Jordanian chemistry (student) teachers' beliefs about chemistry teaching and their views on educational reform

By

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Summary

This work is an accumulative thesis consists of four main papers. The purpose of this thesis was, to investigate different aspects of (students) teachers' beliefs about chemistry teaching in secondary schools for the case of Jordan - a country where the base of knowledge about teachers' beliefs is very rare. The principle points that were primarily dealt with are achieving a general overview of chemistry teachers' beliefs in Jordan while taking findings from a developed Western country (Germany) and research on a mid-western country with a development level between Jordan and Western Europe (Turkey) as external references. Beliefs to be researched were focusing on curricula and pedagogies in chemistry teaching and learning, the aims and objectives of chemistry lessons, and the nature of good education. Further investigations were made concerning explanations and beliefs for the reasons of the prevalent practice in chemistry education in Jordan and effects of ongoing reform.

Different instrument were used to perform this research in order to try to get a comprehensive overview about the beliefs held by Jordanian (student) teachers and framing them by respective data from Turkey and Germany. The first one was applying the modified Draw A Science Teacher Instrument by Markic, Eilks and & Valendis (2008). The instrument is based on (student) teachers' drawings of themselves in typical teaching situations in their subject and includes a set of open questions to explain the drawn situation. The data was evaluated by a grid based on Grounded Theory analyzing Beliefs about Classroom Organization, Beliefs about Teaching Objectives and Epistemological Beliefs on different scales between very traditional towards modern/theory-conform beliefs. A second evaluation using part of the same data source was made by applying the 'Draw-A-Science-Teacher-Teaching'-Checklist from Thomas, Pedersen and Finson (2001). This evaluation analysed the data by a rating checklist to decide upon the degree of teacher- or student-centeredness of the (student) teachers` beliefs. A third instrument from Hermans, Van Braak and Van Keer (2008) was focusing (student) teachers' beliefs about what constitutes good education in general based on Likert-questionnaire methodology. Based on the data found in by the written survey semi-structured interviews with experienced teachers were conducted. The interviews were inspired by the findings on the Jordanian chemistry teachers' and student teachers' beliefs about the pedagogies and goals of chemistry teaching and learning. This instrument aimed to investigate the Jordanian teachers' consideration for the reasons of the actually applied teaching practices in chemistry education and their perception of intentions and effects within ongoing educational reform in Jordan.

The results from the modified DAST, and original DASTT-C that were applied on the Jordanian, Turkish and German chemistry (student) teachers show that both the Jordanian and Turkish (student) teachers hold very traditional beliefs when it comes to teaching and learning chemistry. Their beliefs can be characterized by high level of teacher-centeredness, a transmission-oriented understanding of learning, and a strong focus on the pure learning of subject-matter. This is even slightly more the case for Jordan than in Turkey. On the other hand, we saw in the case of the German (student) teachers that it is possible to hold modern beliefs concerning chemistry teaching and learning, characterized by student-centeredness, orientation on scientific literacy for all and more constructivistic learning.

From the studies about the nature of good education, which reveals that all the groups that were researched value modern educational beliefs than traditional beliefs more when it comes to teaching and learning in general. It seems that the teachers instinctively understand that learning is far more than rote memorization and that learning is a developmental process. But, in concurrency to transmission oriented beliefs of education the picture is more diverse. Here the samples from Jordan pronounce rote transmission of knowledge nearly as important as the development of more general skills. In Turkey and even more in Germany the (student) teachers much more supported the developmental educational beliefs than they do for the rote transmission oriented beliefs. A clear tendency was found here too.

The findings from the interviews which aimed to explain the situation thoroughly in Jordan supported the findings from the written surveys. The teachers also described a dominance of a traditional and teacher-centered style of chemistry teaching in Jordan as it was mirrored in the beliefs of chemistry student teachers and teachers described the written tools. Many reasons were named from problems in infrastructure and too big class sizes, via traditional curricula, textbooks and assessment systems, towards teacher education programs too less oriented at the later profession of being teachers. The study revealed also that despite many reform initiatives in Jordan took place in recent years, most of the teachers in Jordan are not very acquainted to the reforms, and implementation rate is slow.

As a conclusion, this study asks for reflecting the structure of chemistry teacher education in Jordan (and maybe also in Turkey). It seems that a more thorough focus on changing the (student) teachers' beliefs towards a modern understanding of education in chemistry is necessary. Perhaps offering additional courses on modern educational theory and pedagogies and to connect them more thoroughly with own teaching experiences might help. Anyhow, a more comprehensive set of approaches might be needed that might consist of three points of potential action: (I) integrating reflection on prevalent beliefs into prospective

teachers learning about their later profession of being a chemistry teacher within their university studies, (II) re-organize the introductory seminars in the initial phase of teaching towards more connectedness with modern educational theory and own teaching experience, and (III) establish long-term CPD programs based e.g. on teacher collaboration, interactive workshops, or action research based innovations (Mamlok-Naaman & Eilks, 2011). Aside, the study also puts light on the ongoing reform process in Jordan. It seems that reform in Jordan (chemistry) education needs to put stronger emphasis to take the teachers' beliefs into account and to apply more interactive and participatory strategies of reform considering the teachers being more partners in the reform process rather than being passive consumers.

Zusammenfassung

Bei der vorliegenden Arbeit handelt es sich um eine kumulative Dissertation bestehend aus vier Hauptartikeln. Das Ziel dieser Arbeit war es, verschiedene Aspekte der Vorstellungen (angehender) Chemielehrer über den Chemieunterricht an weiterführenden Schulen zu untersuchen – und zwar in Jordanien, einem Land, in welchem bisher wenig über Lehrervorstellungen bekannt ist. Der Schwerpunkt liegt in einem Überblick über die Situation in Jordanien im Vergleich mit Ergebnissen aus Deutschland, einem hochentwickelten westlichen Land, sowie dem mittleren Westen, wobei hier die Türkei als Referenz hinzugezogen wird. Es wurden insbesondere Vorstellungen in den Bereichen Curricula und Pädagogien, Ziele und Zielvorgaben von Chemieunterricht und das Wesen guten Unterrichts untersucht. Zusätzliche Untersuchungen betrafen Erklärungsmuster und Vorstellungen für die Gründe der gängigen Praxis der schulischen Ausbildung im Bereich Chemie in Jordanien und die Einflüsse der dort laufenden Reformen.

