked to the goal of treating patients, and teaching and learning activities that contribute to the educational goal of ward rounds. A further dimension, non-demanding activities, accounted for activities that were not tied to the two goals. This first study proved the adequacy of these dimensions to capture ward round activities and contributes a theoretical framework for ward round research.

To assess activities' learning potential, Chi's (2009, 2011) overt learning framework was applied. This theory classifies observable learning activities shown in formal learning environments (e.g. lessons in school) regarding the cognitive engagement they evoke. This first study of the thesis proved that this framework could also be transferred to informal learning context. Professional activities were interpreted in light of their underlying cognitive processes they were likely to trigger and coded accordingly. While this framework originally referred to only observable activities, it did not account for thinking and reflection processes as higher level activities but as passive activities. This issue implies the necessity to extend the original framework for a category that reflects these non-observable cognitive activities. Despite this limitation, Chi's (2009) framework for overt learning activities provides a valuable classification of learning activities based on a sound empirical basis that prior studies (e.g. Walton, & Steinert, 2010) lacked.

For both levels of analysis, clear definitions and examples for all dimensions enhanced the coding procedure. Moreover, they ensured comparability of data and can be used for future studies. However, performance-based measures are recommended to fully assess appropriateness of the two types of classifications applied in this study. Combining both interview data and video data of authentic ward round situations may also answer the question of consistency of understanding of and behaving in ward round situations which comprise the two sides of a script.

# Chapter 8: Study 2 – Facilitating the development of medical students' ward round scripts through reflection prompts

## 8.1 CONTEXT

Ward rounds constitute a daily responsibility of physicians employed in a hospital. Despite their importance, medical curricula fail to prepare students for this duty and both medical students and junior physicians reported challenges in understanding and conducting ward rounds properly (Nikendei et al., 2008; Norgaard et al., 2006).

Referring to the script theory (Fischer et al., 2013; Schank, 1999), the previous study captured and analyzed medical students' ward round understanding regarding the course of ward rounds. In a second step, students' scripts were contrasted with those of more experienced individuals to identify deficits in students' scripts.

Comparisons revealed that medical students' scripts showed a high similarity on a superficial level. However, in-depth analysis of scenes revealed that students neglected physical examinations as inherent part of ward rounds. Moreover, analysis of the mentioned scriptlets showed that students perceived ward rounds as notably passive encounters in which higher levels of knowledge construction occur only rarely. Besides, students' scriptlets were characterized by a high amount of non-demanding activities indicating a lack in strategic understanding of ward rounds.

It suggests itself that medical student are in need of support to acquire proper ward round scripts that enable them to perform ward rounds properly once they are responsible for this duty.

Prior script research showed that script development depends on repeated exposure with a situation (Kolodner, 2007; Schank, 1999). Recent approaches (Fischer et al., 2013) pointed out that scripts are flexible in nature and can undergo changes. According to Fischer et al. (2013), insufficient scripts are responsible to failures which in turn initiate the reconfiguration of a script. However, the authors

did not consider the role of metacognitive processes such as reflection as significant influence on script development.

To provide students with the opportunity to acquire professional knowledge and to reconfigure their ward round scripts, insights from educational sciences were used and the relevance of case-based learning with videos of authentic professional activities was underlined (Blomberg et al., 2014; Borko et al., 2008; Sherin, & van Es, 2009). The implementation of sufficient support was recommended to make participation in such learning environments a valuable experience also for unexperienced students who may be challenged by the ill-structured characteristics that case-based learning environments provide. Guidance through instructional scaffolding thus was identified to be essential to increase learning success (Davis, & Linn, 2000; Hmelo-Silver, Duncan, & Chinn, 2007). One promising approach of instructional support is the use of reflection prompts which provide the potential to direct students' attention to relevant aspects of the ward round and initiate reflection processes (Bulu, & Pedersen, 2010; Davis, 2003; Demetriadis et al., 2008).

Two particularly promising prompts for encouraging students to consciously reconfigure their scripts are (1) *engagement reflection prompts* that direct students' attention to opportunities for engaging students into the ward round process to enhance knowledge construction and (2) *sequence reflection prompts* that shift students' focus on the process of the ward round.

The next section provides an overview on the aim of the second study as well as the research questions and hypotheses that are addressed.

## 8.2 AIM OF THE STUDY, RESEARCH QUESTIONS AND HYPOTHESIS

The aim of this study is to investigate the effect of instructional support on the development of medical students' ward round scripts in a computer-supported case-based learning environment using videos of typical ward round situations. More specifically, students are scaffolded through two kinds of reflection prompts: *engagement reflection prompts* and *sequence reflection prompts*. To answer the superior research question of how script development can be facilitated, the subsequent questions are addressed.

### 8.2.1 Effects of prompts on students' learning processes in the individual learning phase (RQ 1)

As mentioned in Chapter 5, prior research (Bulu, & Pedersen, 2010; Davis, & Linn, 2000; King, 1994; Quintana et al., 2004) showed that prompts hold the potential to shift learners' attention to situational characteristics. As a result, learners were found to show increased deliberate effort to identify relevant information for a situation and outperformed non-prompted students in their learning outcomes. In line with these findings, the groups around Demetriadis (2008) and Papadopoulous (2011) pointed to the significance of reflection prompts to increase students' cognitive activity while working on a task. Prompted students were found to spend more effort in a respective task resulting in a deeper elaboration of a solution for a given problem. The emerging first question for this study is:

*RQ 1: To what extent do engagement reflection and sequence reflection prompt influence students' learning processes in the individual learning phase?*

Consistent with this finding, differences are expected to be found in students' notes made during the individual learning phase.

It specifically is assumed that students who receive engagement reflection prompts concentrate on opportunities of how physicians may actively involve students in the course of the ward round. As a result, this group of learners is expected to achieve higher values for identified engagement opportunities than students who do not obtain this kind of prompt (hypothesis 1.1).

Students who obtain sequence reflection prompts are assumed to direct their attention to the process of the ward round and, consequently, to achieve higher scores for identified key scenes of the ward round than students who do not receive this kind of prompt (hypothesis 1.2).

Students who are prompted with both engagement and reflection prompts are expected to direct their attention to both educational opportunities and the sequence of the ward round, and are expected to achieve high scores for identified engagement opportunities as well as for identified key scenes (hypothesis 1.3).

### 8.2.2 Effects of prompts on script development (RQ 2)

Prompts were not only found to positively impact students' learning processes while working with case material, but also to shape learning outcomes. Students who obtained specific prompts were shown to direct their attention to the targeted aspects in a post-intervention test and were found to be able to both focus on relevant information and to apply appropriate and goal-oriented strategies for solving a problem (Demetriadis et al., 2008; Papadopoulus et al., 2011).

Prior studies mainly targeted problem solving strategies (e.g. Demetriadis et al., 2008). No comparable study has been performed for the development of scripts of a particular professional task such as ward rounds. The second research question thus is:

*RQ 2: To what extent can engagement reflection prompts and structure reflection prompts influence the development of medical students' ward round scripts?*

The transferability of prior results (e.g. Demetriadis et al., 2008) was assumed also on script development and that engagement reflection prompts would have an impact on individuals' expectations regarding ward round activities by considering both their content and their potential for knowledge construction. Moreover, it was expected that the implementation of sequence reflection prompts would impact individuals' expectations towards key scenes of the ward round.

Regarding the content of ward round scriptlets, it was hypothesized that students who are prompted to shift their attention to relevant situational characteristics mention fewer non-demanding activities than non-prompted students (hypothesis 2.1). Moreover, students who are prompted by engagement reflection prompts are assumed to shift their attention to educational opportunities in the ward round. As a result, they are hypothesized to report more teaching and learning activities than students who did not receive this prompt (hypothesis 2.2).

In terms of scriptlets' potential for knowledge construction, it is assumed that students who receive engagement reflection prompts increasingly recognize opportunities that contribute to knowledge construction. This group of students is expected to mention a higher amount of interactive and constructive activities

(hypothesis 2.3) and a smaller amount of passive activities (hypothesis 2.4) than students who receive sequence reflection prompts or no prompts at all.

Another emphasis is put on the question how the implementation of prompts shapes students' understanding of the sequence of the ward round. Sequence reflection prompts are used to shift students' attention to the ward round process. As a result, it is expected that students who receive this kind of reflection prompt mention more key ward round scenes than students who are not prompted in this regard (hypothesis 2.5).

Students who receive both kinds of prompts direct their attention to both educational opportunities and the ward round process. This group of students is assumed to benefit from this support in a sense that they mention both a high amount of teaching and learning activities, a high amount of interactive and constructive activities, a low amount of passive (high and low) activities as well as a high number of key scenes at the same time (hypothesis 2.6).

### 8.2.3 Effect of students' learning processes on script development (RQ 3)

Davis and Linn (2000) as well as the groups around Demetriadis (2008) and Papadopoulous (2011) pointed out that students who received prompts showed increased cognitive activity in a task and, as a result, also featured better learning outcomes in post-intervention measures. Transferring their insights to this study, the third question is:

*RQ 3: How do scores achieved in the individual learning phase correlate with learning outcomes in students' ward round scripts?*

Students who are prompted to direct their attention to possibilities how physicians could engage medical students in the ward round process are expected to achieve higher scores in identifying engagement opportunities than individuals who do not obtain this kind of prompt (see RQ 1). It is likely that the scores individuals achieve for identified engagement opportunities correlate with the amount of teaching and learning activities in individuals post-intervention ward round scripts (hypothesis 3.1). Higher correlations are expected for students who receive engagement prompts (hypothesis 3.2) than for students who do not receive this kind of prompts. Moreover, it is expected that students' engagement scores correlate

positively with the amount of interactive and constructive activities and correlate negatively with the amount of passive activities (both high and low level) students expect in their post-intervention ward round script (hypothesis 3.3). Higher correlations are expected for students who receive engagement prompts than for students who do not receive this kind of prompt (hypothesis 3.4).

Students who are prompted regarding the sequence of the ward round are expected to receive higher scores for the identified key scenes (see RQ 1). It is likely that these scores correlate with the number of mentioned key scenes students mention in their post-intervention ward round script (hypothesis 3.5). Higher correlations are expected for students who receive sequence reflection prompts than for students who do not obtain this kind of prompt (hypothesis 3.6).

### 8.2.4 Effect of prompts on the acceptance of the learning environment (RQ 4)

RQ 4: *How do students in the different prompt conditions differ in the acceptance of the learning environment? And how does the acceptance of the learning environment correlate with students' learning?*

It is plausible to expect that students in the different experimental conditions differ in the acceptance of the learning environment. Based on prior studies (Amulya, 2004; Davis, & Linn, 200) that support the effectiveness of question prompts for learning and to avoid that students' struggle with learning material, one could conclude that students who are supported by prompts show higher acceptance of the learning environment (hypothesis 4).

## 8.3 METHODS

### 8.3.1 Participants and design

The study sample consisted of $N$ = 210 medical students from the medical faculty of the University of Munich. Students participated in the compulsory course "ward round training" which belongs to the Module 23. In line with the declaration of Helsinki, participation in this study was voluntary and based on informed consent. The study was approved by the local ethic committee. Students who did not want to participate in this instructional intervention were offered the traditional simulation-based ward round training.

Participating students were all in the clinical semesters of the medical curriculum. Participation in the so called "Blockpraktikum Innere Medizin" which refers to a one-week clerkship in one elective field in internal medicine prior to this course was compulsory. This clerkship provides the opportunity to apply theoretical knowledge in a practical context and to gain first experience with ward rounds. This first experience is important for this study since prior experience builds the basis for both learning and internal script development (Kauffman, Yoskowitz, & Patel, 2008). On average, the participants were 24.2 years old ($SD$ = 3.82), among them, 57.65% were female and 39.28% were male; six students did not provide information on their gender. The data of 26 students had to be excluded prior to data analysis since they did not follow the instructions, e.g. did not answer the posttest. The resulting final sample consisted of $N$ = 184 participants.

*Table 7*: Design of the study on facilitating script development.

| **Engagement reflection prompt** | **Sequence reflection prompt** | |
|---|---|---|
| | **With** | **Without** |
| **With** | 48 | 46 |
| **Without** | 45 | 45 |

A 2x2 factorial design with the factors engagement reflection prompt (with vs. without) and sequence reflection prompt (with vs. without) was implemented (see *Table 7*). The students were randomly assigned to one of the four experimental

conditions. *Table 8* provides an overview on demographical information of participants as well as their educational status.

*Table 8*: Means (and standard deviations) of participants' age, Abitur grade, grade in the first state examination, semester, number of organ units and clerkships, prior knowledge of typical and ideal ward rounds.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With structure reflection prompt n = 48 *M* (*SD*)** | **Without structure reflection prompt n = 46 *M* (*SD*)** | **With structure reflection prompt n = 45 *M* (*SD*)** | **Without structure reflection prompt n = 45 *M* (*SD*)** |
| Age | 24.87 (4.11) | 23.85 (2.99) | 24.13 (3.06) | 24.07 (3.16) |
| Abitur grade | 1.69 (0.64) | 1.53 (0.55) | 1.46 (0.46) | 1.47 (0.50) |
| Grade first state examination | 2.75 (0.72) | 2.67 (0.87) | 2.82 (0.89) | 2.58 (0.76) |
| Semester | 7.02 (0.45) | 7.02 (0.49) | 7.11 (0.89) | 7.16 (0.53) |
| Number of organ units | 5.21 (1.74) | 4.57 (1.97) | 5.40 (1.08) | 5.36 (1.40) |
| Number of clerkships | 1.56 (0.85) | 1.54 (0.84) | 1.69 (0.60) | 1.73 (0.81) |
| Prior knowledge about typical ward rounds* | 3.32 (0.74) | 3.21 (0.60) | 3.24 (0.75) | 3.46 (0.69) |
| Prior knowledge about ideal ward rounds* | 2.84 (0.86) | 3.08 (0.72) | 2.90 (0.69) | 3.11 (0.94) |

*Note.* *Prior knowledge was measured with a 5-point Likert-Skale (1 = very low, 5 = very high).

### 8.3.2 Pilot study

Prior to implementing the learning environment, the ideas of this study were tested by several students to ensure feasibility of instruments and the learning environment.

The paper-based structure formation technique was tested with $N = 8$ medical students who voluntarily noted down their conceptions of ward rounds and assessed the comprehensibleness of instructions and procedure. Adjustments were made until the final procedure and wording of instruction were determined. The different kinds of learning environments and instruments used for this study were then pilot-tested

by $N = 10$ medical students representing the target group for this study. Two or three students were each assigned to one condition of the learning environment, balancing for gender. Each student worked individually and provided feedback regarding comprehensibility, feasibility and acceptance of the learning environment and the instruments. Adjustments were made and another $N = 4$ students tested the learning environment until the final procedure was determined.

### 8.3.3 Learning environment

The learners worked individually in a computer-based learning environment. The case materials were video-based ward round scenarios embedded in the computer-supported learning environment 'CASUS' (Fischer, 2000). The cases and ward round scenarios were developed by an experienced physician in internal medicine involved in medical education. This ensured quality of cases and scenarios. A senior physician in internal medicine also involved in medical education and responsible for the ward round training in undergraduate medical education approved the cases and scenarios for validity. To ensure a high quality of video material, the videos were planned referring to the aforementioned heuristics for designing video for productive learning (Blomberg et al., 2013; Hoppe-Seyler et al., 2014) and were recorded by an experienced film team.

Altogether, students worked on four cases typical for the different fields in internal medicine that students would encounter regularly in their future work in hospital. The cases were: (1) Thrombosis and pulmonary embolism, (2) Anaphylactic reaction towards insect, (3) Pneumonia, (4) Gallstone. The complexity of cases was low in terms of unambiguousness of both diagnosis and treatment so that students could understand the medical details on the basis of their prior knowledge. As a consequence, students were enabled to focus on the ward round process instead of mainly focusing on medical aspects they would not understand. Moreover cognitive overload was avoided.

The videos followed a typical sequence of ward round scenes and activities as identified in study 1. Each video involved one ward physician, one resident, one medical student in her Modul 23 and one patient.

Each case started with a brief introduction of the case including basic information regarding the patients. After that, the first video sequence started. The

videos stopped at pre-defined points and students were asked to fill out text boxes that were labeled with prompts specific to students' experimental condition. In the condition that referred to engagement reflection prompts, students were prompted to think about (1) opportunities of how physicians could involve the student into the ward round and (2) positive and negative aspects of teaching elements in the observed video sequence. Students who were assigned to the condition structure reflection prompts were prompted to (1) predict the subsequent phase of the ward round and to (2) compare the observed video with their prior experience with ward rounds.

### 8.3.4 Procedure

At first, the experimenter explained the purpose and procedure of the study using standardized instructions to ensure comparable preconditions for the participants who registered for different course groups. Subsequently, the participating students filled out a questionnaire on demographics and the status of their studies, and thematic interest. These questionnaires were followed by a pretest on ward round understanding which was conducted using a paper-based version of the structure formation technique (Scheele, & Groeben, 1988) and a test on prior medical knowledge comprising of six items. Two questions were related to the cases used in the learning environment, and four questions referred to the broad field of internal medicine. The knowledge test was developed based on modified questions of the second state examination in medicine and was adjusted to the target group participating in the intervention. An experienced physician in internal medicine who is involved in medical education developed the questions and answers taking into account guidelines for developing examinations in medicine (Gesellschaft für Medizinische Ausbildung, GMA-Ausschuss Prüfungen, &, Kompetenzzentrum Prüfungen Baden-Württemberg, 2008). Items were validated by a senior physician involved in both undergraduate medical education at the faculty of medicine and item development for the IMPP which is responsible for the development of exams for the second state examination in medicine.

Then, the medical students continued with an individual learning phase in which they worked on the four ward round scenarios. After each case scenario, students filled out process questionnaires in which individual interest regarding the case and perceived effort were measured. A posttest for individuals' ward round

understanding referring to the structure formation technique (Scheele, & Groeben, 1988) was conducted and students filled out further questionnaires that were not included into this thesis. For an overview on the procedure and estimated durations see *Table 9*. No restrictions were made in the duration of the individual learning phase.

*Table 9*: Procedures and durations.

| **Procedure** | **Estimated duration in minutes (minutes cumulated)** | |
|---|---|---|
| Introduction by experimenter | 10 | (10) |
| Questionnaires and pre-test (paper based) | 50 | (60) |
| Individual learning phase (4 case scenarios including prompts and process questionnaire; online) | 100 | (160) |
| Post-test (paper based) | 60 | (220) |
| Feedback and debriefing | 10 | (230) |

### 8.3.5 Experimental conditions

#### *Engagement reflection prompts*

The learners in the condition with engagement reflection prompts were prompted to reflect on chances to engage students in the ward round. Two prompt types were used and each was implemented at three points of case one, two and three. The first, third and fifth engagement reflection prompt considered prognosis prompts and targeted to the recognition of opportunities for physicians to involve the student into the ward round. The second, fourth and sixth prompt constituted evaluation prompts and focused positive and negative aspects of teaching elements in the observed video sequence. Learners had to enter their answer into a textbox directly after each prompt was presented (see *Table 10*).

In contrast to the first three cases, the fourth case did not include reflection prompts. Instead, each video sequence was followed by an opportunity to enter individual notes on the observed video.

*Table 10*: Prompts used for students in the engagement reflection prompt condition.

| Name of the prompt | Question |
|---|---|
| Prognosis | How can the physicians engage the medical student into the next phase of the ward round process? |
| Evaluation | Which positive and negative aspects of teaching did you recognize? |

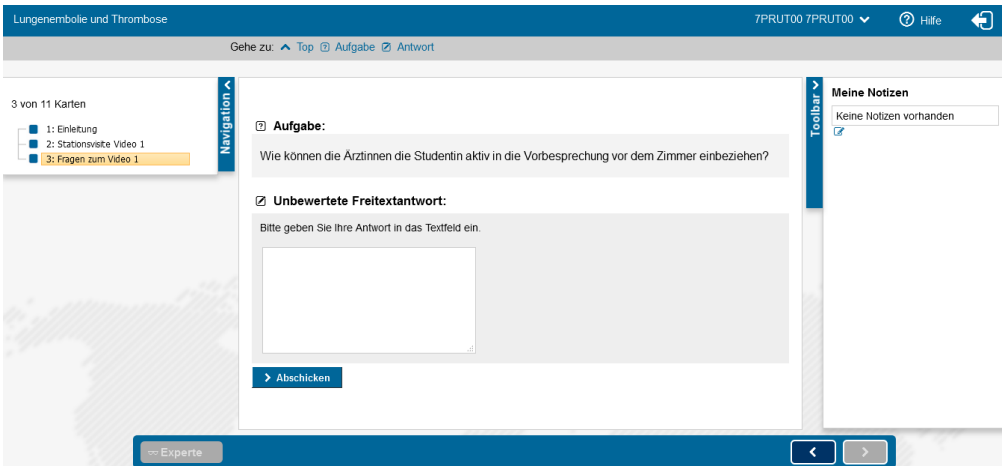


*Figure 14*: Screenshot from the CASUS learning environment. Prognosis for opportunities on how physician may engage the medical student into the first phase (discussion of patient in front of the room) of the ward round process.

### *Sequence reflection prompts*

In the condition that referred to sequence reflection prompts, students were scaffolded to reflect on the ward round process. They received two prompt types, each implemented at three points of a case one to three. The first, third and fifth prompt considered prognosis prompts and targeted on predicting the following phase of the ward round, while prompts two, four and six were evaluation prompts and directed students' attention to comparisons between the observed video and their prior experience with ward rounds (*Table 11*).

Similar to the students in the engagement reflection condition, learners had to type their answer into a textbox after being prompted. Also, prompts were only presented in cases one to three while case four only consisted of textboxes for individual notes.

*Table 11*: Prompts used for students in the sequence reflection prompt condition.

| Name of the prompt | Question |
|---|---|
| Prognosis | Building on your prior knowledge on ward rounds, how will the next phase of the ward round proceed? |
| Evaluation | How and in which regard did the observed ward round resemble ward rounds that you experienced during your clerkship? |

*Table 12*: Prompts used for students in the combined condition.

| Name of the prompt | Question |
|---|---|
| Prognosis | (a) Building on your prior knowledge on ward rounds, how will the next phase of the ward round proceed?<br>or<br>(b) How can the physicians engage the medical student into the next phase of the ward round process? |
| Evaluation | (a) Which positive and negative aspects of teaching did you recognize?<br>or<br>(b) How and in which regard did the observed ward round resemble ward rounds that you experienced during your clerkship? |

***Combined condition consisting of engagement and sequence reflection prompts***

While the aforementioned groups only received one group of reflection prompts, students in the combined condition received both types of prompts. To ensure comparable conditions as reflected in the number of prompts, the prompt types were balanced: for half of the students in this group, prompt one, three and five (prognosis) referred to engagement reflection while the second, fourth and sixth prompts (evaluation) focused on sequence reflection. For the other half of the students in this group, the first, third and fifth prompts (prognosis) corresponded to sequence reflection, while the other prompts (evaluation) referred to engagement reflection (see *Table 12*).

Similar to the other group, prompts were only applied in cases one to three, while case four only used textboxes for individual notes.

***Control group***

The control group served as a baseline to assess the effectiveness of the different prompt conditions. In contrast to the three above-named groups, the control group did not receive prompts. Instead, each video sequence in each of the four cases was followed by a textbox which allowed students to take individual notes.

To ensure the greatest possible comparability between groups, individuals in the different conditions of the learning environment observed the same video sequences. After each sequence, individuals in all conditions received prompts or had the opportunity to take notes. The number of prompts was equal for those groups who received prompts. Cases one to three each comprised six prompts while case four contained four questions. The control group had the opportunity to enter notes at four times in each case.

### 8.3.6 Data sources and instruments

**Pretest**

*Ward round scripts*. A paper-based version of the structure formation technique (Scheele, & Groeben, 1988) was applied to capture individuals' ward round scripts. Similar to the first study, the script components roles, scenes and scriptlets (Fischer et al., 2013) were used as a structure. Students were asked to write down typical ward round members - the roles ward physician, resident and medical student were given - as well as the relating activities performed by them in the three given superordinate phases "in front of patient's room before seeing the patient", "consultation of the patient inside patient's room", "in front of patient's room after seeing the patient".

*Medical knowledge.* Medical students' medical knowledge was measured through a six item single-choice questionnaire. Two questions directly referred to cases used in the learning environment, while four items were linked to the broad field of internal medicine. Questions were based on tasks from the second state examination and were adjusted to the target group by a physician having experience

in internal medicine, teaching and test development. Questions were validated by a senior physician in internal medicine who is responsible for teaching and assessment in medical education. In the questionnaire, only one answer was right in every question. To decrease guess probability, the option "I don't know" was offered. Learners received one point for every correctly marked answer. Students who chose the option "I don't know" received zero points while students who marked a wrong answer or marked multiple answers received a deduction of points. A maximum of six points could be achieved in this test. Cronbach's $\alpha$ was 0.43 for this test.

*Thematic interest* was measured with a test developed by Schiefele, Krapp, Wild, and Winteler (1993). Six questions referred to students' current mood and four questions were related to individuals' interest in ward rounds. Responses were on a four point Likert scale ranging from zero (fully disagree) to four (fully agree). Overall Cronbach's $\alpha$ was .82, with a Cronbach's $\alpha$ of .83 for the first six items and Cronbach's $\alpha$ of .85 for the four items on students' interest in ward rounds.

**Process data**

*Processing time*. The learning environment logged the time spent on each "slide". Thus, information on the time spent on each task respective step (i.e. prompt) can be exported and used for analysis. The time spent on a learning content can be interpreted as processing time. Accordingly, the time spent on a task can be seen as an indicator for depth of processing of presented information (Sánchez & García-Rodicio, 2013). To account for differences in the number of prompts (six for all conditions receiving prompts)/opportunities for notes (four for the control group) between groups and to avoid resulting bias, each the second and third as well as the fourth and fifth answers of students who received prompts were added and an average was calculated.

*Data from the individual learning phase*. The learning environment logged students' notes made when the videos stopped and students were asked to answer the prompt questions or to take notes. Written data were exported and used for analysis. Two aspects were considered for analysis: (1) the potential for knowledge construction of activities that were regarded as possible strategies for physicians to include the student in the ward round as mentioned for the subsequent video sequence and (2) the number of key scenes mentioned for the subsequent videos.

To assess both activities' content and potential for knowledge construction and mentioned scenes, coding schemes (Appendices F, G and H) were used. For the activities, the four dimensions interactive, constructive, active and passive were differentiated. No distinction was made between higher and lower level passive activities. Each category was assigned a score: interactive gained four points, constructive three points, active two points, passive one point. Zero points were given when no activity was mentioned. In case that a student mentioned more than one activity, the activity with the highest contribution to knowledge construction (interactive > constructive > active > passive) was counted. For each case, a student could receive a maximum of 12 points and a maximum of 48 points across all cases.

For the scenes, the key scenes as derived from the first study were used as classification. Each mentioned key scene was assigned one point. A student could receive a maximum of eight points per case and a maximum of 32 points across the four cases.

**Posttest**

*Ward round scripts*. To investigate students' script development, the posttest consisted of a second paper-based *structure formation technique* (Scheele, & Groeben, 1988). Similar to the pretest, students were asked to fill in their understanding of ward rounds and were guided by questions.

*Table 13*: Instruments and internal consistencies.

| **Measures** | **Cronbach's α** |
|---|---|
| *Pretest* | |
| Medical knowledge | .43 |
| Thematic interest | .82 |
| Situative interest | .83 |
| Individual interest | .85 |
| *Posttest* | |
| Acceptance of the learning environment | .80 |

*Acceptance of the learning environment.* The acceptance of the learning environment was measured with three items that were based on items from a short questionnaire from Stark, Herzmann, and Krause (2010). A 5-point Likert scale (1 =

I fully disagree, 5 = I fully agree) was used. *Table 13* provides an overview on used instruments and internal consistencies (Cronbach's $\alpha$).

### 8.3.7 Coding Procedures

*Structure formation technique*. The resulting structures consisted of a broad range of different ward round activities for the three given phases "in front of patient's room before seeing the patient", consultation of the patient inside patient's room", "in front of patient's room after seeing the patient" and for the noted ward round participants. In a first step, remaining structures were transferred to excel sheets. To allow comparability, data were coded by three independent trained coders using the inductive-deductive coding scheme (see Appendix D) as used in the first study. Interrater reliability was very satisfying with a Fleiss' Kappa of .87, with 93% agreement for 20% of material. In a next step, activities were coded in terms of (1) their content and (2) their potential for knowledge construction. (1) As in the first study, medical, social, administrative, teaching and learning, and non-demanding content of activities was differentiated (see Appendix F). (2) While the initial coding scheme differentiated interactive, constructive, active and passive activities, two levels for passive activities were differentiated: higher and lower level passive activities (see Appendix J). Higher level passive activities refer to activities that require to initiate cognitive or thinking processes (e.g. listen to the physicians; pay attention) and contribute to individual's knowledge construction while lower level activities correspond to activities that do not require or initiate cognitive or thinking processes (e.g. stand around; open the door) and do not contribute to knowledge construction. For both dimensions, 20% of data were coded by three independent coders with a very satisfying interrater reliability: Fleiss' Kappa of .85, with 92% agreement. In a next step, two coders coded data in terms of scenes using the inductive-deductive coding scheme used in study 1 (see Appendix F). An interrater reliability of Cohen's Kappa K = .94, 98% agreement for 20% of data material was reached. Assessment of interrater reliability was balanced across the different experimental conditions and the field of internal medicine in which students' passed their clerkship.

*Data from the individual learning phase*. Process data was logged in CASUS and transferred to Excel sheets for further analysis. Data of all cases were coded for all experimental groups in terms of (a) the maximum potential for knowledge

construction for the mentioned activities for engaging medical students into the ward round, and (b) the number of key scenes as mentioned for the further phases of the ward round using coding scenes (see Appendix F). Data were coded by four coders. Interrater reliability was very satisfying with a Fleiss' Kappa of .79 and 84% agreement.

### 8.3.8 Statistical analysis

Absolute frequencies were calculated for scriptlets' content and potential for knowledge construction. Data were transferred to SPSS and relative frequencies were calculated to account for varying numbers of mentioned activities. Further, the number of mentioned scenes and key scenes were calculated and transferred to SPSS.

T-tests, ANOVAs, ANCOVAs and MANCOVAs with a significance level of $p = .05$ were used to compare means between the experimental groups and to account for the impact of covariates on learning outcomes. Post-hoc comparisons were made using linear independent, pairwise and Bonferoni-adjusted contrasts.

In case of violation of the assumption of equal error variances for ANCOVAs and MANCOVAs, a more conservative alpha level was used to determine significances (Tabachnick, & Fidell, 2007) and the alpha level was set to $p = .01$. Partial eta squared was used as a measure of effect sizes. Values of about .01 were considered weak effect size, of around .06 as medium and .14 as large effect size (Cohen, 1988). Also, the significance level was adjusted to avoid type 1 errors.

While variance analysis are based on (multivariate) normal distribution, a sample size of $N = 30$ per group was assumed to ensure robustness to modest violation unless violation of normality goes back to outliers (Tabachnick, & Fidell, 2007). Outliers thus were checked and excluded from analysis.

Partial correlations were calculated to investigate the relationship between two variables controlling for a third variable. Correlations of about .1 to .29 are considered small, of .30 to .49 as medium and of about .50 to 1 as large (Cohen, 1998).

## 8.4 RESULTS

### 8.4.1 Preliminary Analyses

Preliminary analyses were performed to ensure that there were no significant differences between groups already before participation in the intervention. Students' prior ward round scripts, medical knowledge, thematic interest and practical experience therefore were compared between groups.

#### 8.4.1.1 Prior ward round scripts

*Script components.* Analysis of the number of mentioned script components were performed. Students mentioned an average of 7.68 (*SD* = 2.75) scenes, 25.82 (*SD* = 11.43) scriptlets and 3.81 (*SD* = .99) roles, see Table 14. There were no significant differences between conditions prior to the instructional intervention (scenes: all *F*s(1, 180) < .69, *n.s*; *scriptlets:* all *F*s(1, 180) < 4.25, *n.s.*; *roles:* all *F*s (1, 180) < 3.17, *n.s.*.

*Table 14*: Absolute frequencies for the script components scenes, scriptlets, and roles in the pretest.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Number of scenes | 7.46 (2.12) | 7.72 (3.22) | 7.56 (2.77) | 7.98 (2.89) |
| Number of scriptlets | 24.67 (9.91) | 23.30 (7.71) | 27.67 (13.37) | 27.62 (14.74) |
| Number of roles | 3.65 (0.91) | 3.80 (0.91) | 4.16 (1.02) | 3.64 (1.13) |

Descriptive analysis of the role component shows that individuals in all groups expected the roles ward physicians, residents and students as typical members of the ward round team. Also nurses were perceived as frequently participating role in the ward round process. The attendance of senior physicians was expected by

around 25% of the sample. Final students, patients and other participants such as relatives or professionals from other professions like physiotherapy were reported only rarely (see *Table 15*).

*Table 15*: Mentioned roles by students in the different groups in the pretest.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Senior physician | 11 | 11 | 12 | 8 |
| Ward physician | 47 | 45 | 45 | 44 |
| Resident | 47 | 44 | 45 | 42 |
| Final year student | 2 | 2 | 5 | 2 |
| Student | 47 | 46 | 44 | 43 |
| Nurse | 21 | 24 | 30 | 21 |
| Patient | 1 | 1 | 4 | 3 |
| Other | 3 | 2 | 3 | 1 |

*Scriptlets' content*. Scriptlets were analyzed in terms of the activities that were expected for typical ward rounds. Medical (49.30%) and social (31.50%) activities were mentioned most frequently followed by administrative (10.66%) activities. Teaching and learning (3.80%) and non-demanding (4.46%) were rarely reported, see Figure 15. There were no significant differences between conditions prior to the instructional intervention (medical: all $F$s(1, 180) < .21, $p$ < .76; social: all $F$s (1, 180) < 1.96, *n.s.*; administrative: all $F$s (1, 180) < 5.15, *n.s.*; teaching and learning: all $F$s (1, 180) < 1.67, *n.s.*; non-demanding: all $F$s (1, 180) < 3.19, *n.s.*).

*Scriptlets' potential for knowledge construction*. Analysis showed that participants across all groups expected a high amount of constructive (40.20%) and active (27.55%) activities followed by interactive (16.66%), high level passive (10.98%) and low level passive (4.34%) activities, see *Figure 16*. No significant differences were found between conditions prior to participation in the instructional intervention (interactive: all $F$s (1, 180) < 1.35, *n.s.*; constructive: all $F$s (1, 180) <

5.15, *n.s.*; active: all *F*s (1, 180) < 2.10, *n.s.*; passive high: all *F*s (1, 180) < 1.75, *n.s.*; passive low: all *F*s(1, 180) < 1.12, *n.s.*).

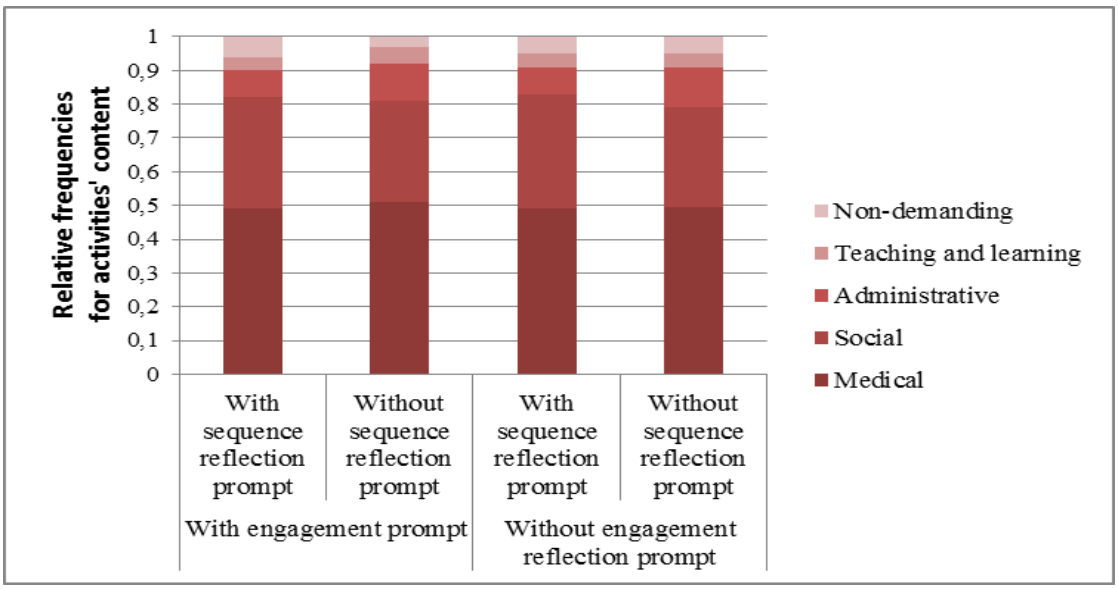


*Figure 15*: Relative frequencies for activities' content as mentioned by participants in the four experimental groups in the pretest.

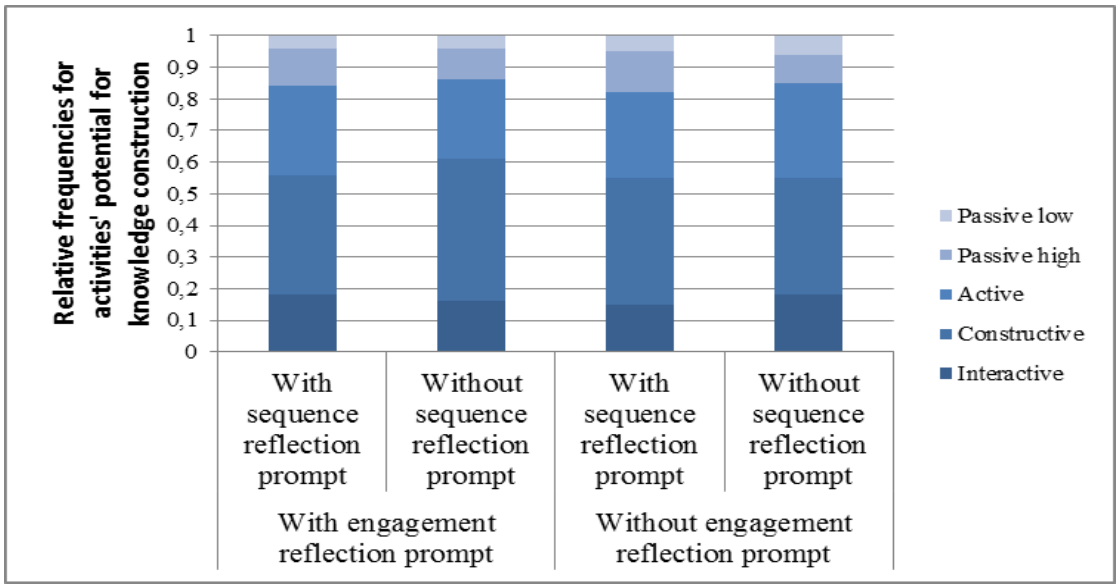


*Figure 16:* Relative frequencies for activities' potential for knowledge construction as mentioned by participants in the four experimental groups in the pretest.