Um einen umfassenden Überblick über die Vorstellungen (angehender) Chemielehrer in Jordanien zu bekommen und diese mit den Daten aus Deutschland und der Türkei in Beziehung zu setzen, wurden verschiedene Instrumente genutzt. So wurde das erweiterte Draw-a-Science-Teacher-Teaching-Instrument von Markic, Eilks & Valanidis (2008) eingesetzt. Das Instrument basiert auf Zeichnungen der Studenten/Lehrer, die sich in typischen Unterrichtssituationen darstellen. Hinzu kommen offene Fragen, mit Hilfe derer die gezeichnete Situation erklärt werden soll. Die Daten wurden mit Hilfe eines Rasters auf Basis der Grounded Theory evaluiert, wobei die Schwerpunkte auf der Analyse der Unterrichtsorganisation, den Vorstellungen über Lernziele und den erkenntnistheoretischen Vorstellungen lagen. Die in dem Raster verwendeten Skalen reichten von sehr traditionellen bis zu modernen/theoriekonformen Vorstellungen. In einer weiterführenden Untersuchung wurden Teile der gewonnenen Daten mit Hilfe der originären Draw-a-Science-Teacher-Teaching-Checkliste von Thomas, Pedersen & Finson (2001) analysiert. Hierbei wurden die Daten nach dem Grad der Schüler- bzw. Lehrerzentriertheit der Vorstellungen bewertet. Ein drittes Instrument von Hermann, Van Braak und Van Keer (2008) fokussiert auf die Vorstellungen (angehender) Lehrer im Bezug auf eine gute Ausbildung im Allgemeinen. Hier wurde auf einen Fragebogen mit Likert-Skala zurückgegriffen. Basierend auf den Ergebnissen dieser schriftlichen Befragungen wurden halbstrukturierte Interviews mit erfahrenen Lehrern durchgeführt. Die Interviewfragen wurden auf Basis der Ergebnisse hinsichtlich der Vorstellungen von (angehenden) jordanischen Lehrkräften über die Pädagogien und die Ziele

des Chemieunterrichts formuliert. Das Instrument wurde mit dem Ziel, die Überlegungen von jordanischen Lehrkräften zu den Gründen der aktuellen Praktiken des Chemieunterrichts und ihre Sichtweise auf die Absichten und die Effekte der gerade stattfindenden Bildungsreformen in Jordanien zu untersuchen, eingesetzt.

Die auf die (angehenden) jordanischen, deutschen und türkischen Lehrkräfte bezogenen Ergebnisse des modifizierten DASTT-Instruments und der ursprünglichen DASTT-Checkliste zeigen, dass die jordanischen und türkischen Lehrkräfte sehr traditionelle Vorstellungen über das Lehren und Lernen der Chemie haben. Ihre Vorstellungen sind geprägt durch einen hohen Grad an Lehrerzentriertheit, ein transmissionsorientiertes Verständnis des Lernens und einen starken Fokus auf den reinen Erwerb von Fachwissen. All dies ist bei den jordanischen Lehrkräften noch etwas mehr ausgeprägt als bei den türkischen. Auf der anderen Seite besitzen die (angehenden) deutschen Lehrer moderne Vorstellungen von schülerzentriertem Unterricht, sie konzentrieren sich auf naturwissenschaftliche Grundbildung für alle und auf ein eher konstruktivistisches Lernen.

Die Untersuchungen zum Wesen guten Unterrichts ergaben, dass alle (angehenden) Lehrkräfte eher die modernen und nicht die traditionellen Vorstellungen über das Lehren und Lernen im Allgemeinen schätzen. Es scheint, als würden die Lehrkräfte unterbewusst verstehen, dass Lernen mehr als das reine Auswendiglernen von Fakten und zudem noch ein sich entwickelnder Prozess ist. Jedoch ist die Streuung der Ergebnisse groß. Beispielsweise schätzen die jordanischen Lehrer die reine Wissensübertragung als genauso wichtig ein wie die Entwicklung allgemeiner Fähigkeiten. Die türkischen und noch mehr die deutschen (angehenden) Lehrer unterstützen im Vergleich beider Denkmuster stärker die entwicklungsorientierten Vorstellungen von Bildung und nicht die reine Wissensübertragung. Hier wurde eine klare Tendenz festgestellt.

Die Ergebnisse der Interviews, deren Ziel es war, die Situation im Jordan umfassend darzustellen, korrelierten mit den Erkenntnissen aus den schriftlichen Befragungen. Die Lehrkräfte beschrieben ebenfalls den überwiegend traditionellen, lehrerzentrierten Unterricht in Jordanien, der auch von den (angehenden) Chemielehrern in den schriftlichen Befragungen dargestellt wurde. Hierfür wurden vielfältige Gründe genannt: zu große Klassen, traditionelle Curricula, Schulbücher und Prüfungsformen und die mangelnde Praxisorientierung bei der Lehrerausbildung. Die Studie hat außerdem zu der Erkenntnis geführt, dass viele Lehrkräfte trotz diverser Initiativen nur wenig von den Bildungsreformbemühungen in Jordanien wissen, so dass die Umsetzungsrate niedrig ist.

Die Studie soll nun zu einem Umdenken in Sachen Chemielehrerausbildung in Jordanien (und evtl. auch in der Türkei) führen. Es scheint notwendig, einen größeren Fokus auf eine Transformation der veralteten Vorstellungen von (angehenden) Lehrekräften zu legen, sodass diese sich ein moderneres Verständnis von naturwissenschaftlicher Bildung aneignen. Eventuell wären zusätzliche Kurse oder Fortbildungen und die Verknüpfung dieser mit der eigenen Berufspraxis sinnvoll. Auf jeden Fall ist ein umfassendes Set von Maßnahmen notwendig, um Veränderungen einzuleiten: (I) die Integration von Reflexionen über eigene Vorstellungen in die universitäre Ausbildung zukünftiger Lehrkräfte darüber, was es heißt, eine Chemielehrerin/ein Chemielehrer zu sein, , (II) Reorganisation der Einführungsseminare für Lehramtsanwärter im Hinblick auf moderne Theorien und die Verknüpfung dieser mit der eigenen Praxis, (III) die Einführung von längerfristigen CPD-Programmen (Continuing Professional Development), beispielsweise basierend auf der Kooperation von Lehrkräften, interaktiven Workshops oder auf Aktionsforschung basierenden Innovationen (Mamlok-Naaman & Eilks, 2011). Zudem macht die Studie auch auf die Reformen im Jordan aufmerksam. Es scheint, als müssten diese stärker auf die Vorstellungen von (angehenden) Lehrern ausgerichtet sein und mehr interaktive und partizipative Methoden nutzen, sodass die Lehrkräfte nicht nur Konsumenten, sondern Mitwirkende bei der Reform des Bildungssystems sind.

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Jordanian chemistry (student) teachers' beliefs about chemistry teaching and their views on educational reform

1-Introduction:

''Perhaps the most important single cause of a person's success or failure educationally has to do with the question of what he believes about himself.'' (Arthur Combs)

1-1 Beliefs in science education

From Shulman (1986), the process of teaching involves three dimensions of teachers' knowledge: subject matter knowledge, pedagogical knowledge and pedagogical content knowledge. A fourth dimension which is personal practical knowledge was added by Beattie (1995). But, not only knowledge is considered being relevant. Munby (1982) and Clarck and Peterson (1986) also emphasize beliefs as a fundamental part of teachers' general knowledge through which teachers perceive, process and act upon information in the classroom.

Since Pajares (1992) in his review of research on teachers' beliefs pointed that teachers' beliefs can and should become a proper assessment and investigation, teachers' beliefs became a prominent focus in educational research. Belief studies became an active field of research on teachers' cognition, as it can provide a promising base to better understanding of teacher behaviour (Fenstermacher & Soltis, 1986; Nespor, 1987). Additionally Deng (2004) argued that teachers' beliefs and views should become the focus of change if teacher programs are directed to prepare teachers to teach in a more constructivist manner. When prospective teachers enter their professional studies they possess a lot of beliefs and views about teaching and learning and these entering beliefs act as filters in the learning process (Raths & McAninch, 2003). Kennedy (1997) explained if new ideas are introduced, students weigh them in terms of their current understanding and beliefs. If the new ideas clash with

their beliefs, the ideas are resisted or rejected. Moreover, in teacher education programs pedagogical practices that are based on constructivist theories won't be adopted if the teacher candidates are exclusively transmission oriented and thus contradict the newly gained information.

Describing that belief research is boosting, we have to mention the obstacles that faces it. Pajares (1992) described difficulties in studying teachers' beliefs. These difficulties are caused by definitional problems, poor conceptualization, and differing understanding of what are beliefs and beliefs structures. Additionally, most of the research tends to fragment and isolate beliefs about teaching and learning, and researchers rarely give attention to consider the multiple ideas that are held simultaneously and probably incongruously by teachers (Eisenhart, Shrum, Harding, & Cuthbert, 1988). Fenstermacher (1978) described that a group of beliefs that is held and seemed accepted by one person, could become non reasonable beliefs once they are weighed and altered.

1-2 Beliefs and knowledge

By defining beliefs, one has to mention how this concept differs from knowledge, and what are the relationship between beliefs and actions. Nespor (1987) differentiates between beliefs and knowledge, he identified the main features to distinguish beliefs from knowledge e: existential presumptions, alternativity, affective and evaluative loading, and episodic structure. In addition to the beliefs stronger affective and evaluative components are operated independently of the cognition related to knowledge. So knowledge of a domain differs from feelings about the domain (Nespor, 1987). Knowledge was described as a cognitive outcome of thought which is purer than belief and closer to the truth or falsity of a thing (Ernest, 1989). Furthermore, Richardson (2003) derived from Green (1971) a philosophical distinction between beliefs and knowledge. She defined beliefs "*as propositions that are accepted as true by the individual holding the belief, but they do not require epistemic warrant. Knowledge on the other hand does. Knowledge defined as a set of warranted propositions held by a community of experts."*In his study on knowledge and beliefs Ernest referred to beliefs as "*it consists of the teacher's system of beliefs, conceptions, values and ideology also referred to as the teacher's 'dispositions'".* (Ernest, 1989). In addition to the characterization that differentiate knowledge and beliefs, teachers' beliefs are more difficult to measure compared to knowledge (Clark & Peterson, 1986).

1-3 What are beliefs?

Finding a working definition of' teacher beliefs seems to be difficult in the educational research literature. According to Eisenhart and her colleagues (1988), inconsistencies in the belief definition reflect the diversity of research agendas and represent the paradigmatic assumptions rather than any incontrovertible truth inherent in the belief construct. So diverse definition can be found in the belief literature, some of them are listed below:

- Pajares (1992) defined beliefs as the individual's judgment of the truth or falsity of a proposition, and described them *at best a game of player's choice.* Anyhow he made clear, how diverse the use of the term beliefs is:
  "They [the beliefs] travel in disguise and often under alias names – attitudes, values, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual system, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practice principles, perspectives, ..." (Pajares, 1992, p. 309).
  Also, he described cluster of beliefs being around particular situation to form attitude, which becomes further as action agendas that guide behaviour and decisions.

- Nisbett and Ross (1980) described beliefs as *" a filter through which a host of instructional judgements and decisions are made."*
- Bandura (1997) characterized them to be *"the best indicators of the decisions people make throughout their lives"*.

- Schoenfeld (1998) defined them as *" a mental constructs that represent the codifications of people's experiences and understandings. Teachers have beliefs about themselves, the nature of intellectual ability, about the nature of the discipline they teach, about students, about learning, about environment in which they work ...and more. People's beliefs shape what they perceive in any set of circumstances, what they consider to be possible or appropriate in those circumstances, the goals they might establish in those circumstances, and the knowledge they might bring to bear in them."*

- In the mathematics education literature, Aguirre and Speer (1999), elucidated that current beliefs definitions focus mainly on how do teachers think about the teaching and learning nature of mathematics. They defined beliefs within this context as *"conceptions, personal ideologies, world views and values that shape practice and orient knowledge."*

- Eisenhart et al (1988) described teacher beliefs as *"the product of long term, and anticipatory socialization pressure; of intensive interaction among members of a group facing common problems; of the intersection of the school system structural characteristics and teacher initiative (objectives) in that system; and the cumulative teaching experience."*

- And the final definition was suggested by Markic, Valanides and Eilks (2008) , who suggested the understanding of the term 'teachers' beliefs' *"to mean all mental representations that teachers or student teachers consciously and unconsciously hold in their minds which influence, to a certain extent, their (potential) behaviour as teachers within their subject. Within this perspective, teachers' beliefs can be interpreted as all personal constructs connected to the practice of teaching influenced by experience, knowledge, and social background."*

1-4 Educational research on beliefs

Different factors shape teachers' beliefs, such as the quality of pre-service experience in the classroom, the opportunity for reflection on the pre-service experience and the influence of the discipline (Bean & Zulich, 1992; Cherland, 1989) . Furthermore, as beliefs directly affect teacher actions, they are described as a crucial factor in restructuring science education, and further research should enrich our understanding of the relation between the teachers beliefs and science education reform (Tobin, Tippins, & Gallard, 1994), as many reforms have ignored this critical ingredient in the factors that determine what happens in the classrooms. Based on the increased attention to teachers' beliefs and their effect on teaching and learning, Brophy and Good (1986) stated that educational effectiveness could be enhanced via better understanding of teachers' belief systems. Moreover, some researchers argued that successful reforms should not ignore teachers' beliefs if we aim to have an overall change in the classroom (Lumpe, Haney, & Czerniak, 2000). In the light of the various benefits that beliefs

studies have, knowing pre-service teachers' beliefs should be a precondition for identifying program experiences that require candidates to confront their own beliefs and to develop conceptual models of effective teaching (Minor, Onwuegbuzie, Witcher, & James, 2002). The net of many research in studying teachers' beliefs conclude that it is very difficult to change (student) teachers beliefs, especially within the frame of traditional pre-service programs that are applied (Raths & McAninch, 2003).

Pajares (1992) pointed in his review the construct of educational beliefs as being broad and widespread, diffuse, context free, and difficult to operationalize for research purposes. And he tried to divide general educational beliefs into categories: starting by teacher efficacy which is the educational beliefs about confidence to affect students' performance, epistemological beliefs, about the nature of knowledge, attributions, locus of control, motivation, writing apprehension, math anxiety are beliefs about causes of teachers' or students' performance. Self-esteem is a belief about one's perception of self and feeling of self worth. Self efficacy is a belief about confidence to perform specific tasks.(Pajares, 1992).

In an increasing attention of teachers' beliefs in educational research (Munby, Russel, & Martin, 2001) and in the science education field (Abell, 2007; De Jong, 2007) the latter field is expanding with studies focusing on both in-service teachers (Smith, 1993; Woolley, Benjamin, & Woolley, 2004) and student teachers (Abed, 2009; Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003). Research on (student) teachers' beliefs has become an active field, since such studies provide promising approaches to better understanding teachers' learning processes and behavior in the classroom (Fenstermacher & Soltis, 1986; Nespor, 1987). Evidence of student teachers' beliefs is also valuable for teacher trainers, who can map out currently-held ideas about teaching and learning, then see how they can be applied and/or changed (Nisbett, 1980). Such knowledge also shows potential for improving university teacher education programs in order to better facilitate candidates' personal learning and professional development (Bryan, 2003). Finally, research on beliefs is seen as useful for curriculum innovators and planners, who can more effectively implement curriculum changes by taking existing teachers` beliefs into consideration (De Jong, Veal, & Van Driel, 2002; Eilks, Ralle, Markic, Pilot, & Valanides, 2006; Justi & Van Driel, 2006).