*Table 16*: Absolute frequencies of key scenes as mentioned by participants in the four experimental groups in the pretest.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Key scenes | 4.00 (1.05) | 3.61 (1.33) | 4.09 (1.33) | 4.36 (1.43) |

*Key scenes*. Analysis revealed that individuals mentioned an average of 4.02 (*SD* = 1.29) key scenes, see Table 16. Comparisons between the four experimental groups did reveal a significant result for students who received engagement reflection prompts ($F(1, 180) = 4.83$, $p = .03$): this group of students was found to identify fewer key scenes in the pretest. There was no significant main effect for structure reflection prompts ($F(1, 180) = .11$, *n.s.*). Neither an interaction effect was found ($F(1, 180) = 2.99$, *n.s.*).

### 8.4.1.2 Comparison of the scene component between pre- and posttest

Comparisons of the number of identified key scenes between pre- and posttest revealed no statistically significant difference ($t(183) = -1.954$, $p = .06$).

*Table 17*: Absolute frequencies (and standard deviations) the number of identified key scenes as mentioned by participants in the four experimental groups in the pre- and posttest.

| | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | | **Without sequence reflection prompt n = 46 *M* (*SD*)** | | **With sequence reflection prompt n = 45 *M* (*SD*)** | | **Without sequence reflection prompt n = 45 *M* (*SD*)** | |
| | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** |
| Number of key scenes | 4.00 (1.05) | 4.37 (1.28) | 3.61 (1.32) | 3.88 (1.02) | 4.09 (1.33) | 4.39 (1.15) | 4.36 (1.43) | 4.31 (1.29) |

For an overview on the absolute frequencies of identified key scenes in pre- and posttest, see *Table 17*.

*Table 18*: Relative frequencies (and standard deviations) for scriptlets' content as mentioned by participants in the four experimental groups in the pre- and posttest.

| | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | | **Without sequence reflection prompt n = 46 *M* (*SD*)** | | **With sequence reflection prompt n = 45 *M* (*SD*)** | | **Without sequence reflection prompt n = 45 *M* (*SD*)** | |
| | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** |
| Medical | .48 (.16) | .50 (.16) | .50 (.17) | .46 (.15) | .49 (.16) | .47 (.16) | .48 (.15) | .45 (.15) |
| Social | .33 (.16) | .31 (.16) | .31 (.14) | .30 (.14) | .34 (.15) | .33 (.15) | .30 (.15) | .31 (.14) |
| Administrative | .09 (.07) | .08 (.06) | .12 (.09) | .11 (.09) | .10 (.09) | .11 (.09) | .12 (.11) | .11 (.09) |
| Teaching and learning | .04 (.07) | .08 (.07) | .04 (.07) | .11 (.11) | .03 (.04) | .08 (.08) | .04 (.07) | .10 (.09) |
| Non-demanding | .06 (.08) | .04 (.08) | .03 (.05) | .01 (.03) | .05 (.07) | .01 (.03) | .05 (.07) | .02 (.04) |

#### 8.4.1.3 Comparison of the scriptlet component between pre- and posttest

*Scriptlets' content*. Comparisons of the scriptlet component revealed that, across all experimental groups, individuals' expectations of typical ward rounds differed between pre- and posttest. Students expected fewer medical (pretest: 48.92%, posttest: 47.11%; $t(184) = 1.77$, $p = 0.08$), administrative (pretest: 10.75%, posttest: 10.25%; $t(184) = .80$, $p = .42$) and non-demanding activities (pretest: 4.41%, posttest: 2.08%) in the posttest. The difference was significant for the non-demanding dimension ($t(184) = -4.34$, $p < .01$). While the amount of teaching and learning activities was significantly higher than in the posttest (pretest: 3.71%, posttest: 9.10%; $t(184) = -8.30$, $p < .01$), the amount of social activities was constant in both tests (pretest: 31.96%, posttest: 31.51%; $t(184) = .46$, $p = .67$). For an

overview on the relative frequencies for scriptlets' content between pre- and posttest for each experimental group, see *Table 18*.

*Scriptlets' potential for knowledge construction*. Students' expectations of scriptlets of different potential for knowledge construction also differed between pre- and posttest: students mentioned significantly less interactive (pre: 16.5%, post: 13.00%, $t(184) = 4.47$, $p < .01$), higher level passive (pre: 11.25%, post: 7.75%, $t(184) = 4.77$, $p < .01$) and lower level passive (pre: 4.00%, post: 3.00%, $t(184) = 3.99$, $p < .01$) and significant more constructive (pre: 39.75%, post: 47.50%, $t(184) = -5.99$, $p < .01$) and active (pre: 27.50%, post: 30.00%, $t(184) = -2.04$, $p < .04$) activities in the posttest. *Table 19* provides an overview on the relative frequencies of scriptlets' potential for knowledge construction between pre- and posttest for each experimental group.

*Table 19*: Relative frequencies (and standard deviations) for scriptlets' potential for knowledge construction between pre- and posttest for the four experimental groups.

| | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|
| | **With sequence reflection prompt n = 48** | | **Without sequence reflection prompt n = 46** | | **With sequence reflection prompt n = 45** | | **Without sequence reflection prompt n = 45** | |
| | ***M* (*SD*)** | | ***M* (*SD*)** | | ***M* (*SD*)** | | ***M* (*SD*)** | |
| | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** |
| Interactive | .18 (.15) | .14 (.12) | .16 (.12) | .13 (.11) | .15 (.11) | .12 (.10) | .17 (.13) | .13 (.11) |
| Constructive | .37 (.20) | .46 (.16) | .45 (.15) | .50 (.16) | .40 (.17) | .48 (.13) | .37 (.14) | .46 (.14) |
| Active | .28 (.14) | .31 (.15) | .25 (.15) | .29 (.12) | .27 (.14) | .29 (.13) | .30 (.14) | .31 (.15) |
| Passive high | .12 (.11) | .08 (.09) | .11 (.10) | .06 (.08) | .13 (.11) | .09 (.11) | .09 (.11) | .08 (.09) |
| Passive low | .05 (.08) | .04 (.08) | .03 (.07) | .02 (.05) | .03 (.07) | .02 (.05) | .05 (.11) | .04 (.08) |

#### 8.4.1.4 Prior medical knowledge, thematic interest and practical clinical experience

Students achieved an average score of 2.29 (*SD* = 2.16) in the prior medical knowledge test, see *Table 20*. No differences were found with respect to the prompts students received ($F(1, 180) < 2.47$, *n.s.*).

Students in the four experimental groups showed a similar thematic interest in ward rounds ($M = 3.41$, $SD = .62$), and also in the two sub-scales for situative interest ($M = 2.94$, $SD = .77$) and individual interest ($M = 4.13$, $SD = .71$), see *Table 20*. No differences were found between the four experimental groups (thematic interest $F(1, 180) < 1.07$, *n.s.*; situative interest: $F(1, 180) < 2.84$, *n.s.*; individual interest: $F(1, 180) = 1.16$, *n.s.*).

Besides, students spent an average of 6.52 (*SD* = 3.10) weeks in clerkships, see *Table 20*. No group-related differences were found in this regard ($F(1, 180) < .66$, *n.s.*).

Comparability of students assigned to the four experimental groups can be assumed in terms of prior medical knowledge, thematic interest and practical clinical experience.

*Table 20*: Means (and standard deviations) for prior medical knowledge, thematic interest and practical clinical experience.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Prior medical knowledge | 1.90 (2.07) | 2.20 (2.54) | 2.27 (2.07) | 2.76 (1.94) |
| Thematic interest | 3.32 (0.74) | 3.53 (0.50) | 3.45 (0.61) | 3.34 (0.63) |
| Situative interest | 2.84 (0.86) | 3.05 (0.65) | 2.93 (0.79) | 2.94 (0.76) |
| Individual interest | 4.04 (0.92) | 4.22 (0.57) | 4.24 (0.58) | 4.02 (0.78) |
| Practical clinical experience (in weeks) | 6.24 (3.40) | 6.16 (3.36) | 6.76 (2.40) | 6.92 (3.24) |

#### 8.4.1.5 Time-on-task

Initial checks for the time-on-task revealed that students who received both kinds of prompts tended to spend more time on answering prompts than students who received engagement or structure reflection prompts only (see *Table 21*). Moreover,

all prompted students spent more time-on-task than non-prompted students. However, neither a main effect of the implemented prompts nor an interaction effect was found ($F(1, 180) < 2.75$, *n.s.*). Comparability of students who were assigned to one of the four experimental groups can be assumed.

*Table 21*: Means (and standard deviations) for time-on-task.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Time-on-task (sec) | 932.92 (474.82) | 770.32 (470.65) | 809.56 (306.89) | 741.82 (527.13) |

### 8.4.2 Effect of prompts on students' learning processes in the individual learning phase (RQ 1)

The first research question targeted the relevance of prompts on students' learning processes in the individual learning phase. Data derived from the CASUS learning environment was analyzed in terms of the kind of opportunities how physicians could actively engage students in the ward round process and regarding the anticipated key scenes for the ward rounds.

To explore group related differences in the learning process, two separate analyses of variance were conducted with the two kinds of prompts as independent and process measures as dependent variables. Preliminary checks were conducted to test for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. No serious violations were noted. The alpha level was set to $p = .05$.

It was expected that students who were assigned to those experimental groups that received engagement reflection prompts achieved higher scores for engagement opportunities than students who did not receive this prompt (hypothesis 1.1). Against this assumption, no significant main effect was found for engagement reflection prompts ($F(1, 180) = .41$, $p = .53$) on individuals' scores for engagement opportunities. Also, neither a main effect for structure reflection prompts ($F(1, 180) = .49$, $p = .48$) nor an interaction effect ($F(1, 180) = .09$, $p = .75$) could be determined.

*Table 22*: Means (and standard deviations) for scores for recognized engagement opportunities and key scenes by students in the four experimental groups acquired during the individual learning phase.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Scores for opportunities for engagement | 10.98 (11.86) | 14.63 (12.70) | 9.44 (11.25) | 11.24 (12.53) |
| Scores for key scenes | 13.04 (7.28) | 10.87 (7.49) | 10.47 (8.04) | 9.31 (7.95) |

An inspection of the mean scores indicated that students who received engagement reflection prompts achieved slightly higher engagement scores than students in the other experimental groups, see *Table 22*.

Besides, it was hypothesized that students who maintain sequence reflection prompts achieved higher scores for identified key scenes than students who did not receive this kind of prompt (hypothesis 1.2). There was no main effect for sequence reflection prompts on the scores for key scenes from the individual learning phase ($F(1, 180) = 2.15$, $p = .14$) conflicting the initial assumption. Neither the main effect of engagement reflection prompts ($F(1, 180) = 3.32$, $p = .07$) nor the interaction effect ($F(1, 180) = .20$, $p = .66$) were significant. For descriptives, see *Table 22*.

As mentioned above, the two analyses of variances did not show a significant interaction effect for the two reflection prompts on individuals' learning. Against the assumption (hypothesis 1.3), students who received both kinds of prompts did not achieve higher scores than students who received one or no prompt at all.

### 8.4.3 Effect of prompts on students' script development (RQ 2)

To investigate how the two kinds of prompts contribute to medical students' script development, several ANCOVAs and one MANCOVA were performed. Engagement reflection prompts and structure reflection prompts were used as

independent variable and values for scriptlets' content (teaching and learning, non-demanding) and potential for knowledge construction (interactive, constructive, passive high and low) and the number of key scenes from the posttest as dependent variable. To account for prior ward round scripts, pre-intervention values for scriptlets' content, scriptlets' potential for knowledge construction and the number of key scenes were used as covariate variables.

Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes and reliable measurement of the covariate.

**General effect of prompts**

Regarding the content of expected ward round activities, it was hypothesized that prompted students shifted their attention to relevant situational characteristics and mentioned a smaller amount of non-demanding activities than non-prompted students (hypothesis 2.1).

An ANCOVA with the amount of non-demanding activities as dependent and the prompt condition (with vs. without prompt) as independent variable was conducted. Pre-intervention scores were used as covariate to eliminate confounding effects of students' prior scripts. No violation of pre-assumptions was detected.

*Table 23*: Means (and standard errors) for the amount of non-demanding activities between prompted and non-prompted students adjusted for pre-intervention scores.

| | **With prompt**<br>**n = 137**<br>***M* (*SE*)** | **Without prompt**<br>**n = 45**<br>***M* (*SE*)** |
|---|---|---|
| Non-demanding | .02 (.05) | .02 (.03) |

Analysis showed no effect of the use of prompts on the amount on non-demanding activities mentioned by prompted vs. non-prompted students ($F(1, 180) < .00$, *n.s.*). Against the initial assumption, students who received prompts did not mention fewer non-demanding activities (see *Table 23*).

### Effect of prompts on students' expectations of ward round activities

Students who were prompted by engagement reflection prompts were expected to report more teaching and learning activities than students who did not receive this prompt (hypothesis 2.2).

An ANCOVA with engagement and sequence reflection prompts as independent and the amount of teaching and learning activities as dependent variable was conducted. Individuals' pre-intervention scores were implemented as covariate to control for confounding effects.

The adjusted means and standard errors are presented in *Table 24*. There was no main effect of engagement prompts on the amount of mentioned teaching and learning activities ($F(1, 180) = .013$, $p = .91$, partial $\eta^2 < .01$), conflicting the initial assumption. A significant main effect was found for structure reflection prompts ($F(1, 180) = 4.861$, $p = .03$, partial $\eta^2 < .01$). An inspection of the mean scores indicated that students who obtained structure reflection prompts mentioned a smaller amount of teaching and learning activities than students who did not receive this kind of prompts. No interaction effect was found ($F(1, 180) = .51$, $p = .47$, partial $\eta^2 < .01$).

*Table 24*: Means (and standard errors) for the amount of teaching and learning activities between students in the four experimental groups adjusted for pre-intervention scores.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SE*)** | **Without sequence reflection prompt n = 46 *M* (*SE*)** | **With sequence reflection prompt n = 45 *M* (*SE*)** | **Without sequence reflection prompt n = 45 *M* (*SE*)** |
| Teaching and learning | .07 (.01) | .11 (.01) | .08 (.01) | .10 (.01) |

Regarding scriptlets' potential for knowledge construction, it was expected that students who maintained engagement reflection prompts mentioned a higher amount of interactive and constructive activities (hypothesis 2.3) and a smaller amount of passive activities than students who did not receive this kind of prompt (hypothesis 2.4). Due to conceptual dependency of the dependent variables, one MANCOVA with engagement reflection prompt and sequence reflection prompts as independent variables, the amount of interactive and constructive activities and pre-intervention scores of interactive, constructive and both levels of passive activities as covariates was conducted.

Multivariate analysis did not reveal a significant main or interaction effect of prompts on the amount of interactive, constructive, high and low level passive activities ($F(4, 172) < 1.63$, n.s.) after correcting for pre-intervention scores. See *Table 25* for descriptive information. Hypotheses 2.3 and 2.4 could not be confirmed.

*Table 25*: Means (and standard deviations) for the amount of interactive, constructive, active and high and low passive activities between the four intervention groups adjusted for pre-intervention scores.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SD*)** | **Without sequence reflection prompt n = 46 *M* (*SD*)** | **With sequence reflection prompt n = 45 *M* (*SD*)** | **Without sequence reflection prompt n = 45 *M* (*SD*)** |
| Interactive | .13 (.01) | .14 (.01) | .13 (.01) | .13 (.01) |
| Constructive | .48 (.02) | .49 (.02) | .47 (.02) | .47 (.02) |
| Active | .29 (.01) | .29 (.02) | .30 (.01) | .29 (.01) |
| Passive high | .07 (.01) | .06 (.01) | .08 (.01) | .09 (.01) |
| Passive low | .03 (.01) | .02 (.01) | .02 (.01) | .02 (.01) |

### Effects of prompts on students' sequential understanding of ward rounds

The next block of assumptions refers to the effect of sequence reflection prompts on the number of mentioned key scenes.

It was expected that students, whose attention was directed to the process of the ward round mention more key ward round scenes than students who were not prompted in this regard (hypothesis 2.5).

An ANCOVA was conducted to evaluate the effect of sequence reflection prompts on the number of mentioned key scenes in the pre-intervention test. The adjusted means and standard errors are presented in *Table 26*.

*Table 26*: Means (and standard errors) for the number of key scenes mentioned by the four experimental groups adjusted for pre-intervention scores.

| | **With engagement reflection prompt** | | **Without engagement reflection prompt** | |
|---|---|---|---|---|
| | **With sequence reflection prompt n = 48 *M* (*SE*)** | **Without sequence reflection prompt n = 46 *M* (*SE*)** | **With sequence reflection prompt n = 45 *M* (*SE*)** | **Without sequence reflection prompt n = 45 *M* (*SE*)** |
| Number of key scenes | 4.41 (.19) | 4.09 (.27) | 4.32 (.19) | 4.20 (.23) |

An inspection of the mean scores for mentioned key scenes (see *Table 26*) indicated that students who obtained sequence reflection prompts report a slightly higher number of key scenes. But contrary to the initial assumption, the MANCOVA did not show an effect of the implemented prompts on the number of identified key scenes in the posttest ($F(1, 183) < .48$, *n.s.*).

As no interaction effect could be identified between the two implemented prompts ($F(1, 183) = .22$, $p = .64$), hypothesis 2.6 could not be confirmed either.

### 8.4.4 Relationship between students' learning processes and script development (RQ 3)

The relationship between the individual learning process and students' script development was of further interest. Prior research (Davis, & Linn, 2000; Demetriadis et al., 2008; Papadopoulous et al., 2011) stressed that students who showed increased cognitive activity in a task also demonstrated better learning outcomes in post-intervention measures. Therefore the relationship between scores

for recognized engagement opportunities and key scenes, and students' learning outcomes as reflected in scriptlets' content and potential for knowledge construction and the amount of mentioned key scenes in the post-intervention scripts was examined while controlling for pre-intervention scores.

Partial correlations were calculated to explore the relationship between learning processes (as measured by the scores for recognized engagement opportunities and key scenes) and learning outcomes (as measured by the amount of teaching and learning activities, the amount of interactive, constructive, high and low passive activities, and the number of key scenes mentioned in the post-intervention test) while controlling for individuals' respective pre-intervention scores. A significance level of $p = .05$ was chosen. Values of .10 to .29 were considered small, of .30 to .49 as medium and of about .50 to 1 as large (Cohen, 1998). Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

To investigate experimental group-specific relationships between individual learning processes and script development, correlations were calculated across all groups and for each experimental group separately.