Starting from trainees' general educational beliefs, Van Driel, Bulte and Verloop (2007) were able to distinguish between two different ideologies which form a continuous dimension visible within various belief studies. These ideologies occur as a common feature repeated in various studies. The first system has been called *teacher-centered* (Bramald, Hardman, &

Leat, 1995) or, alternately, *subject-matter oriented* (Billig, et al., 1988). On the opposite end of the spectrum we find the *personal* (Shen, 1997), also called *student-supported* (Samuelowicz & Bain, 1992; Trigwell, Prosser, & Taylor, 1994) or *learner-centered* (Bramald, et al., 1995) learning. Markic and Eilks (2008) suggested viewing this spectrum as a range between traditional beliefs (transmission-oriented beliefs of learning with a focus on pure subject-matter knowledge) and modern beliefs (beliefs based on constructivistic learning, student-oriented classroom structures, and an orientation on more general educational skills, including Scientific Literacy for all). This dichotomy is in line with other studies, e.g. Thomas, Pederson and Finson (2001). It also parallels discussions about educational reform and differences between traditional practices and the reform movement in science education in general (Van Driel, et al., 2007).

Additionally to the presence of the two orientations themselves, the relationship linking them together is also of great importance. Do these viewpoints represent the opposite extremes of a continuous scale with intermediate ideologies between them as suggested by Van Driel et al. (2007)? Can individuals hold different beliefs with respect to different subtopics or domains? Do these beliefs always have to be coherent within them? Minor, Onwuegbuzie, Witcher, and James (2002) described pre-service teachers' beliefs as representing a seemingly contradictory mix of ideas. In their study, some student teachers supported both transmissive and constructivistic beliefs of teaching simultaneously. Although such beliefs about teaching and learning appear to be contradictory and dichotomous (Chai, Hong, & Teo, 2009), the presence of both beliefs might be understood as a continuum of positions, thus allowing teachers to adapt to a situation depending on both the content and their view of the context (Samuelowicz & Bain, 1992). However, it also has become clear that beliefs can be changed by educational programs, thus moving candidates away from more teacher- and content-structured beliefs to more open, student-orientated contents and methods (Luft, 2009; Markic & Eilks, 2011).

The timeframe in which pre- and in-service teachers` beliefs are recorded also seems to be of particular relevance. In this context Markic and Eilks (2011) compared student teachers' beliefs at different stages of their pre-service teacher training in Germany. The German system is based on a bottom-up teacher training style, where courses on education and domain-specific learning accompany a five year university program, including school internships. Three different groups of chemistry student teachers were studied. A substantial change in candidates' beliefs about teaching and learning was indicated as a result of the

teacher training program. The data showed that student teachers` beliefs swung dramatically during their university education from very traditional, teacher-centered beliefs in the beginning to more modern, learner-oriented educational beliefs based on constructivistic theories of learning by the end. Moreover, Luft (2009) considered the first year of practical teaching as the most difficult period for a teacher and therefore crucial for more detailed research efforts. This study went on to describe the effect of induction programs on the professional development process of first year teachers in the US. Analysis of the results revealed that teachers participating in science-specific induction programs significantly abandoned their teacher-centered beliefs and practices in favor of more student-supportive ones. Changes concerning teachers' epistemological beliefs on the learning of scientific concepts were described for a course on science curricula and methodologies. This observation shows that such courses can be both effective and potentially advantageous for improving teachers' epistemological perceptions. But questions about the depth, penetration and sustainability of changes in teachers' beliefs and knowledge base remain open.

2-Aims of the study

The growing body of research has shed light on many aspects of science teachers' beliefs. Nevertheless, beliefs are context-bound and thus related to the educational and cultural circumstances in which teachers live, the institutions in which they were educated, and the places where they currently work (Alexander, 2001; Woolfolk-Hoy, Davis, & Pape, 2006). In such context, Klassen and his colleagues (2009) explored the self efficacy beliefs of the teachers in five countries, and Cakiroglu, Cakiroglu, and Boone (2005) compared the pre-service teachers self efficacy beliefs regarding science teaching in Turkey and USA. Both studies elucidated differences in level of beliefs across cultural and educational groups of teachers Moreover, comparisons of (student) teachers' beliefs in the foreground of different cultures and educational systems are rare. Such comparisons may help to better understand and frame results about beliefs of single groups of science teachers or student teachers, in addition to clarify the different beliefs measurement across countries with different educational reforms.

The purpose of this study was, therefore, to investigate different aspects of (students) teachers' beliefs about chemistry in secondary schools for the case of Jordan -á country where the base of knowledge about teachers' beliefs is very rare. The principle points that were primarily dealt with are achieving a general overview of chemistry teachers' beliefs in Jordan while taking findings from a developed Western country (Germany) and research on a

country with a development level between Jordan and Western Europe and geographically located in between (Turkey) as external references. Beliefs to be researched were focusing on curricula and pedagogies in chemistry teaching and learning, the aims and objectives of chemistry lessons, and the nature of good education. Where there is sufficient evidence about the situation in Germany, for the case of Turkey respective evidence had to be gathered within this project, Further investigations were made concerning reasons, explanations and beliefs concerning the prevalent practice and effects of ongoing reform in chemistry education in Jordan.

The research questions in detail were:

2-1-Paper 1

1. Which beliefs do Jordanian chemistry student teachers and experienced chemistry teachers hold regarding chemistry teaching and learning, including student- and teacher-centeredness, overall teaching objectives, understanding the learning process, and the nature of good education?
2. What are the similarities and/or differences in beliefs about teaching and learning for these two groups regarding the above-mentioned fields?

2-2-Paper 2

1. Which beliefs do Turkish chemistry student teachers and experienced chemistry teachers hold regarding to chemistry teaching and learning, i.e. concerning student- and teacher-centeredness, teaching objectives, and the nature of good education?
2. What are the similarities or differences in the beliefs about teaching and learning of these two groups regarding the above-mentioned fields?

2-3-Paper 3

1. How can the beliefs of chemistry student teachers and experienced chemistry teachers from Jordan regarding chemistry teaching and learning, i.e. concerning student- and teacher-centeredness, teaching objectives, and the nature of good education be classified in comparison to respective beliefs of chemistry student teachers and experienced chemistry teachers from Turkey and Germany?

2-4-Paper 4

1. What is the perception of experienced chemistry teachers in Jordan about the actual teaching situation in chemistry classes? How do they consider and explain the balance of student- and teacher-centeredness? What are the reasons for the prevalent strong teacher-centered beliefs among most student teachers and experienced teachers as described in Paper 1 and 3?

2. What do experienced Jordanian chemistry teachers think about recent educational reform in Jordan? Do they agree to the reform? What do they consider as being fostering and hindering factors for reform? Which direction should reform take from their point of view?