**Relationship between scores for engagement opportunities and script development: analysis of teaching and learning activities**

A high correlation of scores for recognized engagement opportunities and the amount of teaching and learning activities was expected for students across the four experimental groups (hypothesis 3.1). Statistical analysis revealed a weak positive partial correlation for engagement opportunities scores and the amount of teaching and learning activities, controlling for the pre-intervention amount of teaching and learning activities ($r = .06$, $n = 181$, $p = .23$). Contrary to hypothesis 3.1, a high correlation could not be determined. Separate examination of data from the four experimental groups confirmed this weak positive partial correlation between the two variables when controlling for pretest scores for all four experimental groups (see *Table 27*).

Contrary to the initial assumption (hypothesis 3.2), no higher correlations for students who obtained engagement reflection prompts were detected. In contrast,

correlations tended to be higher for those who did not receive this kind of prompt, see *Table 27*. None of these correlations was significant.

*Table 27*: Partial correlations for the relationship between scores for engagement opportunities and the amount of teaching and learning activities for the four experimental groups.

| | | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control variable | **With sequence reflection prompt n = 48** | | **Without sequence reflection prompt n = 46** | | **With sequence reflection prompt n = 45** | | **Without sequence reflection prompt n = 45** | |
| | | *r* | *p* | *r* | *p* | *r* | *p* | *r* | *p* |
| Teaching and learning | pretest score | .05 | .75 | .07 | .63 | .08 | .62 | .08 | .63 |
| | none | .15 | .32 | .03 | .84 | -.03 | .86 | .12 | .44 |

**Relationship between scores for engagement opportunities and script development: scriptlets' potential for knowledge construction**

*Interactive and constructive activities.* A high positive correlation was expected for engagement opportunities scores and the amount of interactive respective constructive activities. Also, a negative correlation was expected for engagement opportunities scores and the amount of high and low level passive activities (hypothesis 3.3).

Across all experimental groups, there was a weak non-significant negative correlation ($r$ = -.04, $n$ = 181, $p$ = .61) between students' engagement opportunities scores and the amount of interactive activities, controlling for the pre-intervention scores. In the next step, data from students from the four experimental groups were examined separately. A weak positive correlation between both variables was found for students who received both kinds of prompts or no prompts at all. A weak negative partial correlation was found between the two variables for students who received engagement reflection prompts and a medium partial correlation was found for students who obtained sequence reflection prompts when controlling for pre-intervention scores (see *Table 28*). This correlation turned significant for students who received structure reflection prompts only ($r$ = -.32, $n$ = 181, $p$ = .03): students

who received this kind of prompt were found to report significantly fewer interactive activities than students in the other experimental groups.

Across all experimental groups, a weak positive partial correlation was found between the relationship between students' engagement opportunities scores and the amount of constructive activities, when controlling for pre-intervention scores ($r$ = .09, $n$ = 181, $p$ = .26).

Separate examination of this relationship for each experimental group revealed a significant moderate positive correlation between the two variables for students who received engagement reflection prompts: receiving this kind of prompt goes in line with mentioning a higher amount of constructive activities ($r$ = .37, $n$ = 181, $p$ = .01).

A weak positive partial correlation was identified for students who obtained no prompts. For students who received both kinds of prompts and sequence reflection prompts, a weak negative correlation was found for the two variables (see *Table 28*).

*Passive activities.* A weak negative partial correlation between students' engagement opportunities scores and the amount of higher level passive activities ($r$ = -.01, $n$ = 181, $p$ = .91) was determined when controlling for pre-intervention scores. Separate examinations of the partial correlations between students' engagement opportunities scores and the amount of higher level passive activities revealed that students who received engagement reflection prompts and students who received no prompts showed a weak negative correlation between both variables. Students in contrast who obtained both engagement reflection prompts and sequence reflection prompts were found to show a weak positive correlation between the two variables (see *Table 28*).

A weak negative partial correlation was also identified between students' engagement opportunities scores and the amount of low level passive activities ($r$ = -.03, $n$ = 181, $p$ = .69), when controlling for pre-intervention scores. Separate examinations of the partial correlations between students' engagement opportunities scores and the amount of low level passive activities revealed that students who obtained engagement reflection prompts and sequence reflection prompts showed a weak negative correlation between the two variables, whereas a positive partial

correlation between the two variables was found for students who received both kinds of prompts or no prompts.

*Table 28*: Partial correlations for scores for engagement opportunities and the amount of interactive, and constructive activities for the four experimental groups.

| | | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Control variable** | **With sequence reflection prompt n = 48** | | **Without sequence reflection prompt n = 46** | | **With sequence reflection prompt n = 45** | | **Without sequence reflection prompt n = 45** | |
| | | *r* | *p* | *r* | *p* | *r* | *p* | *r* | *p* |
| Interactive | pretest score | .18 | .25 | -.18 | .23 | -.32 | .03 | .09 | .55 |
| | none | -.01 | .93 | -.12 | .42 | -.28 | .07 | .14 | .37 |
| Constructive | pretest score | -.11 | .45 | .37 | .01 | -.08 | .62 | .09 | .57 |
| | none | -.03 | .83 | -.08 | .58 | -.19 | .21 | -.16 | .31 |
| Passive high | pretest score | .06 | .70 | -.10 | .52 | .17 | .28 | -.18 | .24 |
| | none | .06 | .68 | -.06 | .71 | .18 | .25 | .18 | .25 |
| Passive low | pretest score | .06 | .67 | -.05 | .75 | -.16 | .29 | .01 | .92 |
| | none | .11 | .45 | -.02 | .90 | -.12 | .45 | .05 | .76 |

In summary, the analysis of the relationship of scores for engagement opportunities and script development provided only little insight into individual learning. Only two significant relationships could be determined: against the initial assumption, the scripts of students who obtained sequence reflection prompts were found to be characterized by a significantly lower amount of interactive activities than scripts of students in the other experimental groups. Besides, meeting the hypothesis, the scripts of students who received engagement reflection prompts were found to be characterized by a significantly higher amount of constructive activities than was the case for students in the other experimental groups. Against the initial assumptions, there were no further statistically significant relationships between individual learning processes and script development.

**Relationship between scores for key scenes on script development**

A high correlation of scores for recognized key scenes and the number of key scenes mentioned in the posttest was expected for students across the four experimental groups (hypothesis 3.5).

There was a weak positive partial correlation ($r$ = .02, $n$ = 181, $p$ = .85) between the scores for recognized key scenes and the number of post-intervention key scenes, controlling for pre-intervention scores. Against hypothesis 3.5, no high correlation could be determined.

*Table 29*: Partial correlations for scores for key scenes and the number of mentioned key scenes in the posttest controlling for pretest scores for the four experimental groups.

| | | **With engagement reflection prompt** | | | | **Without engagement reflection prompt** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Control variable | **With sequence reflection prompt n = 48** | | **Without sequence reflection prompt n = 46** | | **With sequence reflection prompt n = 45** | | **Without sequence reflection prompt n = 45** | |
| | | *r* | *p* | *r* | *p* | *r* | *p* | *r* | *p* |
| Number of key scenes | pretest score | -.17 | .37 | .01 | .98 | .25 | .19 | -.01 | .98 |
| | none | -.08 | .69 | -.01 | .98 | .26 | .16 | -.15 | .50 |

Separate examination of the four experimental groups revealed a weak positive partial correlation between the two variables for students who obtained engagement reflection prompts and sequence reflection prompts; weak negative partial correlation was found for the other two experimental groups. In line with hypothesis 3.6, the correlation between individuals' scores for recognized key scenes and post-intervention scores was highest for students who received structure reflection prompts (see *Table 29*). However, this correlation was not significant.

### 8.4.5 Students' acceptance of the learning environment (RQ 4)

To answer the question of whether the prompts students receive affect their acceptance of the learning environment, one t-test with the availability of prompts as independent and acceptance of the learning environment as dependent variable was performed. No violation of pre-assumptions was detected through preliminary checks.

Based on prior findings (Amulya, 2004; Davis, & Linn, 2000), the use of prompts was expected to lead to effectiveness of students' learning and to prevent them from struggling with learning material. As a result it was hypothesized that students who received prompts showed a higher acceptance of the learning environment than non-prompted students (hypothesis 4).

The data of 161 students who filled out the questionnaire for acceptance of the learning environment was included into statistical analysis.

*Table 30*: Means (and standard deviations) for the acceptance of the learning environment for prompted and non-prompted students.

| | **With prompt n = 119 *M* (*SD*)** | **Without prompt n = 42 *M* (*SD*)** |
|---|---|---|
| Acceptance of the learning environment | 3.02 (.97) | 3.24 (.94) |

*Note*. Scores ranged on a 5-point Likert scale, 1 = fully disagree to 5 = fully agree.

The t-test revealed no statistically significant difference in the acceptance of the learning environment between prompted and non-prompted students, $t(159) = -1.25$, $p = .21$. Inspection of the means for both groups suggests that non-prompted students tended to accept the learning environment better than prompted students.

## 8.5 DISCUSSION

In this chapter, the results of the second study are discussed in light of findings from prior research. This is followed by a section of limitations and implications for future research and teaching practice.

### 8.5.1 Discussion of results

The presented study investigated how medical students' ward round scripts could be enhanced with a case-based learning environment using video and instructional support through reflection prompts. $N$ = 184 medical students participated in this intervention study. Four typical ward round videos that were interrupted by prompts at predefined points were used. Engagement reflection prompts and sequence reflection prompts were applied as factors for a 2x2 factorial design. Individuals' ward round scripts were measured before and after participation in this learning environment using a paper-based version of the structure formation technique (Scheele, & Groeben, 1988). Individuals' ward round scripts were analyzed. An emphasis was put on scriptlets' content and potential for knowledge construction (Chi, 2009; 2011) as well as on the scenes mentioned by students.

I was especially interested in the relevance of prompts for individuals' learning processes in the individual learning phase (*research question 1*), on students' script development (*research question 2*) and of individuals' learning progress in the individual learning phase on students' script development (*research question 3*).

Basing on the assumption that reflection prompts direct students' attention to relevant situational features (Bulu, & Pedersen, 2010; Davis, & Linn, 2000; Quintana et al., 2004), it was expected that students who obtain engagement reflection prompts would achieve higher scores for recognized engagement opportunities than students who did not obtain this kind of prompts in their individual learning phase. Moreover, it was hypothesized that students who receive sequence reflection prompts would achieve higher scores for identified key scenes. Students who receive both kinds of prompts were assumed to achieve high scores in both target scores.

Preliminary analysis of individuals' ward round scripts of pre- and posttest showed that participation in the intervention resulted in changes in individuals' scripts. T-test revealed that students mentioned a significantly lower amount of non-demanding activities while mentioning a higher amount of teaching and learning

activities. Besides, students mentioned a significantly smaller amount of interactive and high and low level passive activities while mentioning a higher amount of constructive and active activities.

Further investigation was conducted to explore the role of the implemented prompts for these observed changes in medical students' ward round scripts.

The first research question targeted the effect of prompts on students' learning process in the individual learning phase. Against the initial assumption, no effect of prompts could be identified and students of all intervention groups achieved comparable scores. These scores were rather low as compared to the maximum score students could achieve.

There are three likely explanations for this result: First, it is possible that the prompt characteristics impeded the learning process as they were not appropriate by means of their directedness. Both Davis (2003) and van Merrienboer (2013) stressed that directed prompts have the potential to be too specific in nature and to only target single aspects of the overall situation while distracting students from basic principles of the overall situation. Generic prompts in contrast would provide students with the opportunity to reflect on aspects that they themselves regard as relevant - while simultaneously being at risk to being distracted by irrelevant information (Davis, 2003). It is possible that students who did not receive prompts benefited from this leeway for ideas. Second, the videos used for the intervention may be the reason for the little differences in individuals learning processes. The videos showed ideal-typical ward rounds in internal medicine. As mentioned in Chapter 5.1, using video for learning bears the danger that the observed practice appears already well-known and it is likely that students require only little cognitive effort to acquire relevant knowledge (Salomon, 1984). Besides, it is reasonable to assume that students perceived the observed videos as very typical and as matching their prior experience with ward rounds and that the implemented prompts were not able to stimulate deeper elaboration of case material (Bjork, & Bjork, 2011). Third, building on the findings of Renkl (2002) and Heitzmann (2014) it also renders possible that the prompts caused cognitive conflicts through experienced situational discrepancies between prior ward round experience during clerkships and presented case material. Students in the control group who did not receive prompts may have not perceived such conflicts and achieved scores comparable to the intervention groups.

The second research question considered the effect of prompts on individuals' script development. It was expected that prompting directs learners' attention to aspects relevant for a situation (Ge, & Land, 2003). Contrary to this assumption, no general effect of prompts was found when contrasting the amount of non-demanding activities of prompted and non-prompted students. When examining the effect of both kinds of prompts on the mentioned ward round scriptlets in terms of their content and their potential for knowledge construction, only one effect turned out to be significant: students who received structure reflection prompts mentioned a significant smaller amount of teaching and learning activities than students who did not obtain this type of prompt. It is reasonable that prompting students to directing their attention to the ward round sequence simultaneously inhibits or decreases their attention to identifying opportunities for teaching and learning on the round. There are some possible explanations for the lack of effects going back to the applied prompts such as the directedness of prompts. Again, it is possible that the implemented videos did not stimulate deeper elaboration of learning material (Bjork, & Bjork, 2011; Salomon, 1984). As all students observed the same ward round videos that followed a predefined and standardized sequence of the ward round process that encompassed several scenes in which the physicians engaged the medical student into the ward round it might be well that these case characteristics already impacted learning while the implemented prompts only played a minor role (Blomberg et al., 2013).

Script research provides additional explanations for the gained results. Schank (1999) and Kolodner (2007) stressed that scripts develop over time and require repeated exposure with an (professional) encounter such as ward rounds. Similarly, Fischer et al. (2013) indicated that the induction of a script as well as the reconfiguration of an appropriate script requires time and opportunities to assess the appropriateness of a current script. The learning environment used in this second study only consisted of four cases. Working on the cases and prompts took about 100 minutes. It is likely that the learning environment did not provide enough opportunities to change individuals' scripts significantly. Beyond that, building on the findings and recommendations from prior studies conducted in the area of worked examples (Heitzmann, 2014; Schmidt, & Bjork, 1992; McLaren et al., 2012), it is also plausible to assume that individuals' learning gains tend to become apparent

only some time after participation in an intervention. According to them, learning with complex cases requires deep generative learning processes. These afford time and result in delayed learning.

Such a delayed learning might also be the case for students' script development. While working on the four cases, students were confronted with ward rounds that differently match their prior professional experience. Discrepancies between known practice and new information may result in reflection processes that - after some time - result in the induction of new or the reconfiguration of currently available scripts.

The third research question investigated the relationship between students learning processes and individuals' script development. Prior research (Davis, & Linn, 2000; Demetriadis et al., 2008; Papadopoulous et al. (2011) indicated that students who show increased cognitive activity in a task also demonstrated better learning outcomes in post-intervention measures. Partial correlations between learning process (as measured by the scores for recognized engagement opportunities and key scenes) and learning outcomes (as measured by the amount of teaching and learning activities, the amount of interactive, constructive and high and low passive activities) controlling for pre-intervention scores provided only little insight into individual learning: a significant positive correlation between engagement opportunities scores and the amount of interactive activities was found for students who received engagement reflection prompts while a significant negative correlation was found between interactive activities and engagement opportunities scores for students who obtained structure reflection prompts. As mentioned before, shifting students' attention to one relevant ward round goals may simultaneously hinder or decrease students' attention to other relevant aspects of the learning environment.

From a theoretical perspective, it is also likely that the study design was not appropriate for measuring changes in individuals' scripts and, as a consequence, learning outcomes appear small. As previously mentioned scripts are understood to develop over time and repeated exposure with a situation (Fischer et al., 2013; Kolodner, 2007; Schank, 1999). Consisting of only four cases and requiring only 100 minutes of dealing with learning material, a radical change in medical students' scripts would hardly be observable. Moreover, the study design included a pre-intervention test of students' scripts directly before the intervention took place. It is

conceivable that the pre- intervention test activated the ward round scripts of all students, independent of the intervention group they were assigned to, and that students' learning occurred in light of their prior ward round scripts while the intervention itself played a minor role for script development.

Considering insights from expertise research saying that novices' knowledge structure is characterized by a high fragmentation and only few connections (Anderson et al., 1997), it is also reasonable to assume that the participating students struggled in connecting new information - as gained through the observed videos and/or the applied prompts - with prior ward round knowledge (Schmidt, & Boshuizen, 1993; Schmidt, & Rikers, 2007). Featuring students with additional time for reflection of ward round practice and relating it to learning material may have provided more insights into group-related differences in script development.

### 8.5.2 General discussion

The outlined study was faced by the challenge to foster skills that appear general in nature or even self-evident at first sight (e.g. involving students into the ward round process, performing ward rounds according to a clear structure) but pose severe challenges to individuals when faced with real professional encounters (AlMutar et al., 2013; Krautter et al., 2014; Nikendei et al., 2008; Norgaard et al., 2004). Directing learners' attention to these crucial aspects to stimulate deeper elaboration and reflection processes thus was of utmost importance to facilitate conscious script development (Bjork, & Bjork, 2011; Fischer et al., 2013). The implementation of case-based learning with video and two kinds of reflection prompts, namely engagement and sequence reflection prompts, was regarded as valuable means to impart a realistic model of professional practice and to enhance students' reflection of their future workplace affordances (Borko et al., 2008; Jonassen, & Hernandez-Serrano, 2002; Papadopoulous et al., 2011; Sherin, & Van Es, 2007).

Analysis revealed that, across all intervention groups, participation in the learning environment led to some changes in individuals' ward round scripts supporting the relevance of case-based learning. However, the results did not meet initial expectations and script development could not be clearly attributed to the implemented reflection prompts.

As outlined above, there are several likely explanations for these little insights. On the one hand, the characteristics of the learning environment may have caused these little group-related differences; the prompts were characterized by a high level of directedness and shifted students' attention to specific aspects of the learning environment (engagement opportunities vs. sequence of the ward round). It is possible that students thus were distracted from other information relevant for conducting ward rounds (Davis, 2003). The finding that students who received structure reflection prompts mentioned a significantly smaller teaching and learning related activities after having participated in the intervention than students who did not receive this kind of prompts supports this assumption. Similarly, students who obtained high scores in the identification of key scenes in the individual learning phase, put a smaller emphasis on interactive activities when externalizing their ward round expectations in the post-intervention test. However, engagement reflection prompts encouraged students to engage with learning material and, as a result, to anticipate a higher amount of activities at higher levels of knowledge construction in the post-intervention test. The results suggest that structured reflection of the ward round process can - to a certain extent - feature script reconfiguration.

Another explanation going back to the learning environment refers to the used videos. They constitute four ideal-typical ward round scenarios with a high standardization to render comparability. It is possible that, due to their comparable low level of complexity, the videos did not stimulate deeper elaboration of learning material (Bjork, & Bjork, 2011; Salomon, 1984).

On the other hand, theory provides further possible explanations for the observed results. As aforementioned, script research also stressed the importance of repeated experience with a particular situation to enhance script development (Schank, & Abelson, 1977; Kolodner, 2007; Schank, 1999). While theory and research suggest that scripts develop over time and cannot be easily changed by a comparably short intervention but requires extensive and repeated training, (Ericsson, 2005; Ericsson, 2006; Kolodner, 2007; Schank, 1999; Schmidt, & Boshuizen, 1993), this intervention only referred to four cases to enhance ward round scripts. The little changes in individuals' scripts thus are not surprising but confirm prior theoretical assumptions.

The next paragraphs outline limitations this study faced, followed by implications for both future research and teaching practice.

### 8.5.3 Limitations

Besides the aspects that were discussed in the previous section, this section provides an overview on potential limitations of the second study.

First of all, as previously mentioned, one limitation lies in the design of the intervention. The outlined study emphasized the development of medical students' ward round scripts from a cognitive perspective and stimulated students to reflect on typical ward round videos that were embedded in a case-based computer-supported learning environment. Videos provided the opportunity to observe typical ward rounds and the behavior of individuals typically engaged in this situation. Students had the opportunity to critically reflect on observed information and to contrast them to prior experience (Van Es, 2008; Van Es, & Sherin, 2002). While observing the videos, students were in a rather passive role. The implemented prompts however stimulated active (e.g. summarize observed information) and constructive (e.g drawing conclusions, making predictions) activities that were regarded as beneficial for knowledge construction and deeper learning. Despite their potential for learning processes, this intervention however did not encompass interactive activities that required the involvement of other learners (such as exchanging views) (Chi, 2009; Chi, 2011; Menekse et al., 2013). Adding mandates to act with a learning partner would have been one possible and valuable addition to this learning setting.

Moreover, students did not have the opportunity to act themselves and to apply the knowledge they gained in an authentic (real world or simulation-based) environment. Prior studies stressed that such a transfer would be inevitable to evaluate students' performance and the development of competences (Baker, & Salas, 1992; Clark, 2008; Van Deursen, & Van Dijk, 2010). Above, providing students with practice-based assessments also extends their involvement and the application of new learning content in a meaningful context (Kleinknecht, & Poschinski, 2014).

A stronger reference to practice would also have been desired from the perspective of script research (Frank, Land, & Schack, 2013). While this intervention

contributed to students' metacognitive abilities and enhanced their ward round scripts with regard to understanding, a transfer to practice would have been desired to evaluate the appropriateness of scripts and to provide students with the opportunity to reorganize their scripts in case of failure in practice (Fischer et al., 2013).

As outlined in the previous section, script research stressed the importance of repeated experience with a particular situation to enhance script development (Schank, & Abelson, 1977; Kolodner, 2007; Schank, 1999). The learning environment only encompassed four typical ward round situations that followed a standardized sequence of the round process. It cannot be assumed that ward round scripts can be fully obtained or changed within the relatively short time of the intervention and with only few cases. In fact, extensive and repeated training in a long-term perspective is necessary to enhance ward round scripts (Ericsson, 2005; Ericsson, 2006; Kolodner, 2007; Schmidt, & Boshuizen, 1993).

The instructional intervention alone is not able to predict students' behavior in authentic ward rounds. Neither is clear, whether and to what extent scripts are consistent when considering their two functions: guiding both understanding of and acting in a professional encounter. Another open question is the stability of acquired scripts that could not be assessed since no follow-up test was implemented. Prior studies (Heitzmann, 2014; Schmidt, & Bjork, 1992; McLaren et al., 2012) that were conducted in the field of worked examples claimed for delayed follow-up tests. According to them, learning gains tend to become apparent only some time after having participated in an intervention as learning with complex cases requires deep generative learning processes that afford more time and result in delayed learning. Assuming that script development also occurs delayed since reflection requires time, a similar effect can be assumed also for the learning processes of the participating medical students. The implementation of delayed follow-up tests thus is highly recommended for future studies.

Another limitation goes back to the assessment methods that were used. Students' ward round scripts were measured directly before and after participation in the intervention using a paper-based version of the structure formation technique (Scheele, & Groeben, 1988). It needs to be critically considered that the pretest might have activated prior ward round scripts of all students. It is likely that script

activation confounded the identified results, and learning gains cannot be fully explained by allocation to one of the four experimental conditions. Due to ethical considerations, reasons of privacy protection and due to practical reasons, the pretest could not be conducted at an earlier point to avoid such confounding effects. Future studies, however, should account for this issued and strive for an earlier pretest for scripts.

As students filled out the paper-based version of the structure formation technique themselves, it might have occurred that students failed to externalize their full knowledge on ward rounds (e.g. Kinchin, & Cabot, 2010). Also, especially for the posttest, a motivational bias may have occurred which may have resulted in tests that do not fully represent individuals' scripts but are filled out incompletely.

Certainly, also contextual influences going back to the test environment may have impacted quality of data. Data collected was run through the whole winter term 2014/2015 and students participated in one of 16 sessions. Biases tied to the allocation to one of these groups and group effects are possible and could not be excluded.

Even though students were randomly assigned to one of the four experimental groups, biases in individual prerequisites between groups were inevitable and personal preferences, cognitive abilities and personality might have resulted in a better/worse fit with the assigned experimental condition (Blömeke et al., 2014).

### 8.5.4 Implications for future research

There are several questions that remained open or arose in the course of the presented study.

So far, there has not been a comparable study yet that investigated the development of scripts from a cognitive perspective through the implementation of a case-based learning environment using video and reflection prompts. Future studies should follow the identified advancements and investigate opportunities for improving the scripts learners have of a professional practice in different domains (e.g. teacher education or professional development). An emphasis should be put on the role of students' metacognition for script development as well as the consistency

of scripts in the two functions: guiding individuals' understanding of and acting in a professional situation.

The case-based learning was found to have potential for the development of medical students' ward round scripts. The question on the role of reflection prompts could not be answered with this intervention study. Future studies should follow this open question and also investigate whether instructional approaches other than case-based learning are promising for script development. Comparing case-based learning with rather action-based approaches would be one possible next step and a response to prior research that claimed students' active engagement in professional activities (Billett, 2001; Chi, 2009; Melo Prado et al., 2011). Action-based approaches such as simulation-based learning (Mollo et al., 2012; Ponzer, 2004) could use interactive learning activities (Chi, 2009; Menekse et al., 2013) to make use of collaboration between students for script development. To increase the quality of interactions, external collaboration scripts (Kollar et al., 2006) could be implemented.

Independent of the function of scripts that future studies focus on, follow-up tests are strongly recommended to judge the long-term effectiveness as can be seen in the stability of scripts and to account for delayed learning (Heitzmann, 2014; Schmidt, & Bjork, 1992; McLaren et al., 2012). Moreover, learning outcomes should be considered in light of the interplay of features of the instructional design and learner characteristics (e.g. prior scripts, affective components, attitudes, epistemological beliefs) (Blömeke et al., 2014; Kleinknecht, & Poschinski, 2014; Kleinknecht, Schneider, & Syring, in press).

To measure scripts at several times, the application of economic measures for scripts is inevitable. For the intervention study, the paper-based structure formation (Scheele, & Groeben, 1988) served an easy-to-use instrument for students to note down their ward round understanding but required extensive work in terms of coding data and making it accessible for analysis.

Especially the classification of scripts by means of their components scenes, scriptlets and roles guided students while filling out the structure and also contributed to data analysis. The analysis of scriptlets in terms of the content (Walton, & Steinert, 2010) and potential for knowledge construction (Chi, 2009) of expected activities again provided a valuable guide to grasp individuals' scripts. However, analysis of these structures turned out to be time consuming and non-

economic. A computer-assisted program could provide a useful support to directly and validly map individuals' scripts and allocate students to an appropriate learning environment that fits their individual needs and preferences.

### 8.5.5 Implications for teaching practice

One of the main achievements of this intervention study was to sensitize participating students for educational opportunities on the ward. Prompts and the design of case material helped students to identify opportunities for active engagement on the ward and to contrast new information with prior ward round experience.

In the sense of script research, it however is important to provide students with several opportunities for developing their ward round scripts on a long-term perspective instead of targeting ward rounds only once during their medical studies to facilitate the development of stable scripts (Kolodner, 2007; Schank, 1999). One opportunity would be to focus ward rounds continuously in the course of clinical studies. This could occur through the repeated use of case-based learning environments to stimulate students' reflection of the ward round process. Another approach would be to refer to simulation-based training to provide students with the opportunity to transfer their obtained knowledge to an authentic context (Ponzer, 2004) and to receive feedback on their shown behavior (Fanning, & Gaba, 2007).

Moreover, ward round scripts could also be facilitated in the workplace in the context of compulsory clerkships. Structuring students' observation of (Osman, 2008) or fostering active involvement in rounds (Melo Prado et al., 2011) followed by feedback (Krautter et al., 2014; Wölfel et al.,2016) are two opportunities to enhancing students' ward round scripts. Combining different teaching and learning formats in both internal medicine and other medical fields (e.g. surgery and psychiatry; Vietz et al., in prep.) provides students with manifold opportunities to experience similarities and differences in ward rounds and to develop and reconfigure comprehensive scripts that can be used for future professional practice.

# Chapter 9: Discussion and Conclusion

The overall aim of this thesis was to measure and to facilitate individuals' ward round understanding. For this purpose, two studies were conducted.

This chapter aims at discussing these studies. Contributions to and implications for research are illustrated and implications for teaching practice are deduced from the findings. Limitations that the studies encountered are then described. This chapter ends with a final conclusion.

## 9.1 SUMMARY OF THE STUDIES

The first study aimed at measuring ward round scripts of medical students and physicians at different stages of expertise referring to Schank's (1999) script concept. A secondary aim was to contrast students' ward round scripts with those of more experienced individuals. For this purpose, an interview study with $N$ = 50 participants referring to the structure formation technique (Scheele, & Groeben, 1988) was conducted which allowed illustrating individuals' understanding of the ward round already in the course of the interviews and a consensus between interviewer und interviewee for ensuring validity of data. The script components *scenes*, *scriptlets* and *roles* as introduced by the Script Theory of Guidance (Fischer et al., 2013) were used to structure both interviews and data analysis and proved a valuable guidance for this study.

The resulting ward round scripts were analyzed in terms of their components and an emphasis was put on the analysis of the scriptlets. For the analysis of scriptlets, (1) the content (Walton, & Steinert, 2010), and (2) the potential for knowledge construction processes (Chi, 2009) were differentiated. Analysis revealed that on a structural level, medical students' scripts showed a high similarity to those of more experienced physicians, conflicting prior insights from expertise research that assumed novices' scripts to be rather fragmented (Nievelstein et al., 2008; van de Wiel et al., 2000). Further analysis of the scene and scriptlet component revealed that students failed to recognize the physical examination of the patient as typical

scene of the ward round pointing to their lack in strategic knowledge (Berliner, 1987; Eteläpelto, 2000).

Moreover, novices' scriptlets were characterized by a high amount of non-demanding activities that could not be connected with ward rounds' goals. Experts in contrast expected mainly activities tied to these goals representing their multifaceted understanding of ward rounds (Frank, 2005). Analysis also showed that students failed to understand ward rounds as encounters in which activities at high levels of knowledge construction take place which was reflected in a high amount of passive activities (e.g., stand around, listen). This passive focus was especially prominent when investigating individuals' expectations of the role "medical student". Novices attributed their own role with mainly passive activities while more experienced individuals recognized this role to be associated with rather active activities. Acknowledging the opportunities for their own active participation in the ward rounds however would be relevant for students to acquire medical knowledge (Melo Prado et al. 2010) and to enhance knowledge construction on the ward (Chi, 2009).

Building on these findings, the main question of the second study targeted whether and to what extend two kinds of reflection prompts implemented in a case-based learning environment with videos can enhance the conscious development of medical students' script in terms of expectations of the sequence of the round and ward round activities.

The conducted intervention study referred to case-based learning with video (Borko et al., 2008; Krammer, & Reusser, 2005; Kleinfeld, 1992; Sherin, & van Es, 2009) and used reflection prompts to direct students' attention to relevant information and to provide them with opportunities for reflection (Bell, & Davis, 2000; Chen, & Bradshaw, 2007; Davis, 2003; Papadopoulous et al., 2011). A 2x2 factorial design with the factors sequence reflection prompts (with vs. without) and engagement reflection prompts (with vs. without) was implemented. $N$ = 184 medical students participated in this study and were randomly assigned to one of the four experimental conditions. In the course of the intervention, students in all groups observed the four videos representing typical ward rounds that followed a clear structure and displayed students' engagement at several points of the round. Videos were interrupted at predefined points and invited students to reflect on specific aspects (IG) or to take notes (CG).

A paper-based version of the structure formation technique (Scheele, & Groeben, 1988) was used to measure individuals' ward round scripts before and after participation in the intervention. Again, the script components scenes and scriptlets were analyzed to investigate students' expectations of the sequence of ward rounds and typical activities. Mentioned scriptlets were analyzed in terms of the expected content (Walton, & Steinert, 2010) and the potential for knowledge construction (Chi, 2009) and mentioned scenes were analyzed in terms of their significance for the ward round process.

The first question targeted the issue whether the implemented reflection prompts affected medical students' learning in the individual learning phase. Statistical analysis revealed that, against the initial assumption, there was no effect of the implemented prompts on the learning process and that individuals of all groups achieved comparable learning outcomes as measured in the scores for identified engagement opportunities and the number of identified key scenes.

The second question considered the effect of prompts on individuals' script development. Contrary to the initial assumption that prompting would direct learners' attention to aspects relevant for a situation, no general effect of prompts was found when contrasting the amount of non-demanding activities between prompted and non-prompted students. Analysis of the effect of the prompts on the mentioned ward round scriptlets considering their content and potential for knowledge construction, there was only one main effect: students who received structure reflection prompts mentioned a significant smaller amount of teaching and learning activities than students who did not obtain this type of prompt.

The third research question investigated the relationship between students' learning processes and script development. Partial correlations between learning process (as measured by the scores for recognized engagement opportunities and key scenes) and learning outcomes (as measured by the amount of teaching and learning activities, the amount of interactive, constructive and high and low passive activities) controlling for pre-intervention scores provided only little insight into individual learning: a significant positive correlation between engagement opportunities scores and the amount of interactive activities was found for students who received engagement reflection prompts while a significant negative correlation was found

between interactive activities and engagement opportunities scores for students who obtained structure reflection prompts.

Several explanations were provided for these little results. First, the design of the learning environment was identified as influence on individual learning. All students observed the same standardized videos of ward round encounters in internal medicine that followed a predefined structure. It might well be that observed professional practice already impacted individuals' learning and provoked vicarious learning while the implemented prompts played only a minor role (Blomberg et al., 2013; Stegmann et al., 2012). The possibility that the observed ward round encounters appeared well-known and similar to ward rounds that they were involved in during their clerkships so that they required only little cognitive effort and prompts did not have the potential to stimulate deeper elaboration of learning material (Bjork, & Bjork, 2011; Salomon, 1984) was considered as another reason for the identified results. The few differences between the four intervention groups support this assumption. As aforementioned, it is also likely that the used instructional reflection prompts hindered learning. Davis (2003) and Merriernboer (2013) argued that prompts might be too specific in nature and thus bear the danger to shifting learners' attention to only single aspects of a situation while distracting students from basic principles of the overall situation or other aspects relevant for conducting ward rounds successfully. Generic prompts in contrast were assumed to be superior in providing students with the opportunity to reflect on aspects that they themselves regard as relevant - while simultaneously being at risk to be distracted by irrelevant information (Davis, 2003).

Second, from a theoretical perspective, the characteristics of scripts provide an explanation for possible difficulties in transferring and externalizing acquired ward round knowledge to the posttest. As outlined before, scripts are understood to develop over time and through repeated exposure with a situation (Fischer et al., 2013; Kolodner, 2007; Schank, 1999). As the instructional intervention was rather short in time and consisted of a little number of ward round scenarios, a substantial change in or reconfiguration of medical students' scripts would hardly be achievable and, in turn, be observable. Considering that individuals' of low professional expertise were found to have fragmented knowledge (Anderson et al., 1997; Schmidt, & Boshuizen, 1993; Schmidt, & Rikers, 2007) it is also reasonable to

assume that the participating students struggled in connecting new information - as gained through the observed videos and/or the applied prompts - with prior ward round knowledge.

The next chapters outlines the contribution to and implications from the two studies for research on ward rounds and scripts (Chapter 9.2) and for teaching practice (Chapter 9.3).

## 9.2 CONTRIBUTION TO AND IMPLICATIONS FOR RESEARCH ON WARD ROUNDS AND SCRIPTS

With the two studies, this thesis contributed to both research on ward rounds and that on scripts.

I referred to script research (Schank, & Abelson, 1977; Fischer et al., 2013; Schank, 1999) to investigate medical students' deficits in understanding professional practice. An adaption of the structure formation technique (Scheele, & Groeben, 1988) was used to extract individuals' scripts of ward rounds. The Script Theory of Guidance (Fischer et al., 2013) that distinguishes the script components *scenes*, *scriptlets*, and *roles* was used to organize individuals' ward round knowledge. The analysis of the scene component allowed the extraction of a typical ward round sequence while the analysis of the scriptlet component rendered identification of typical ward round activities.

The scriptlet component was further analyzed with respect to the content which was linked to the ward round goals *treating the patient* and *education* (Walton, & Steinert, 2010; Weber, & Langewitz, 2011; Weber et al., 2007). Scriptlets moreover were analyzed in terms of the potential for knowledge construction processes they are likely to evoke (Chi, 2009; Menekse et al., 2013). While the last-mentioned classification originally was developed for formal contexts, it was transferred to an informal professional context and considered ward round activities in light of the underlying cognitive processes. A weakness of this framework became apparent when analyzing data from the first study: the framework of overt learning activities puts an emphasis on only observable or so called overt activities. Underlying cognitive processes of different passive activities were not a major subject of Chi (2009) and the group around Menekse (2013). The impact of these kinds of activities

and their impact on individual learning processes and relevance for knowledge construction thus were not examined in their studies.

The second study accounted for this shortcoming and the classification was expanded by a distinction between high level passive activities that refer to activities that encompass or induce cognitive activity (e.g. reflect, think, listen), and low level passive activities that cannot be linked to cognitive activity (e.g. stand around).

The utilized classification offered a sound basis for both coding and analyzing data as derived from both studies and can be recommended for future research in the context of ward round research as well as for studies conducted in other domains and learning settings.

Building on evidence from the first study, it was possible to derive clear learning goals that were followed in the second study. This study was driven by the idea that script development can be enhanced by metacognitive processes such as reflection. While prompts contributed only little to the development of individuals' scripts, case-based learning with video was found to be a valuable instructional approach to featuring students with multiple opportunities to observe and reflect professional practice and slight changes in individual ward round scripts were noticed.

Despite the little effects, this study serves an important starting point for future research both in the context of ward rounds and in the field of script research.

Future studies may address questions that remained open or derived from the conducted studies. Most notably, future research should target scripts not only from one perspective but in light of the two functions a script has: guiding both understanding of and acting in a particular situation (Schank, 1999). The consistency of both functions of a script thus should be target of future studies. Combining both cognitive and performance measured therefore can be regarded as a valuable means. Performance data can also be used to assess the transferability of scripts acquired through instructional interventions as well as the stability of scripts over time (Baker, & Salas, 1992; Clark, 2008; van Deursen, & van Dijk, 2010).