3-Methods

3-1 The Modified Draw-A-Science-Teacher-Test (used in paper 1, 2, 3)

The first part of the study is qualitative in nature and is based on a modified version of the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C). The original DASTT-C (Thomas, Pedersen, & Finson, 2000; 2001) requests the participant to draw him/ herself as a teacher and the learners in a typical classroom situation. The drawing is followed up by two open-ended questions asking about the activities of teacher and students. Markic, Eilks, and Valanides (2008) added another two open-ended questions to this to gain a more detailed overview of the situation see Appendix 1. The added questions inquire into the teaching and learning objectives of the situation depicted and the approach chosen towards the drawn situation. An evaluation grid was also developed based on Grounded Theory (Markic et al., 2008). This grid categorizes a range stretching from traditional beliefs to more modern beliefs in line with current educational theory. Traditional beliefs are characterized by teacher-centered classroom organization, strong orientation on the structure of the subject matter, and transmission-oriented beliefs about teaching and learning. Conversely, modern beliefs are characterized by student-oriented classroom organization, an orientation on problem-solving and scientific literacy objectives, and constructivistic learning theories. The evaluation pattern analyzes participants` beliefs in three qualitative categories: 1) *Beliefs About Classroom Organization*, 2) *Beliefs about Teaching Objectives*, and 3) *Epistemological Beliefs*. Each category was evaluated using a range from -2 to +2 to describe beliefs in the above-mentioned dimensions along an ordinary, but non-linear scale. An overview of the categories is presented in Table 1. A full description of the categories can be found in Markic et al. (2008).

Data was encoded by two independent raters. The agreement rate using this grid remained continuously above 80%. In cases of disagreement, joint rating was carried out by searching for inter-subjective agreement (Swanborn, 1996).

Table 1: An overview of the scales in the qualitative part of the study (Markic & Eilks, 2008)

	Traditional beliefs		***Modern beliefs***
Beliefs About Classroom Organization	Classroom activities are mostly teacher-centered, -directed, -controlled and dominated by the teacher.	↔ -2, -1, 0, 1, 2	Classes are dominated by student activity and students are (at least partially) able to choose and control their activities.
Beliefs About Teaching Objectives	The focus of science teaching is more-or-less exclusively focused on content learning.	↔ -2, -1, 0, 1, 2	Learning of competencies, problem solving or thinking in relevant contexts are the main focus of teaching.
Epistemological Beliefs	Learning is passive, top-down and controlled by the dissemination of knowledge.	↔ -2, -1, 0, 1, 2	Learning is a constructivistic, autonomous and self-directed activity.

3-2--Draw A Science Teacher Test Checklist DASTT-C (used in paper 1, 2, 3)

The second instrument applied the original evaluation pattern from the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C) by Thomas et al. (2000; 2001). In DASTT-C, (student) teachers` drawings and the open-ended questions about the activities of teacher and learners (see above) are evaluated using a checklist. The total score depends on the presence or absence of thirteen attributes in three main areas (see Appendix 2): the teacher, the students, and the environment. The accompanying questions in our case are only used to better understand the drawings. The presence of any of the thirteen attributes within a section is scored with a "1", an absence with "0". Thus, the total score can fall between 0 and 13. Scores of 0-4 indicate student-centered teaching, while values between 7 and 13 represent teacher-centeredness. For scores of 5 or 6 no decision can be made (Thomas et al., 2000). Data was rated by two independent raters according to the checklist, the inter-rater reliability was moderately high (κ= 0.70 - 0.76).

3-3-Beliefs About the Nature of Good Education (used in paper 1, 2, 3)

A third source of information was provided by a Likert-questionnaire on (student) teachers' beliefs about the nature of good education. The questionnaire asks about how teaching practices should be organized (Hermans, Van Braak, & Van Keer, 2008). It consists of eighteen Likert-items describing two dimensions: *Transmissive Beliefs* (TD) and *Developmental Beliefs* (DB). Transmissive Beliefs cover ideas that education satisfies external goals which can be met using closed, curriculum-oriented outcomes. The extent of knowledge acquisition can be viewed as being achieved through transmission. Developmental Beliefs represent education as oriented toward individual development within an open curriculum, including to what degree knowledge should be acquired through constructivistic means. The core concept of this dimension is the presence of students as active participants in the education process (Smith, 1997). In our study, we evaluated both dimensions using a six-point Likert-scale ranging from 1 (strongly disagree) to 6 (strongly agree). Data was interpreted by calculating mean scores, standard deviations and missing values. Pearson correlations and t-tests between the scales and between the two groups were also explored. Cronbachs α for both scales was between 0.42-0.82 and is considered to be acceptable (Hatcher & Stephanski, 1994).

3-4-Semi-structured interview (used in paper 4)

The last study bases on semi-structured interviews. The interview guide was developed taking into account the previous findings on Jordanian student teachers' and teachers' beliefs in Papers 1an 3 and the research questions on reflecting teachers' beliefs about educational reform in Jordan. The interview guide was cyclical refined by discussions within the research group. Finally, the interview guide was translated into Arabic language.

Five main areas of questions were elaborated (see Appendix 3):

- The first group of questions deals with current chemistry teaching practices in Jordan. It also focuses the teachers' experiences by asking for reflecting their own teaching concerning the roles of the teacher and the students in class, the teaching objectives, applied pedagogies, and the role of experiments in chemistry teaching.
- A second group of questions deals with the teachers' knowledge and views about recent educational reforms in Jordan.
- The third part of the interviews asked the teachers to reflect and explain the prevalent very traditional and teacher-centered beliefs of Jordanian chemistry

student teachers and experienced teachers evaluated on the base of drawing of classroom situations in Papers 1 and 3.

- The fourth aspect focused on the potential reasons for the very traditional views of the chemistry student teachers on teaching and learning chemistry in the foreground of the Jordanian educational reforms and international trends in science education.
- The last focus of the interviews encompassed questions on the teachers' wishes and expectations for future development of chemistry education in Jordan.

The interviews were conducted in Arabic language within the teachers' school environment. The interviews lasted between 30 and 60 minutes and were audio-taped. Data was inductively analyzed (Thomas, 2006) following the basic tenets of qualitative content analysis (Mayring, 2000). Validation of interpretations was done by a communicative discourse on the base of translated interview excerpts in the means of a search for inter-subjective agreement (Swanborn, 1996).

4-Short descriptions of the studies:

The studies in this thesis were made to get an overview about Jordanian chemistry (students) teachers' beliefs about teaching and learning and a classification in the foreground of other countries having a different cultural and socio-economic background. Different instrument were used to perform this research in order to try to get a comprehensive overview for the beliefs held by the Jordanian (student) teachers and framing them by respective data from Turkey and Germany.

4-1-Exploratory Study 1

Jordanian chemistry (student) teachers' beliefs about teaching and learning and the nature of good education (Paper 1)

4-1-1- Sample

The sample in this study consists of two groups: Jordanian chemistry student teachers (N=23) and in-service chemistry teachers (N=44). The student teachers all attended different public universities with a secondary school teacher training program, but had not yet completed their Bachelor's degree. They had not had any courses related to teaching and learning prior to this study. This meant that they had not yet been influenced by the teacher training program normally given to teachers during the first year of their teaching career.

Table 2: Characteristics of the sample

Characteristic		***Student Teachers***		***Teachers***	
		Number	***Percentage***	***Number***	***Percentage***
Gender	*Female*	13	56	25	57
	Male	10	44	19	43
Age	*19-25*	11	48	4	9
	26-36	11	48	20	45
	37-47	1	4	17	39
	48-58	0	0	3	7

The in-service chemistry teachers sample consisted of teachers from various schools in Jordan. All of these teachers possess at least a Bachelor's degree and have completed the workshop-based training unit. Eight of these forty-four teachers had finished a Master's of Education program. Some of the characteristics of both groups are presented in Table 2.

4-1-2 Findings

a- Traditional vs. modern beliefs in science education.

Data was analyzed along the three categories (see Table 1) that were developed by Markic et al. (2008) and that represent a traditional-modern spectrum of teaching beliefs in parallel to current educational theory. The results of the chemistry (students) teachers show that the Jordanian chemistry teachers in this sample hold a wide variety of beliefs concerning teaching and learning. Nevertheless, clear tendencies can also be recognized in Figure 1.

In the category *Beliefs about Classroom Organization* strong tendencies towards teacher-centered beliefs can be recognized in both groups. Over 90% of the student teachers and almost 80% of experienced teachers described a classroom dominated by the teacher, where student activity plays only a minor role and is completely dominated by the teacher. The same can be said for *Beliefs about Teaching Objectives*. A dominant majority (about 80%) of student teachers expressed traditional beliefs about the objectives of chemistry lessons. The more-or-less exclusive goal of chemistry lessons in their estimation is the learning of subject-matter content.

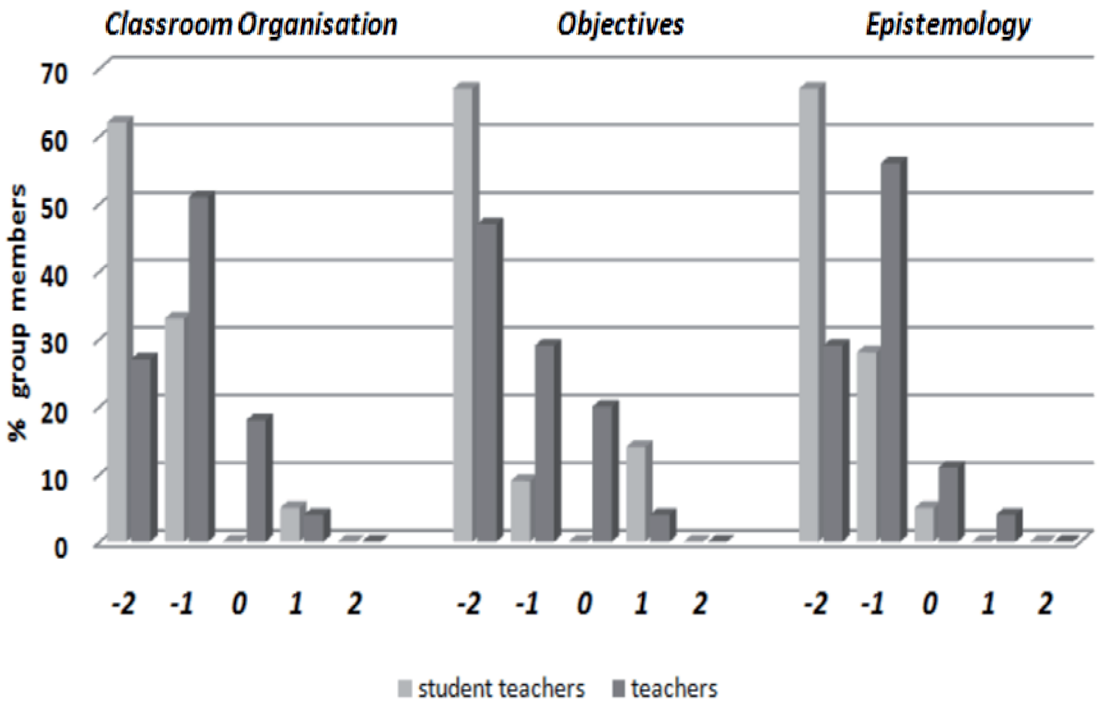


Figure 1: Distribution of traditional vs. modern beliefs about chemistry education

The same can be said for the group of in-service chemistry teachers, by the number is being a bit less extreme but the tendency towards the most strongly traditional beliefs was more pronounced. For *Epistemological Beliefs* both groups draw situations with chemistry teaching being quite strongly as a transmission of knowledge organized by the teacher (scores "-2" and "-1"). About 70% of the student teachers expressed strong traditional beliefs about teaching (score "-2"). The in-service teachers were not as traditional as the student teachers in this regard. The majority received a score of "-1" in this category, which can be interpreted as being "rather transmission-oriented". No student teacher professed beliefs which could be rated as either modern or quite modern; even among experienced teachers there were only about 5% (scores "2" and "1") of participants who expressed relatively modern ideas.

In summary, both groups professed strong teacher-centered, content-structure, and transmission-oriented beliefs when it comes to teaching and learning chemistry, with student teachers being pronouncedly stronger in this direction than the experienced teachers

b- Beliefs about teacher- and student-centeredness

Based on evaluating the results by the categories defined by Thomas et al. (2001), we can see 87% of student teachers fall into the teacher-centered area (a score of 7-13). Also the majority of experienced teachers nearly 70% also achieved scores of 7-13. This group is

slightly smaller than that of the student teachers. Our results showed that only 4% of student teachers and 16% of the in-service teachers attained a score (0- 4) which consider them to be student-centered (Figure 2).

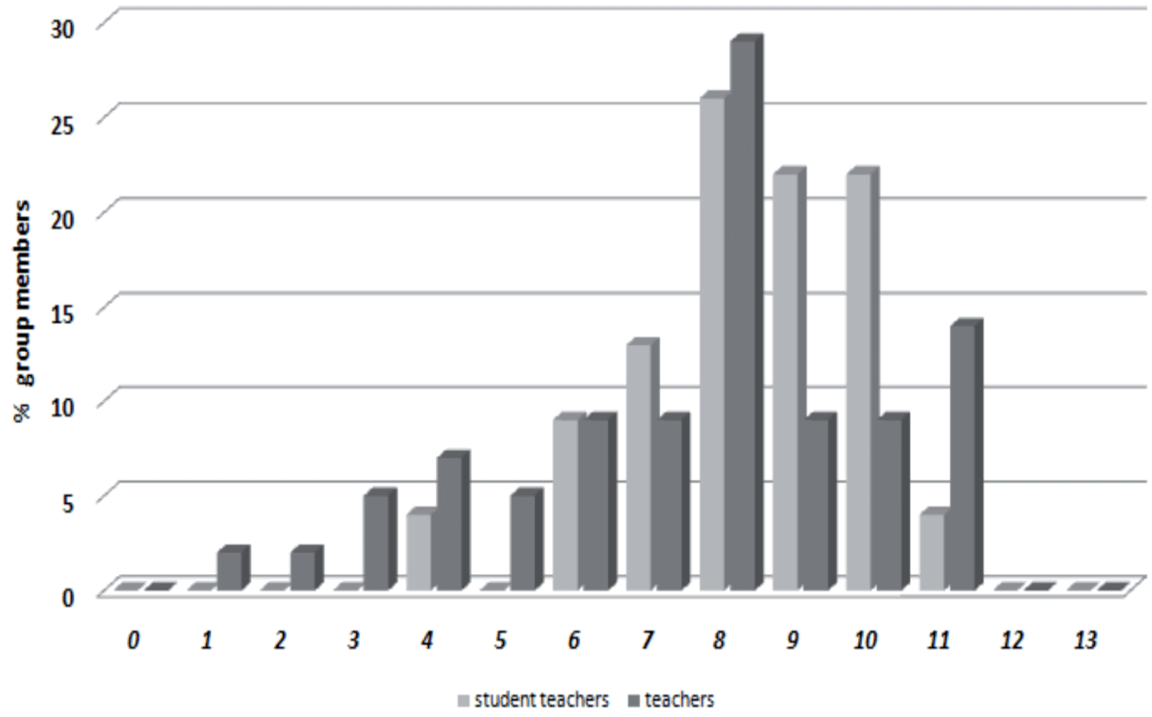


Figure 2. Distribution of student and in-service teachers according to DASTT-C

c. Beliefs About the Nature of Good Education

Both Jordanian chemistry (students) teachers groups supported the transmissive views in which education serves external goals and is outcome oriented within a closed curriculum, but student teachers, expressed this beliefs more strongly (mean 4,76) than in-service teachers (mean 4,53). On the other hand, both groups intensely support more modern beliefs than transmissive beliefs. These differences were statistically significant between both groups. This area states that education should be oriented towards broad and individual development, be process oriented within an open curriculum, and that knowledge should be largely acquired through constructivistic means. Both groups of teachers favored developmental beliefs when it comes to the nature of good education. But transmissive beliefs also received high levels of support.