To examine the sustainability of learning gains as reflected in reconfigurations of scripts, the implementation of delayed follow-up tests is recommended (McLaren et al., 2012; Schmidt, & Bjork, 1992).

Another question refers to the potential that different instructional approaches provide for script development. In line with previous research, case-based learning with video and the implementation of reflection prompts was found to be a valuable means to provide students with the possibility to observed ward rounds. Only few effects of the implemented reflection prompts on individual learning and script development were notices. Future research should investigate the role of prompts of different characteristics (directed vs. generic; Davis, 2003; van Merrienboer, 2013) to contribute to script development through shifting students' attention to information relevant for ward rounds (Davis, 2003; Moreno, & Valdez, 2007; Papadopoulous et al., 2011). Besides the use of different types of instructional scaffold, the use of action-oriented approaches such as simulation-based (Ponzer, 2004) or workplace-based (Billett, 2001) training could be one area of future studies.

Besides these ideas of research, the adaptability of the structure formation technique (Scheele, & Groeben, 1988) to other contexts or domains could be target of future research.

## 9.3 IMPLICATIONS FOR TEACHING PRACTICE

Ward rounds represent an important professional encounter for physicians in their daily practice in hospital. However, prior studies pointed to students' difficulties in understanding and acting in them properly (Nikendei et al., 2008; Norgaard et al., 2004).

Based on the findings from study one, an instructional intervention that empowered students to reflect on observed ward round practice in terms of the sequence of a round and opportunities for engaging students actively was implemented. In that, students showed an improvement in their expectations of ward rounds.

Assuming that scripts develop through repeated exposure with a situation, it is likely that one single course such as the instructional intervention is neither enough to change scripts completely nor to reconfigure them on a long-term perspective (Fischer et al., 2013; Kolodner 2007; Schank, 1999). Instead, students should be provided with as much meaningful experience as possible. Workplace-based training such as in the context of mandatory clerkships (Ärztliche Approbationsordnung,

2002), simulation- or workplace-based training (Billett, 2001; Ponzer, 2004) or case-based learning environments such as used for the second study provide various possibilities to sharpen students' ward round scripts and to initiating reconfigurations of them. However, instructional support seems necessary in each instructional format to support both students' active engagement and reflection of current and/or observed practice (Blomberg et al., 2013). Structuring students' observation of (Osman, 2008) or fostering active involvement in rounds (Melo Prado et al., 2011) supported by collaboration prompts (Kollar et al., 2006) or followed by feedback (Krautter et al., 2014; Wölfel et al., 2016) are only some opportunities to enhance students' ward round scripts.

## 9.4 LIMITATIONS

Irrespective of the findings from both studies, some limitations of the presented research are apparent.

First of all, the studies targeted only one function of a script when measuring and facilitating individuals' ward round scripts, namely to guide individuals' understanding of a situation. As previously indicated (see Chapter 8.5; Chapter 9.2), script development should not only consider one dimension but understand scripts in light of the interplay between understanding of and behaving within a particular situation. Also future research should reflect that individual goals as well as situational characteristics are subject to permanent change and result in the reconfiguration of scripts (Fischer et al., 2013; Schank, 1999).

Taking into account also the behavioral dimension would have been useful for the assessment of the consistency of both functions of scripts as conducted in the first study. For the second study, performance data would have been a valuable means to assess the transferability of acquired ward round understanding (Baker, & Salas, 1992; Clark, 2008; van Deursen, & van Dijk, 2010).

Another question that arose in the context of the second study refers to the stability and sustainability of students' learning success. While students who participated in the intervention in study 2 showed a slight change in their expectations of typical ward rounds, it remains unclear whether this learning is stable and can be applied to future professional encounters or even shows another increase

due to delayed learning (McLaren et al., 2012; Schmidt, & Bjork, 1992). As mentioned in the section before, delayed follow-up tests to examine both stability and sustainability can be recommended for future studies.

In light of the insights on the relevance of combining both cognitive and performance data, the assessment of the two functions of scripts - despite of the complexity of both performance and analysis - is recommended. One approach would refer to involving medical students in simulation-based ward rounds (Ponzer, 2004). Video recordings of students' performance could be contrasted with their understanding and commonalities and differences could be identified (Fanning, & Gaba, 2007).

The intervention study referring to case-based learning with video and reflection prompts can be regarded as a first and important step to get a deeper understanding on how individuals' scripts may be fostered. While the findings indicate a slight change in individuals' scripts, one cannot assume that such an instructional intervention that consists of only four video cases results in a complete change of scripts or the acquisition of what may be called ward round expertise. Instead, both the results from the first study as well as prior research on expertise (Ericsson, 2005; Ericsoon, 2006; Schmidt, & Boshuizen, 1993) pointed out that extensive and continuous professional experience is required to continually increase in understanding and conducting ward rounds properly.

A further limitation of the presented research refers to the measurement of ward round scripts. Prior ward round scripts were measured directly before the intervention which is likely to serve a confounding effect. Even though the pre-intervention scores were controlled for, differences in posttest data could not be fully attributed to the learning environment and the prompts implemented. Future studies should be aware of such confounding effects and assess prior scripts at an earlier stage. Studies should also consider that self-reported data bears the potential to experience a motivational bias or effects that go back to difficulties in externalizing situation specific knowledge which is likely to occur when little guidance is given.

## 9.5 CONCLUSION

After consideration of previous findings and their relevance for both research and teaching practice, the question is to what extent the initial research questions could be answered.

First of all, it was essential to identify a reliable and valid instrument that empowered individuals to externalize their underlying conceptions of ward rounds. The structure formation technique (Scheele, & Groeben, 1988) was found to be a good choice of an instrument.

With the interview study, it was possible to map and contrast medical students' ward round scripts with those of more experienced individuals and to deduce learning goals from determined discrepancies. The instructional intervention provided a first attempt to contribute to the development of ward round scripts. Case-based learning was identified to be a valuable means to providing students with the opportunity to observe ward round practice. Instructional prompts were implemented to structuring learners' attention and to directing it to relevant information.

However, this learning format was less favorable than assumed from a theoretical perspective. It was pointed to one major characteristic of scripts that may be the reason for the little effect of the second study: scripts develop only over time and through repeated exposure with a situation. It was therefore recommended that medical students' ward round scripts should be facilitated in a long-term perspective and refer to various instructional approaches (e.g. case-based learning, simulation- and workplace-based learning) that foster both understanding of and acting in ward rounds to empowering students to induce and reconfigure scripts. With my research I moreover stressed the necessity to also consider the potential of metacognitive processes for script development that previous research lacked.

In conclusion, the presented thesis serves a valuable first step in script research that includes the measurement and facilitation of scripts. The two conducted studies can be used as a starting point and recommend a transfer of findings to other contexts and domains.

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# Appendices

A: Interview schedule for measuring individuals' ward round scripts

| **Kurze Instruktion und Information zum Verlauf dieses Interviews** |
|---|
| Die Frage, der in diesem Interview nachgegangen wird, ist, wie aus Ihrer Sicht der typische Ablauf einer Visite in der inneren Medizin ist. Es geht hier nicht darum, eine bestimmte Visitensituation zu beschreiben, sondern ein allgemeines Ablaufmodell abzubilden. Daher bitte ich Sie, nicht an eine spezielle Visite zu denken, an der Sie heute, vor einer Woche oder zu einem anderen Zeitpunkt teilgenommen haben, sondern an den generellen Ablauf der Visite in der inneren Medizin. Beziehen Sie sich dabei bitte auf die Visiten in der inneren Medizin am Klinikum der LMU.<br>Bei diesem Interview geht es nicht darum, ob Ihre Antwort richtig oder falsch ist. Wir möchten vielmehr verstehen, wie die Visite in der Inneren typischerweise abläuft.<br>Ich werde Ihnen zunächst einige Fragen zu einer typischen Visite stellen und die zentralen Aspekte auf Kärtchen werden derweil mitgeschrieben und in eine Darstellung zu Ihrer Schilderung einer typischen Visite gelegt. Lassen Sie sich dadurch nicht irritieren.<br>Im Anschluss an den ersten Teil des Interviews werde ich Ihnen dahingehend noch einige weitere Fragen stellen. |

| **1 Rollen innerhalb der Visite** | |
|---|---|
| Wer ist typischerweise an der Visite beteiligt? | Auf klare Beschreibung und Bezeichnung der Rollen achten (d.h. ist mit Student ein Student im klin. Studienabschnitt oder im PJ gemeint?) |
| Bitte nutzen Sie für die jeweilige Rolle im weiteren Verlauf diese Bezeichnung, damit wir Sie und Ihre Schilderungen vom typischen Visitenablauf besser verstehen können. | |

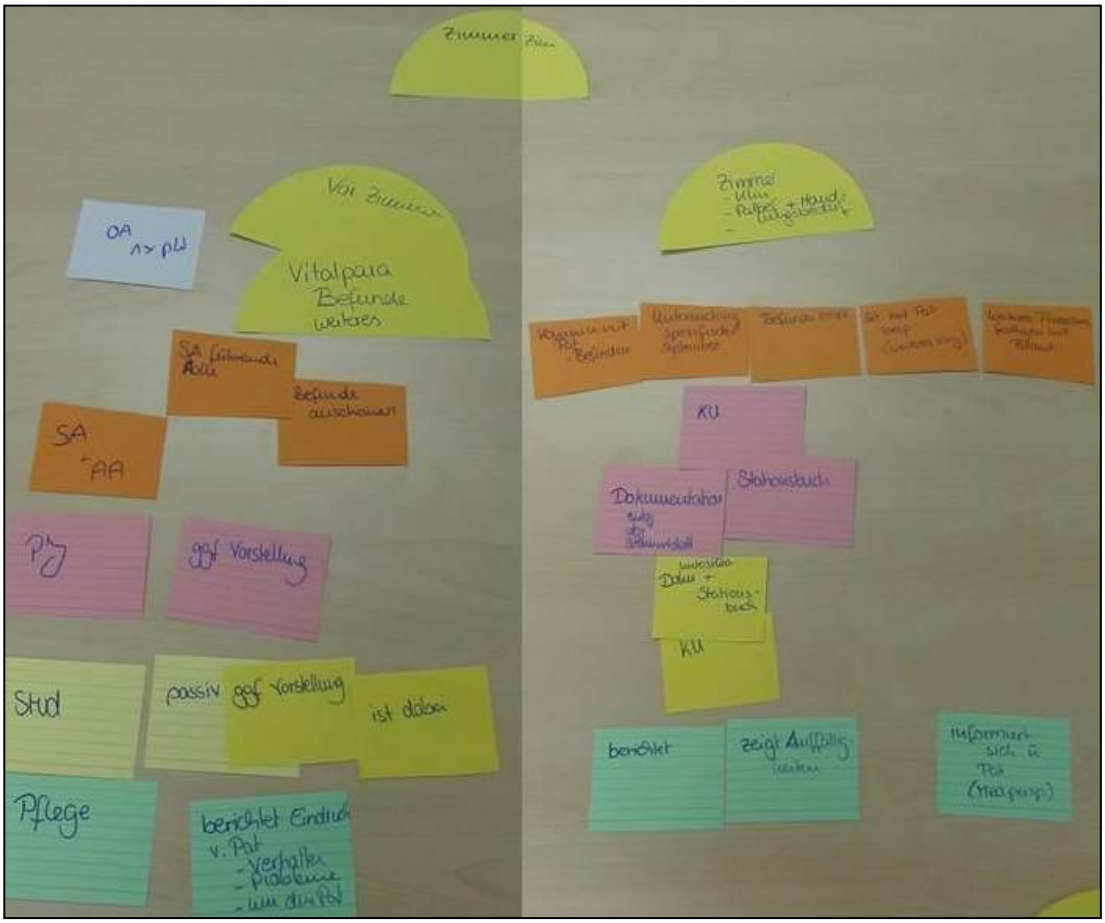
| **2 Szenen innerhalb der Visite** | |
|---|---|
| In welche Phasen bzw. Abschnitte lässt sich die Visite typischerweise untergliedern? | |

| **3 Aktivitäten der einzelnen Rollen in den Szenen der Visite** | |
|---|---|
| Anhand der von Ihnen genannten Phasen und beteiligten Personen würde ich Sie nun bitten, den Verlauf der einzelnen Phasen zu schildern. | |
| Welche Personen sind in der ersten Phase anwesend? | |
| Welche Aktivitäten werden in der ersten Phase typischerweise von wem ausgeführt? | Zur Verdeutlichung:<br>Was passiert in dieser Phase? |

| | |
|---|---|
| | Was tun die einzelnen Personen konkret? Welche Aufgaben haben die einzelnen Personen? |
| Welche Personen sind in der zweiten Phase anwesend? | |
| Welche Aktivitäten werden in der dieser Phase typischerweise von wem ausgeführt? | Phase in dem genannten Begriff wieder geben |
| Welche Personen sind in der dritten Phase anwesend? | |
| Welche Aktivitäten werden in dieser Phase typischerweise von wem ausgeführt? | Phase in dem genannten Begriff wieder geben |
| Welche Personen sind in der vierten Phase anwesend? | |
| Welche Aktivitäten werden in dieser Phase typischerweise von wem ausgeführt? | Phase in dem genannten Begriff wieder geben |
| Welche Personen sind in der fünften Phase anwesend? | |
| Welche Aktivitäten werden in dieser Phase typischerweise von wem ausgeführt? | Phase in dem genannten Begriff wieder geben |

| **4 Konsensfindung zur Strukturlegung** | |
|---|---|
| Anhand Ihrer Antworten wurde diese Darstellung entwickelt. Die Übersicht gibt wieder, wie wir ihre Schilderungen des typischen Visitenverlaufs verstanden haben. | |
| Stimmt diese Darstellung mit dem überein, was sie meinten? | |
| Möchten Sie daran noch etwas verändern, z.B. ergänzen, entfernen, in der Reihenfolge ändern? | |
| Sind alle Personen dokumentiert, die typischerweise beteiligt sind? | |

B: Ward round script of a participant in the interview study



C: Short questionnaire for socio-demographic data and acceptance of the interview technique

Um die Daten über die Teilstudien hinweg zusammen führen zu können, wird ein persönlicher Code verwendet. Dieser ermöglicht eine anonyme Auswertung der gewonnenen Informationen im Verlauf dieses Forschungsprojektes.
Bitte tragen Sie Ihren Code in die dafür vorgesehenen leeren Stellen rechts im Kasten ein.

| **Persönlicher Code** | | |
|---|---|---|
| Der persönliche Code wird aus dem ersten Buchstaben Ihres Geburtsortes, dem zweiten Buchstaben Ihres Vornamens, dem dritten Buchstaben Ihres Nachnamens, dem letzten Buchstaben Ihres Geburtsmonats sowie der letzten Ziffer Ihres Geburtsjahres zusammengesetzt. | | _ _ _ _ _ |
| **Demographische Informationen** | | |
| **Geschlecht** | ☐ | m |
| | ☐ | w |
| **Alter** | _____ | |
| **Profession und Funktion** | **Medizin** | |
| | ☐ | StudentIn im klinischen Studienabschnitt, Modul ___ |
| | ☐ | StudentIn im Praktischen Jahr |
| | ☐ | AssistenzarztIn in Facharztausbildung; Ausbildungsjahr: ____ |
| | ☐ | StationsarztIn |
| | ☐ | OberarztIn |
| | **Gesundheits- und Krankenpflege** | |
| | ☐ | Gesundheits- und KrankenpflegeschülerIn |
| | ☐ | Examinierte/r Gesundheits- und KrankenpflegerIn |
| | ☐ | Weitere Qualifizierung nach Abschluss der Ausbildung, und zwar _____ |
| **Bereich der inneren Medizin** | ☐ | Allgemeininternistischer Bereich |
| | ☐ | Endokrinologie |
| | ☐ | Gastroenterologie |
| | ☐ | (Hämato-)Onkologie/ Rheumatologie |
| | ☐ | Kardiologie |
| | ☐ | Nephrologie |
| | ☐ | Pneumologie |
| **Anzahl der Jahre Berufs-erfahrung auf Station** | _____ | |

Die folgenden Fragen beziehen sich auf das eben durchgeführte Interview und können durch einfaches Ankreuzen beantwortet werden. Bitte antworten Sie möglichst spontan und wahrheitsgetreu.

| | Stimme voll und ganz zu | Stimme eher zu | Stimme eher nicht zu | Stimme gar nicht zu |
|---|---|---|---|---|
| Das Ziel des Interviews war mir klar. | ☐ | ☐ | ☐ | ☐ |
| Die Instruktion war verständlich. | ☐ | ☐ | ☐ | ☐ |
| Die Atmosphäre während des Interviews war angenehm. | ☐ | ☐ | ☐ | ☐ |
| Ich konnte mich gut auf die gestellten Fragen konzentrieren. | ☐ | ☐ | ☐ | ☐ |
| Das Legen der Strukturen hat mich abgelenkt. | ☐ | ☐ | ☐ | ☐ |
| Die Verwendung von Strukturkärtchen ist eine geeignete Methode zur Abbildung des Prozesses der Stationsvisite. | ☐ | ☐ | ☐ | ☐ |
| Das Verfahren des Strukturlegens ist für mich nachvollziehbar. | ☐ | ☐ | ☐ | ☐ |
| Die gelegte Struktur entspricht meinem Verständnis von einer typischen Stationsvisite. | ☐ | ☐ | ☐ | ☐ |
| Durch die gelegte Struktur habe ich ein klareres Bild vom Ablauf der Stationsvisite | ☐ | ☐ | ☐ | ☐ |
| Der zeitliche Aufwand für dieses Interview war angemessen. | ☐ | ☐ | ☐ | ☐ |

**Vielen Dank für Ihre Teilnahme!!**

## D: Coding scheme for the initial recoding of mentioned scenes and scriptlets

| Szene | Inhaltliche Organisation der Scriptletthemen | Scriptlet | Operation |
|---|---|---|---|
| **Rahmen der Visite definieren** | Kommunikation Team | Absprache im Team (z.B. mit Team zusammensetzen) | |
| | Vorbereitung der Visite | Organisatorische Entscheidungen treffen | Visitenbeginn festlegen |
| | | | Visitenteilnehmer festlegen |
| | | Über Station informieren (z.B. Neuaufnahmen, Auslastung der Station) | |
| **Vorbesprechung/ Kurvenvisite im Arztzimmer/ Stationszimmer** | Über Patient informieren | Kurvenvisite | Befunde anschauen |
| | | | Bilder anschauen |
| | | Patienten vorstellen (z.B. Patientenkontext erklären) | |
| | Behandlungsplanung | Anordnung machen | Anordnung schreiben |
| **Vorbereitung der Visite (im Stationszimmer)** | Störungsmanagement | Maßnahmen zur störungsfreien Visite durchführen | Telefon ausschalten |
| | Kommunikation allgemein | Kommunizieren im Team | |
| | | Absprachen im Team treffen | |
| | | Kommunizieren mit Pflege | |
| | | Gespräch leiten | |
| | | Visite leiten | |
| | Über Patienten informieren | Kurvenvisite (z.B. Systematischer Review der Patientenunterlagen, über aktuelle Situation des Patienten informieren) | |
| | | Pflegebericht erfragen | Pflege nach letzten 24h befragen |
| | Über Station informieren | Überblick über Station verschaffen | |
| | Behandlungsplanung | Therapeutische Ziele und Interventionen klären | |
| | Vorbereitung Unterlagen | Materialien vorbereiten | Wagen holen |
| | | | Wagen vors Zimmer fahren |
| | | | Stationsbuch holen |

| | | | |
|---|---|---|---|
| | | | Stationsliste ausdrucken<br>Stationsliste einkleben<br>Verlaufsbogen vorbereiten<br>Verlaufsbogen mitnehmen<br>Schwester Bescheid geben<br>Fehlende Informationen besorgen |
| | Varia | | mitlaufen |
| **Besprechung vor dem Zimmer** | Kommunikation allgemein | Gespräch leiten<br>Rücksprache halten<br>zuhören<br>Compliance erzeugen | |
| | Teamwork | Teamarbeit | |
| | Fragen und Antworten | Fragen stellen (z.B. Nachfragen/ kann Fragen stellen) | Stellt Verständnisfrage (z.B. fragt, wenn etwas unklar ist)<br>Stellt Frage zu Krankheit/ Therapie |
| | Vorbereitung | Vorbereitung der Kurven | Kurven holen |
| | Über Patienten informieren | Informationen austauschen (geben/ empfangen) | Informationen ergänzen<br>Wird informiert |
| | | Patienten vorstellen (z.B. Anamnese berichte, Patientendaten wissen, Anamnese berichten)<br>Sich Patient vorstellen lassen (Fragt, wer im Zimmer liegt)<br>Patienten besprechen (z.B. aktuelle Situation des Patienten besprechen, Patient diskutieren; aktuellen Stand überlegen)<br>Bisheriges Vorgehen berichten (Zusammenfassen bisheriges Vorgehen)<br>Veränderungen besprechen<br>Neue Befunde besprechen | |
| | | Stationsbuchs konsultieren | Patientenliste anschauen |
| | | Kurve konsultieren (in Kardex schauen) | Vitalparameter angucken<br>Neue Befunde angucken<br>Bilder rekapitulieren<br>Labor angucken<br>Medikamente prüfen<br>Ausstehende Untersuchungsergebnisse holen |
| | | Pflegebericht erfragen | Pflege nach letzten 24h befragen |
| | | Pflegebericht geben | Berichtet über besondere Ereignisse |
| | Gespräch planen | Ziel für Patientengespräch festlegen | |

| | | | |
|---|---|---|---|
| | Behandlung planen | Vorstellen von Behandlungsplan (z.B. Informieren über Einleiten neuer Untersuchungen; stellt geplante Behandlung vor;) | |
| | | Anordnung machen | Anordnung schreiben |
| | | Erhält Anweisung | |
| | | Untersuchung koordinieren | |
| | | Behandlungsplan besprechen (z.B. Vorgehen besprechen; diskutiert Behandlungsvorschläge) | |
| | Lehre | Teaching (inkl. Gedankenprozesse explizit machen)/ Lehre | |
| | | Studenten abfragen | |
| | | Korrigiert Antwort | |
| | | Feedback geben | |
| | | Bewertung der Entscheidungen der jüngeren Teamkollegen | |
| | | Student einbeziehen | |
| | Varia | Beobachtet | |
| | | Ist anwesend | |
| | | Über Zuständigkeiten informieren | |
| **Patientenvorstellung** | Fragen und Antworten | Fragen stellen | |
| | Kommunikation allgemein | zuhören | |
| | Über Patient informieren | Patienten vorstellen | |
| | | Untersuchungsergebnisse besprechen | |
| **Konsultation des Patienten/ Gespräch mit Patienten im Zimmer** | Kommunikation allgemein | Patient begrüßen | Hallo sagen |
| | | Visitenteam vorstellen | Sich vorstellen |
| | | Smalltalken | |
| | | beitragen | |
| | | Anweisungen machen | |
| | | Mit Arzt absprechen | |
| | | Gespräch leiten (moderieren) | |
| | | diskutieren | |
| | | Verabschieden | Handschlag |
| | | | Auf Wiedersehen sagen |
| | | Zuhören | Patienten zuhören |
| | | Nonverbal kommunizieren | Freundlich gucken |
| | | Probleme besprechen | |
| | | deeskalieren | |
| | Arzt-Patient-Kommunikation | Kommuniziert (mit Patienten; Gespräch mit Patienten) | Primärkontakt aufnehmen |
| | | Zwischen Oberarzt und Patient vermitteln | Korrigierend eingreifen |

| | | |
|---|---|---|
| | (Patient) kommuniziert | Eigenes Empfinden ansprechen |
| | Anamnese validieren | |
| Patient informieren | Über Untersuchungsergebnisse informieren | |
| Fragen und Antworten | Fragen stellen (z.B. Visitenteam fragen) | Nach Veränderungen des Befindens fragen |
| | | Fragt nach Befinden des Patienten |
| | | Fragt nach Nebenwirkungen |
| | | Fragen nach Neuigkeiten von Patientenseite stellen |
| | | Fragt, ob Patient Fragen hat |
| | | Erwartungen des Patienten erfragen |
| | Verständnis prüfen | Prüft, ob Patient alles verstanden hat (z.B. stellt Sicherheitsfrage) |
| | | Antwortet, ob er verstanden hat |
| | Fragen beantworten | Fragen/ Rückfragen des Patienten beantworten |
| | Fragen an Studierende stellen | |
| | Student einbeziehen | |
| Über Patient informieren | Informationen beschaffen | In Kurve gucken |
| | Informieren | Informationen ergänzen (zu Befund/ Gespräch) |
| | Eindruck vom Patient verschaffen | |
| | Anamnese (sich ein Bild vom Patienten machen) | |
| | Pflegebericht anfordern | Fragt Pflege nach Auffälligkeiten |
| | | Frage an Pflege stellen |
| | Pflegebericht geben | Gibt Informationen zu Patienten beitragen |
| | Ziele der Visite formulieren | |
| | Über Untersuchung aufklären | |
| Patient informieren | Ergebnisse mitteilen | |
| | Informationen über Behandlung geben (z.B. Vorgehen besprechen; Untersuchungsmethode erklären; weiteres Prozedere erklären) | |
| | Über Entlassung informieren | |
| | Über Behandlung aufklären (Aufklärungsgespräch) | |
| | Diagnose überbringen | |
| | erklären | |
| Informationen sichern | Dokumentieren | Mitschreiben im Stationsbuch |
| | | Notizen machen |
| | SOP-Note schreiben | Notiert subjektives Befinden |
| | | Notiert objektive Befunde |
| | | Notiert Planung |
| Untersuchung | Patienten untersuchen | Hört rauf |

| | | | |
|---|---|---|---|
| | | | Wunde anschauen |
| | Behandlung planen | Planen | |
| | | Mit Patienten verhandeln | |
| | Entlassung planen | Plant Entlassung | |
| | Behandlung durchführen | | Medikamente geben |
| | Aufgabenverteilung | Anweisungen entgegen nehmen | |
| | varia | Ist dabei/ u.U. auch aktiv | |
| | | Bringt sich ein | |
| | | | Kurve tragen |
| | | Andere Personen heraus bitten | |
| | | Patient trösten | |
| **Lehre** | Kommunikation allgemein | moderieren | |
| | Über Patient Informieren | Information beschaffen | In Kurve gucken |
| | | | ergänzen |
| | Fragen und Antworten | Fragen stellen (nachfragen/ Rückfragen stellen) | |
| | | Befragt werden | Zu Befunden befragt werden |
| | Klinisches Denken | Übung klinischer Beurteilungskraft (z.B. Einschätzung zur Durchführung treffen) | |
| | | nachvollziehen | |
| **Besprechung (bisheriger) Therapie/ Behandlung** | Kommunikation allgemein | Pflege konsultieren | |
| | | Diskutieren der Symptome und Behandlung des Patienten | |
| | | Verabschieden | Sagt, wir sehen uns später |
| | | Nonverbal kommunizieren | Freundlich gucken |
| | Fragen und Antworten | Fragen stellen | |
| | | Patient befragen | Fragt, ob Patient alles verstanden hat |
| | | Pflege befragen | Pflege befragen |
| | | Verständnis prüfen | Fragt, ob Person alles verstanden hat (z.B. Sicherheitsfrage stellen) |
| | Behandlung planen | Therapie mit Pflege besprechen (z.B. Diskutieren medizinischer Aspekte mit Pflege unter Berücksichtigung bestehender Behandlungspläne) | Sagt, so machen wir das |
| | Über Patient informieren | Pflegebericht anfordern | |
| | | Pflegebericht geben | |
| | | Zusammenfassen des Behandlungsverlaufs | |
| | Patienten informieren | Über Therapie informieren | |
| | | Rückmeldung an Patienten geben | |
| | | Über Untersuchung informieren | |
| | Lehre | Lehrt | |
| | | Studierende befragen | |

| | | | |
|---|---|---|---|
| **Besprechung/ Mitteilen von Untersuchungsergebnissen** | Über Patient informieren | Kurve konsultieren | Laborergebnis anschauen |
| | Behandlungs- und Diagnosemanagement | Bewerten der (neuen) Ergebnisse (Labor, Röntgen, Medikamente) | |
| | | Behandlungsverlauf bewerten | |
| | | Diagnose prüfen (verfeinern der Diagnose) | |
| | Patienten informieren | Mitteilen von Untersuchungsergebnissen | |
| **Körperliche Untersuchung** | Kommunikation allgemein | Beendet Gespräch | |
| | Fragen und Antworten | Stellt Fragen an Studierende | |
| | Untersuchung | Untersuchen des Patienten | |
| | | Kollegen untersuchen lassen | |
| | | Untersuchung demonstrieren | Auf Auffälligkeiten aufmerksam machen |
| | Behandlung planen | Medikamente besprechen | |
| | | Vorgehen planen | |
| | | Beschluss finden | Trägt zur Beschlussfindung bei |
| | | | Ergänzt Beschlussfassung |
| | Varia | Zugucken (z.B. beobachten) | |
| | | Ggf. parallel andere Dinge tun | Aus/ Ins Zimmer gehen |
| **Behandlungsplanung/ Besprechen des weiteren Behandlungsverlaufs** | Kommunikation | Absprache mit Pflege treffen | |
| | | Sich zurück halten | |
| | Fragen und Antworten | Fragen stellen | Bei Unklarheit Frage stellen |
| | | | Frage nach Alternative stellen |
| | | Über Verständnis des Patienten versichern | Frage nach Verständnis des Patienten (ob Patient alles verstanden hat) |
| | Patient informieren | Prozedere erklären | ergänzen |
| | | informiert über Details/ Gründe | |
| | Behandlungsplanung | Vorgehen korrigieren (z.B. Anpassungen machen) | |
| | | Besprechen therapeutischer Ziele | |
| | | Über Untersuchungen entscheiden | |
| | | Patient über Entscheidungen informieren (z.B. Spezifizieren von Problemen, über die später entschieden wird/ wann die Entscheidung getroffen wird) | |
| | | Behandlung planen | |
| | | Prioritäten setzen | |
| | | Anordnung machen | Tests anordnen |
| | Behandlung durchführen | Therapie durchführen | Chemo anhängen |
| | Klinisches Denken | überlegen | |
| | Lehren | Lehren/ Teaching | Erklären der Möglichkeiten und Entscheidungen |
| | Teammanagement | Aufgaben verteilen | Aufgaben an Studierende verteilen |
| | Varia | Einnehmen der Patientenrolle | |

| | | | |
|---|---|---|---|
| **Entlassungsplanung & klären offener Fragen** | Entlassungsplanung | Entlassung planen | |
| | Fragen und Antworten | Fragen stellen | |
| | | | Sicherheitsfrage stellen |
| | | | Fragt, ob Patient alles verstanden hat |
| | | | Stellt offene Fragen zu Unklarheiten |
| | | Antworten | Alles klar/ nicht klar |
| | | Rück-/Fragen beantworten | |
| | Behandlung planen | Weiteres Vorgehen planen | Auf späteres Gespräch verweisen |
| | Hygiene | Hygienisch verhalten | Hände desinfizieren |
| **Festhalten von Anordnungen** | Behandlung planen | Anordnungen machen | |
| | Informationen sichern | Dokumentieren | |
| **Nachbesprechung vor Zimmer** | Kommunikation allgemein | Fasst Visite zusammen (z.B. erklärt noch einmal, was neu ist) | |
| | | Fasst zusammen | |
| | | Erläutern medizinischer Konzepte | |
| | | Besprechen gemeinsamer Einschätzung (z.B. mit OA; Diskutieren; Klärung komplizierter Fälle/ Prozedere, bringt sich ein; Fall noch näher besprechen) | Ergänzt Eindruck |
| | | Feedback geben | |
| | | zuhören | |
| | | Auf OA eingehen | |
| | Fragen und Antworten | Fragen stellen | Stellt Verständnisfragen (Frage stellen, wenn etwas unklar ist; Frage nach Befunden stellen) |
| | | Wird gefragt | |
| | | Lehrbezogene Fragen stellen | |
| | | Fragen beantworten | Eine bestimmte Frage der Studierenden beantworten |
| | Informationen austauschen | Information ergänzen | |
| | Informationen sichern | Unklarheiten erklären (den Studierenden) | |
| | | Zusammenfassen der Diagnose und Untersuchung | |
| | Behandlung planen | Behandlung planen (z.B. weiß, was noch zu tun ist; Untersuchungen festlegen; Plan für weiteres Prozedere) | |
| | | Besprechung des Vorgehens (wenn Austausch zwischen mehreren Personen klar heraus vorgeht) | |
| | | Zusammenfassen der Planungen | |
| | | Konsensfindung mit dem Team und Pflege bzgl. der Pläne(endgültigen Beschluss) fassen) | |
| | Behandlung durchführen | Untersuchung in die Wege leiten | |
| | | Medikamente anpassen | |

| | | | |
|---|---|---|---|
| | Lehre | Lehren | |
| | | Lernt/ nimmt an Lehre teil | |
| | | Fragt Studierende was wichtig war | |
| | | Fragt Studierende aus | |
| | | Notizen machen | |
| | | Information nachschlagen | |
| | Klinisches Denken | Prüfen des Plausibilitätsgehalts | |
| | | Evidenzen schaffen | |
| | | reflektieren (Gedanken machen) | |
| | Teammanagement | Verteilt Aufgaben | Auftrag zur Informationsrecherche an Studierende geben |
| | | Übernimmt Aufgabe | Briefe schreiben |
| | Varia | Bewertung der Visite | Patient für Untersuchung anmelden |
| | | Stationsarzt informieren | |
| | | Kurve konsultieren (z.B. Akte ansehen, In Kardex schauen) | |
| **Aufgabenverteilung** | Teammanagement | Aufgaben verteilen | |
| | | Leitet Aufgabenverteilung | |
| | | Verantwortliche festlegen | |
| **Kurvenvisite am Nachmittag** | Kommunikation allgemein | Fasst Visite zusammen | |
| | | Zusammenhänge erläutern | |
| | | Mit OA kommunizieren | |
| | Fragen | Fragen stellen | |
| | | Fragen beantworten | |
| | Über Patient informieren | Kurve konsultieren | Befunde anschauen |
| | | reflektiert | |
| | Aufgabenbearbeitung | Organisatorisches erledigen | Untersuchung anmelden |
| | | Informationen beschaffen | Wird bei Nachfragen kontaktiert |

E: Coding scheme for the script components role, scene, scriptlet and operation based on Fischer et al. (2013)

| | Definition | Coding rule | Example (data) |
|---|---|---|---|
| **Scene** | The scene component refers to a phase of the overall situation. It encompasses actions of at least one individual that are directed towards a goal. The scene component also comprehends information regarding the physical and chronological setting of a situation. | Code when an interviewee mentioned a scene as such and when this scene comprehends actions of at least one person that are directed towards an instrumental goal. Single activities are not coded as a scene. | - Preparation of the round<br>- Consultation of the patient<br>- Treatment planning |
| **Scriptlet** | The scriptlet component contains knowledge on activities that are performed by one person. Scriptlets are specific for a particular scene and can consist of several operations. | Code when (sequences of) activities are mentioned that are directed to a goal. | - Examine patient<br>- Discuss treatment |
| **Operation** | The operation component contains knowledge on parts of scriptlets that are low in complexity, contribute to a scriptlet and are performed by one person. | Code when a part of a superordinate activity is mentioned that contributes to the goal of a higher order task. | - Disinfect hands<br>- Look up a result in patient file |
| **Role** | The role component comprehends knowledge on individuals involved in a situation who perform activities. | Code when a person mentioned an individual involved in the ward round process. | - (Ward/senior) physician<br>- Student<br>- Nurse<br>- Patient |

## F: Coding scheme for content scenes

| Content scene | Definition | Coding rule | Example (data) |
|---|---|---|---|
| Define ward round context | This content scene refers to the phase of the round in which the context of the round is defined and considers time and involved persons. | When a named phase comprehends information on determining a time-slot and/or the ward round team | - Determination of ward round participants<br>- Determination of a timeslot for the ward round |
| Chart round | The chart round refers to a meeting between physicians (and nurses) in which the patient is discussed. This meeting takes place in the physicians' or nurses' room. | When a named phase refers to chart rounds that are performed in physicians' or nurses' room to discuss patients.<br>Does not apply to chart consultations in front of patient's room. | - Chart round (in physicians' room) |
| Preparation of the round | This content scene refers to preparation of the round by means of patient data, examination results and ward round material. | When a named phase explicitly refers to preparation of patient data, examination results and ward round material.<br>Does not apply to decisions regarding the ward round context. | - Prepare charts<br>- Organize examination results |
| Patient presentation | This content scene refers to a phase in which a patient is presented to the ward round team. | When a named phase refers to a sequence of activities that target presentation of the patient. | - Present patient<br>- Ask for patient presentation<br>- Nurses' report |
| Discussion of results | This content scene refers to the discussion of results from previous examinations or the physical examination of the patient. | When a named phase refers to a sequence of activities that target the presentation and discussion of results from prior examinations and the examination of the patient. | - Presentation of the results of an examination<br>- Discussion of results |
| Treatment planning | This content scene refers to a sequence of activities that target the further planning of the treatment of a patient. | When a named phase refers to a sequence of activities that are tied to discussing and planning treatment both within the ward round team and with the patient. | - Planning future treatment<br>- Discuss treatment options |
| Discharge planning | Discharge planning refers to planning that considers patient's discharge and follow-up care. | When a named phase refers to a sequence of activities that target the planning of discharge of a patient and follow-up care both within the ward round team and with the patient. | - Planning patient's discharge<br>- Discuss follow-up care |

| | | | |
|---|---|---|---|
| Teaching | Teaching refers to educational activities for both physicians and students in the course of the ward round. | When a named phase contains a sequence of activities that are linked to teaching and learning activities. Applies for educating both physicians and students. | - Ask students/physicians questions<br>- Demonstrate a physical examination |
| Documentation | Documentation refers to a phase in which assurance of data is the focus. | When a named phase refers to a series of activities that target the assurance of gained data in patient's file or in a notebook. | - Documentation<br>- SOP-note |
| Communication with patient | Communication with patient refers to interactions between the ward round team and the patient. | When a named phase refers to general interactions between the ward round team and the patient.<br>Does not apply to communication in the context of treatment and discharge planning. | - Interact with patient<br>- Asking questions |
| Physical examination | Physical examination refers to a focused physical check. | When a named phase refers to the examination of the patient performed by physicians or students. | - Examine patient<br>- Check vital signs |
| Task distribution | Task distribution refers to an interactional process in which organizational tasks are distributed within the ward round team. | When a named phase refers to a sequence of activities that refer to the organization of tasks and their distribution between the members of the ward round team. | - Distribute tasks<br>- Take over tasks |
| Discussion and reflection on patient | This scene defines a process in which the ward round team discusses and reflects on the patient to find a consensus on important aspects. | When a named phase refers to a sequence of activities that refer to the discussion and reflection of patient within the ward round team. | - Finding a consensus within the ward round team<br>- Share impressions on the patient<br>- Summing the consultation of the patient up |
| Working on decisions | This scene defines a process in which the ward round team works on decisions made in the ward round. | When a named scene refers to a sequence of activities that target on working on decisions made in the course of the ward round. | - Perform a treatment<br>- Change medication<br>- Organize an examination |