4-1-3 Conclusions

This study describes the beliefs of Jordanian student teachers and teachers about chemistry teaching and learning. The first two parts of the study investigated domain-specific beliefs about teaching chemistry in very concrete teaching situations. Judging from the resulting drawings and answers, we can conclude that both Jordanian in-service teachers and student teachers hold very traditional beliefs when it comes to teaching and learning chemistry, this can be characterized by high levels of teacher-centeredness, a transmission-oriented understanding of learning, and a strong focus on the pure learning of subject-matter. On the other hand, the third part of the study reveals that both groups of teachers value more modern beliefs when it comes to teaching and learning in general. It seems that the teachers instinctively understand that learning is far more than rote memorization and that learning is a developmental process. Unfortunately, it seems that such positive beliefs about developmentally-oriented teaching and learning are forgotten as soon as teachers are asked to picture concrete situations in their chemistry classrooms. Most probably the teachers imagination does not last enough, because own experiences in a different style of learning are as well missing as the repertoire of student-activating teaching methods might be.

4-2- Study 2

Turkish chemistry (student) teachers' beliefs about teaching and learning and the nature of good education (Paper 2)

4-2-1-Sample

The sample of the Turkish study comprised of two separate groups; in-service teachers (n=29) and pre-service teachers (n=27). The pre-service teachers were all last year student teachers in the department of chemistry teaching. The student teachers stem from one of those universities serving chemistry teacher training in Istanbul, Turkey. All in-service teachers were graduated from either a department of chemistry or a department of chemistry teaching. Most of the in-service teachers work as a chemistry teacher in secondary schools. A few of them work also as a science and technology teacher in elementary schools. The in-service teachers were randomly selected from various schools in Istanbul, Turkey. Some more characteristics of the sample are summarized in Table 3.

Table 3. Selected demographics of the participants

Demographics characteristics	Pre-service teachers (n=27)		In-service teachers (n=29)	
	number	percentage	number	percentage
Gender				
Female	19	70	14	48
Male	8	30	15	52
Age				
19 - 25	9	33	3	10
26 - 36	18	67	17	59
37 – 47	-	-	4	14
48 – 58	-	-	3	10
58 and above	-	-	2	7

4-2-2 Findings

a. Traditional vs. modern beliefs in science education.

Based on the categories by Markic et al. (2008), Figure 3 shows that both groups have strong tendencies toward teacher-centered beliefs when it has to do with ideas about classroom organization. Almost 80% of the student teachers and more than 70% of in-service chemistry teachers described classroom situations which are mainly led by the teacher, dominated by teacher activity, and in which student activity is described as minor. On the other side of the continuum, roughly one-fifth of both groups expressed beliefs with student activity at the core, with the teacher present as a facilitator (initiator) of the activities. Similar trends were detectable for the dimension of beliefs about teaching objectives. A majority of the student teachers evidenced strongly traditional beliefs with regard to the objectives of Chemistry lessons. In their view, the more-or-less exclusive goal of Chemistry lessons should be the rote learning of subject matter content. The same held true for the practicing teachers concerning this category. Only about 15% of Turkish student teachers and roughly 10% of practicing teachers expressed ideas about the objectives of teaching and learning which fell in line with modern educational theory. In the third category of epistemological beliefs, both groups emphasized fairly strongly that Chemistry learning is rote transmission of knowledge organized by the teacher (scores "-2" and "-1"). Only about 20% of student teachers and 25%

of in-service teachers professed beliefs describing learning as an autonomous, self-directed process which begins with students' ideas and initiatives.

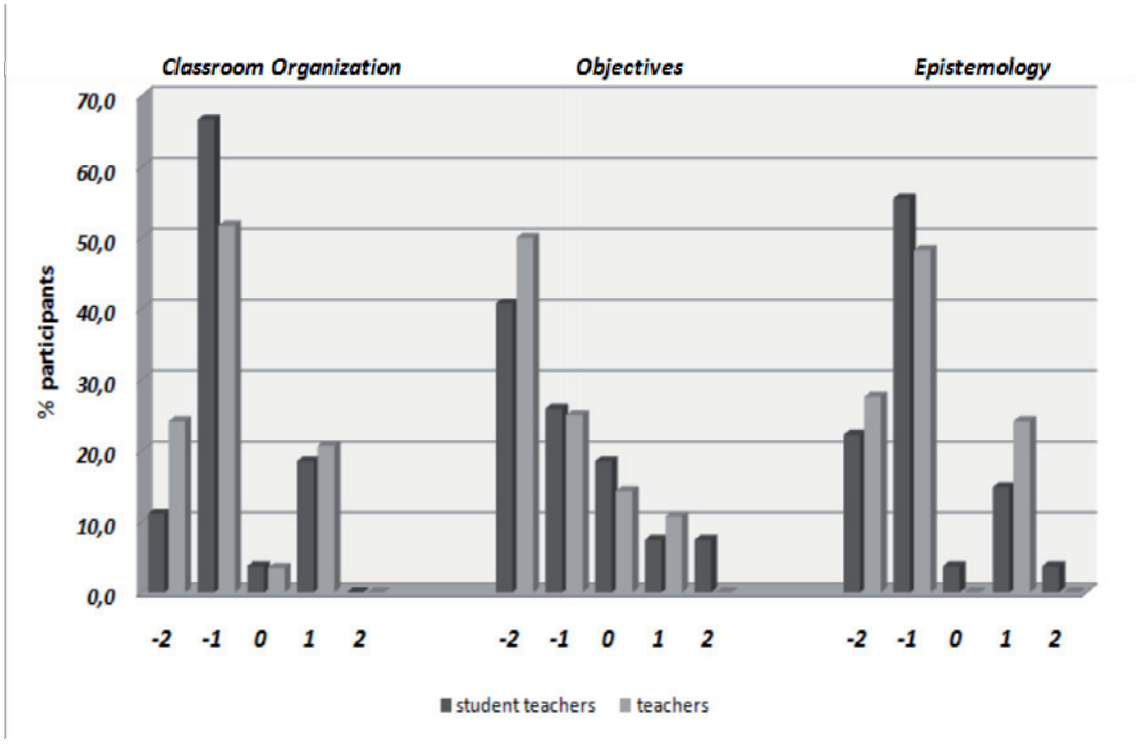


Figure 3. Turkish student teachers and teachers` beliefs about teaching and learning

b. Beliefs about teacher- and student-centeredness

According to the categories defined by Thomas et al. (2001)Table 4 indicates that both Turkish chemistry teachers and student teachers hold predominantly teacher-centered beliefs about teaching and learning.