G: Coding scheme for classifying ward round activities in terms of their content referring to Steinert, & Walton (2010) and Weber et al. (2008)

| | Definition | Coding rule | Example (data) |
|---|---|---|---|
| **Medical** | Medical comprises all those activities that refer to the aim of treating patients. This includes also communicative activities that explicitly refer to medical issues. | Code when activities directly refer to treatment of patients and when communicative activities refer to medical issues.<br>No code when activities' main focus in on communication, administration or teaching and learning. | - chart consultation<br>- present patient<br>- ask for nurse's report<br>- clarify medical goals<br>- consult other staff<br>- exchange information (on patient)<br>- prescribe medication |
| **Social** | Social comprises all those activities that refer to the social aims. They refer to interactions between different participants of ward rounds. Social does not involve communication that refers directly to medical issues. | Code when activities directly refer to social aims that are reached through interaction and/or communication. This also includes activities with a social focus that cannot be assigned to medical aims.<br>No code when activities' main focus in on medical, administration or teaching and learning. | - communicate with team (general)<br>- make an agreement with team (general)<br>- lead conversation<br>- communicate (general)<br>- reach compliance<br>- ask questions (general) |
| **Administrative** | Administrative comprises all those activities that refer to organizational aspects that refer to maintenance of patient. | Code when activities directly refer to organizational aspects in the course of ward rounds.<br>No code when activities' main focus is on medical, social or teaching and learning. | - define beginning of ward round<br>- get an overview on ward<br>- distribute tasks<br>- keep records<br>- register patients for examination<br>- discharge planning |
| **Teaching and learning** | Teaching and learning comprises all those activities that refer to teaching and learning related aspects of ward rounds that refers to education and professional development. | Code when activities directly refer to goels in terms of education and professional development for both students and physicians.<br>No code when activities' main focus in on medical, social or administrative. | - ask students<br>- check learners' understanding<br>- teach<br>- learn<br>- provide feedback<br>- demonstrate examinations |
| **Non-demanding** | Non-demanding comprises all those activities that refer to acting that is not directed towards ward round goals and are low in complexity in terms of affordances. | Code when activities are neither related to medical, social, administrative, teaching and learning but when they focus unspecific aspects. | - attend<br>- look friendly<br>- open the door<br>- enter/ leave room |

H: Coding scheme for scriptlets' potential for knowledge construction referring to Chi's (2009; 2011) framework of overt learning activities

| | Definition according to Chi and Chi & Wiley | Original examples (school context) | Associated verbs (for ward rounds) | Examples (for ward rounds) |
|---|---|---|---|---|
| **Interactive** | "Refers to two or more students engaging with each other through dialogue." | Explaining jointly with a peer<br>Building on each other's contributions in a WIKI way<br>Arguing with a peer (requesting & providing justification)<br>Reciprocally teaching a peer and responding to his questions<br>Discussing a joint product (concept map) with a peer | Discuss<br>Talk about sth<br>Teach<br>Check students' knowledge<br>Communicate | Consensus in ward round team<br>Discuss problems<br>De-escalate<br>Ask nurse for report<br>Question students<br>Come to an agreement with nurse |
| **Constructive** | "Students are constructively engaged when they generate some information beyond what was presented in the learning materials." | Drawing a concept map or a diagram;<br>Self-explaining or elaborating text sentences in an example<br>Posing questions<br>Providing justifications<br>Forming hypotheses<br>Comparing & contrasting | Summarize<br>Explain<br>Judge<br>Inform<br>Ask (general questions)<br>Add information<br>Contribute<br>Plan | Clarify relationships<br>Summarize ward round<br>Contribute impression<br>Plan discharge<br>Decide on examination<br>Check for plausibility |
| **Active** | "We define active engagement as when students are doing something with their hands (or bodies) with the materials." | Copying the solution from the board<br>Underlining the important sentences<br>Manipulating or measuring test tubes<br>Pointing<br>Rehearsing or repeating definitions | Have a look at sth<br>Look at sth<br>Get sth<br>Lead<br>Document<br>Write<br>Note | Document in ward book<br>Have a look at wound<br>Sanitize hands<br>Make a command<br>Register patient for examination<br>Define responsible person<br>Ask for wellbeing |
| **Passive** | "We define the observable behavior of Passive to be when students are oriented toward or receiving instrution (this is what can be considered as "paying attention").<br>But they are not doing anything else overtly. " | Listening to a lecture without taking notes<br>Watching a video or observing a demonstration<br>Studying a worked example<br>Reading silently | Listen<br>Follow so<br>Observe<br>Watch | Get informed<br>Look friendly<br>Let colleagues examine patient<br>Be there<br>Listen to patient<br>Attend |

I: Mentioned content scenes for each expertise group

| Content scenes | Novice | Intermediate | Advanced intermediate | Expert | Total |
|---|---|---|---|---|---|
| **Briefing in doctors'/ nurses' room** | | | | | |
| Chart review | 1 | 2 | 2 | 2 | 7 |
| **Briefing in front of patient's room** | | | | | |
| Chart review | 5 | 5 | 3 | 3 | 16 |
| Patient presentation | 5 | 8 | 7 | 8 | 33 |
| Discussion of findings | 2 | 1 | 1 | 2 | 6 |
| Treatment planning | 2 | 2 | 2 | 3 | 9 |
| Teaching | 3 | 2 | 0 | 0 | 5 |
| Documentation | 0 | 1 | 0 | 0 | 1 |
| Distribution of tasks | 0 | 0 | 0 | 1 | 1 |
| Discussion and reflection of patient | 1 | 1 | 2 | 1 | 5 |
| Working on decisions | 1 | 0 | 2 | 0 | 3 |
| **Consultation of patient in patient's room** | | | | | |
| Chart review | 0 | 1 | 2 | 0 | 3 |
| Patient presentation | 2 | 1 | 2 | 2 | 7 |
| Discussion of findings | 9 | 3 | 5 | 3 | 20 |
| Treatment planning | 11 | 8 | 8 | 11 | 38 |
| Discharge planning | 0 | 1 | 2 | 0 | 3 |
| Teaching | 3 | 1 | 2 | 5 | 11 |
| Documentation | 0 | 1 | 3 | 1 | 5 |
| Communication with patient | 15 | 11 | 12 | 12 | 50 |
| Physical examination | 6 | 7 | 9 | 11 | 33 |
| Distribution of tasks | 2 | 0 | 0 | 1 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| Discussion and reflection of patient | 1 | 2 | 0 | 1 | 4 |
| Working on decisions | 0 | 1 | 2 | 3 | 6 |
| **Debriefing in front of patient's room** | | | | | |
| Discussion of results | 0 | 0 | 0 | 1 | 1 |
| Treatment planning | 1 | 2 | 0 | 2 | 5 |
| Teaching | 4 | 1 | 1 | 3 | 9 |
| Documentation | 2 | 1 | 2 | 1 | 6 |
| Distribution of tasks | 3 | 0 | 0 | 4 | 7 |
| Discussion and reflection on patient | 7 | 3 | 4 | 5 | 19 |
| Working on decisions | 3 | 0 | 0 | 2 | 5 |
| **Debriefing in doctors'/ nurses' room** | | | | | |
| Chart review | 1 | 0 | 0 | 0 | 1 |
| Discussion of findings | 1 | 0 | 0 | 1 | 2 |
| Distribution of tasks | 0 | 0 | 0 | 1 | 1 |
| Discussion and reflection of patient | 1 | 0 | 0 | 0 | 1 |
| Working on decisions | 1 | 0 | 0 | 1 | 2 |

J: Coding scheme for scriptlets' potential for knowledge construction referring to Chi's (2009) framework of overt learning activities extended by high and low level passive activities

| | Definition | Coding rule | Examples (for ward rounds) |
|---|---|---|---|
| **Interactive** | Interactive activities refer to two or more students engaging with each other through dialogue | Explaining jointly with a peer<br>Building on each other's contributions in a WIKI way<br>Arguing with a peer (requesting & providing justification)<br>Reciprocally teaching a peer and responding to his questions<br>Discussing a joint product (concept map) with a peer | Consensus in ward round team<br>Discuss problems<br>De-escalate<br>Ask nurse for report<br>Question students<br>Come to an agreement with nurse |
| **Constructive** | Constructive refers to activities in which students are constructively engaged when they generate some information beyond what was presented in the learning materials. | Drawing a concept map or a diagram;<br>Self-explaining or elaborating text sentences in an example<br>Posing questions<br>Providing justifications<br>Forming hypotheses<br>Comparing & contrasting | Clarify relationships<br>Summarize ward round<br>Contribute impression<br>Plan discharge<br>Decide on examination<br>Check for plausibility |
| **Active** | Active refers to activities in which students are doing something with their hands (or bodies) with the materials. | Copying the solution from the board<br>Underlining the important sentences<br>Manipulating or measuring test tubes<br>Pointing<br>Rehearsing or repeating definitions | Document in ward book<br>Have a look at wound<br>Sanitize hands<br>Make a command<br>Register patient for examination<br>Define responsible person<br>Ask for wellbeing |
| **Passive high** | High level passive activities refer to learning activities that cannot be observed and involve or provoke cognitive activity. | Code when activity cannot be observed but involves or provokes cognitive activity. | Get informed<br>Listen to patient |
| **Passive low** | Low level passive activities refer to learning activities that cannot be observed and do neither involve nor provoke cognitive activity. | Code when activity cannot be observed and does neither involve nor provoke cognitive activity. | Look friendly<br>Be there<br>Attend |

K: Cases used for study 2

## Anaphylaktische Reaktion

Stefanie Müller (32 Jahre) wurde gestern am frühen Abend über die Notaufnahme der Klinik bei anaphylaktischer Reaktion auf einen Insektenstich aufgenommen (Erstereignis). Mit Urtikaria und Juckreiz wurde der Patient per Notarzt in die Notaufnahme gebracht (Vitalparameter bei Aufnahme: AF 20/min, HF 100/min, RR 95/60 mmHg). In der körperlichen Untersuchung fiel zudem eine bronchopulmonale Spastik sowie geringe Zungeschwellung auf. Es erfolgt die Therapie mittels inhalativer Adrenalin- und Sauerstoffgabe sowie die iv-Gabe von Flüssigkeit, Prednisolon sowie Histamin-Antagonisten, welche die Symptomatik rasch verbesserten. Zur weiteren Überwachung wurde die Patientin stationär aufgenommen.

## Thrombose und Lungenembolie

Die 38-jährige Frau Schneider stellte sich vor 4 Tagen in der Notaufnahme der Klinik bei zunehmender Atemnot vor. Eigentlich war die Patientin bis wenige Wochen vor Aufnahme in der Klinik komplett gesund und belastbar gewesen (regelmäßige sportliche Betätigung; keine relevanten Vorerkrankungen). Die Patientin ist Investmentbankerin und hatte in den letzten Wochen aus beruflichen Gründen mehrere Langstreckenflüge. Vor etwa 3 Wochen hatte sie auch eine kurzzeitige Schwellung der linken Wade bemerkt, die aber wieder vergangen sei. In der Notaufnahme fallen in der körperlichen Untersuchungen eine Tachypnoe (AF 24/min), eine Sinustachykardie mit einer Herzfrequenz von 105/min sowie eine geringe Druckdolenz des linken Unterschenkels auf.

Durch CTAngiographie des Thorax und Duplexsonographie der Beinvenen wird die Diagnose einer ausgeprägten beidseitigen Lungenembolie als Folge einer tiefen Venenthrombosen des linken Beins gestellt. Klinisch und echokardiographisch zeigen sich mäßige Rechtsherzbelastungszeichen, so dass die Patientin auf die Überwachungsstation übernommen wurde. Bei rascher Besserung der Rechtsherzbelastung wurde auf eine Lyse verzichtet und die Patientin wurde auf Normalstation verlegt.

## Pneumonie

Die 61-jährige Frau Wirth wurde zwei Tage zuvor bei zunehmender Minderung des Allgemeinzustandes und Fieber über die Notaufnahme der Klinik auf Ihre Station aufgenommen. Ein „beginnender Infekt“ bestand nach Angaben der Patientin schon seit etwa 4 Tagen, bei zunehmendem Krankheitsgefühl und nun Fieber stellt sich die Patientin in der Notaufnahme vor. Sie war bisher nie im Krankenhaus gewesen und nimmt aufgrund eines arteriellen Hypertonus Ramipril (2,5 mg/d) ein - dieser sei hierdurch gut eingestellt. Die Patientin rauche ca. 1 Schachtel Zigaretten pro Tag seit ca. 25 Jahren und habe keine Allergien.

## Gallensteine

Herr Kohler, 47 Jahre, wurde am Vortag aufgenommen, weil die etwa 2 Tagen rechtsseitige Oberbauchschmerzen bestünden. Laut Patient konnte der Hausarzt bisher weder im Labor noch im Ultraschall etwas Auffälliges feststellen. Herr Kohler war bisher nie ernsthaft krank. Der Patient ist Raucher/in (1/2 Schachtel pro Tag seit 25 Jahren). Der Systemüberblick war bis auf die oben genannten Symptome unauffällig.

Bei Aufnahme bestand im rechten Oberbauch bei tiefer Palpation ein Druckschmerz ohne Abwehrspannung. Die Leber war 2 cm unter dem Rippenbogen palpabel. Die übrige körperliche Untersuchung war unauffällig. In den laborchemischen Untersuchungen waren auffällig: Gamma-GT 90 U/l (Referenzwert bis 60 U/l bei Männern); CRP 3 mg/dl (Referenzwert < 1 mg/dl). Das Bilirubin (dir/indirekt), Blutbild inkl. Leukozyten sowie die weiteren Routineparameter waren unauffällig. In einer ersten Abdomensonographie am Aufnahmetag waren die Beurteilbarkeit bei erschwerter Schallbarkeit stark eingeschränkt (Keine Nüchternheit; Darmgasüberlagerung; Adipositas). Soweit beurteilbar, war Sludge in der Gallenblase zu erkennen, 1 solitärer 2cm großer Stein in der Gallenblase, kein sicherer Steinnachweis in den Gallegängen, Ductus hepaticus communis nicht gestaut. Die Gallenblasenwand war ca. 5 mm dick, ohne Dreischichtung (normale Dicke 2-4 mm).

L: Test for students' prior medical knowledge used for study 2

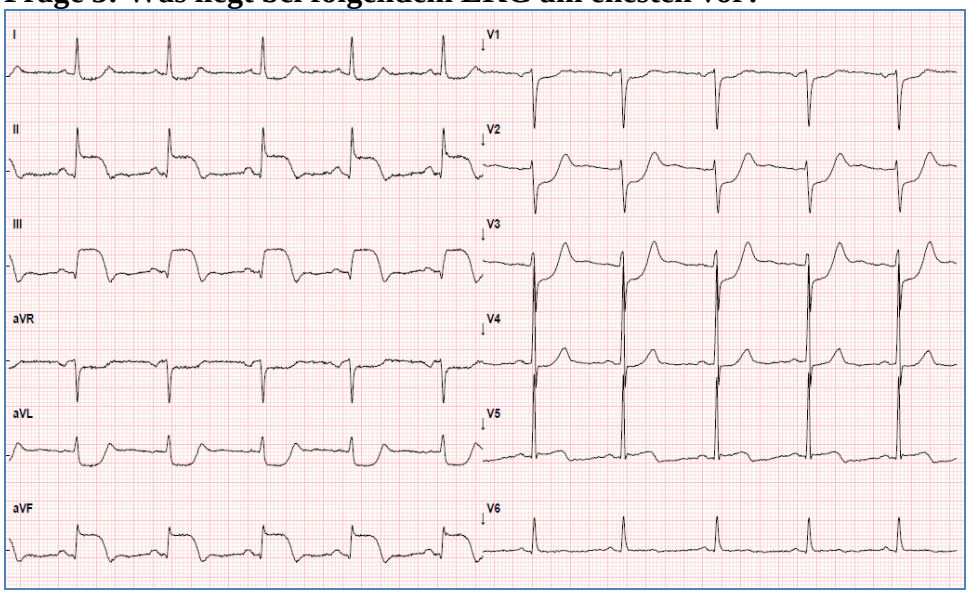
**Frage 1: Welche der folgenden Medikamente sollte am ehesten bei einer anaphylaktischen Reaktion verabreicht werden?**

- ☐ Dihydralazin
- ☐ Dihydrocodein
- ☐ Dihydrogenkarbonat
- ☐ Dimenhydrinat
- ☐ Dimetinden
- ☐ Weiß ich nicht

**Frage 2: Welcher Laborparameter ist am ehesten bei einer hämolytischen Anämie <u>vermindert</u>?**

- ☐ Direktes Bilirubin
- ☐ Ferritin
- ☐ Haptoglobin
- ☐ MCV (=Mittleres Korpuskuläres Volumen)
- ☐ Retikulozytenzahl
- ☐ Weiß ich nicht

**Frage 3: Was liegt bei folgendem EKG am ehesten vor?**



- ☐ AV-Block Grad II
- ☐ Hinterwandinfarkt
- ☐ Linksanteriorer Hemiblock
- ☐ Rechtstyp
- ☐ Schwere Hyperkaliämie
- ☐ Weiß ich nicht

**Frage 4: Welcher der folgenden ist am ehesten ein Risikofaktor für eine Lungenarterienembolie?**

- ☐ Homozygote Faktor V-Leiden Mutation
- ☐ Therapie mit Rivaroxaban
- ☐ Thrombopenie
- ☐ Von-Willebrand-Syndrom (VWS)
- ☐ Vorhofflimmern
- ☐ Weiß ich nicht

**Frage 5: Erythrozytenzylinder im Urin sind ein Zeichen für welche der folgenden Erkrankungen?**

- ☐ Akute intermittierende Porphyrie
- ☐ Beidseitige Nierenarterienstenose
- ☐ Beta-Thalassämie
- ☐ Glomerulonephritis
- ☐ Nephrotisches Syndrom
- ☐ Weiß ich nicht

**Frage 6: Ein erhöhtes TSH bei normwertigen freien Schilddrüsenhormonen spricht für ein/eine/einen**

- ☐ Latente Hypothyreose
- ☐ Medulläres Schilddrüsenkarzinom
- ☐ Morbus Basedow
- ☐ Schilddrüsenautonomie
- ☐ Thyreotoxische Krise
- ☐ Weiß ich nicht