Table 4: Number and percentage of student and teacher scores from the DASTT-C checklist

	Students (N=27)		**Teachers (N=29)**	
DASTT-C Checklist category	**Students frequency**	**% students**	**Teachers frequency**	**% teachers**
Student-centered scores (1-4)	2	7	4	14
Balanced scores (5-6)	5	19	0	0
Teacher-centered scores (7-13)	20	74	25	86
Total sum	**27**		**29**	

Table 4 indicates that 74 % of the student teachers and 86% of the in-service teachers hold predominantly teacher-centered beliefs about teaching and learning.

Only 14% of the experienced teachers and 7% of pre-service teachers can be described as having student-centered beliefs when it comes to the teaching and learning of Chemistry. These findings support the overall considerations listed above in the first part of this study.

c. Beliefs About the Nature of Good Education

The results of Turkish teachers` beliefs about the nature of good education show that both groups supported transmissive views in which the idea that education serves external goals and is outcome oriented within a closed curriculum. Turkish student teachers, however, expressed this beliefs more strongly (mean 4.08) than the teachers (mean 3.66). On the other hand, both groups support modern dimension of developmental beliefs more than the Transmissive Beliefs, thus, they can be characterized developmentally oriented. In this case, education should be oriented towards broad and individual development, be process oriented within an open curriculum, and that knowledge should be largely acquired through constructivist meaning. In both groups these differences are statistical significant between the two dimensions.

4.2.3 Conclusions

The results show that both pre- and in-service teachers in Turkey hold very traditional views when it comes to the teaching and learning of chemistry. These beliefs are characterized by high levels of teacher-centeredness, a transmission-oriented understanding of learning, and a strong focus on pure subject-matter learning. On the other hand, the part of the study examining the nature of good education showed that both groups of teachers value more modern ideas when it comes to teaching and learning in general.

4-3 - Study 3

A classification of Jordanian chemistry (student) teachers' beliefs about teaching and learning chemistry in the foreground of a comparison with chemistry (student) teachers from Turkey and Germany (paper 3)

4-3-1-Sample

The sample in this study consists of six groups from three countries: Jordanian chemistry student teachers (N=23), and in-service chemistry teachers (N=44). Turkish

chemistry student teachers (N=27) and in-service chemistry teachers (N=29). Finally, the German sample consists of (28) chemistry student teachers and (32) in-service chemistry teachers (Table 5).

Table 5. Demographics data of the participants

Demographics characteristics		***Jordan***		***Turkey***		**Germany**	
		Students **23**	***Teachers*** ***44***	***Students*** ***27***	**Teachers 29**	**Students 28**	**Teachers 32**
Gender	***Female***	13	25	19	14	20	18
	Male	10	19	8	15	8	14
Age	***19-25***	11	4	9	3	16	0
	26-36	11	20	18	17	12	19
	37-47	1	17	0	4	-	9
	48-58	-	3	0	3	-	3
	Over 58	-	-	0	2	-	1

4-3-2 Findings

a. Traditional vs .modern beliefs in science education.

Starting with the *Traditional vs. modern* beliefs in science education, and comparing the samples (both groups: students and teachers) from the three countries, our results in Figure 4 shows well distinct two clusters.

In line with Markic and Eilks (2008) and other studies there seems to be an interdependence of the three categories. The interdependence shows up if a similar allocation along the traditional to modern beliefs spectrum is present for each individual. This means the combination of codes from all three dimensions will appear on or near the diagonal stretching from (-2/-2/-2) to (2/2/2). Following Markic and Eilks (2008), placement of (student) teachers` replies within the respective 3D-diagram using this system of evaluation will allow for an overall consideration of the data. The closer the code combination is to the upper, right, back part of the 3D-diagram, the closer are the beliefs to modern educational theory. Conversely, code combinations appearing in the lower, left, front part of a 3D-diagram represent more traditional beliefs.

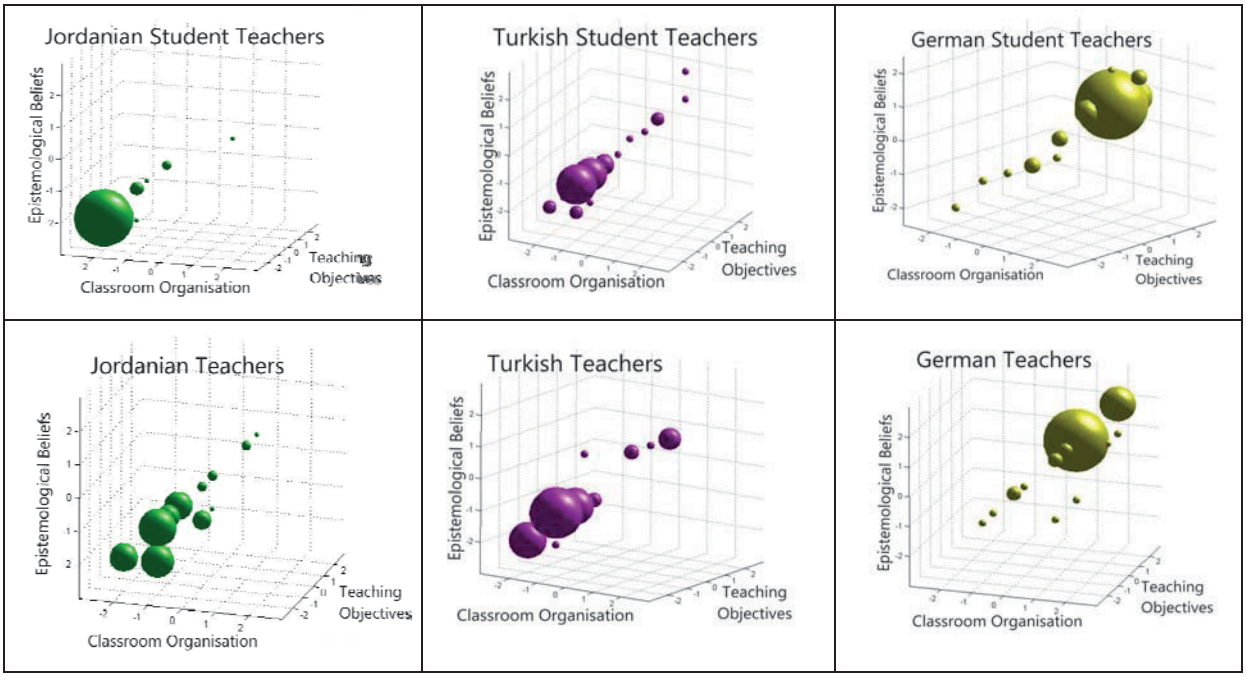


Figure 4. Results of Jordanian, Turkish and German chemistry student teachers` and chemistry teachers` beliefs about teaching and learning

Figure 4 shows the results for the six groups of chemistry student teachers and chemistry teachers from the three different countries: Jordan, Turkey and Germany. From Figure 4 one can see that both Jordanian groups tend to be very traditional in their beliefs about teaching and learning chemistry. The same holds true for the both Turkish groups, however their representation is more scattered in the diagram. Still, both groups show in general strong traditional beliefs about chemistry teaching and learning. Comparing to these both countries, the German groups are holding more modern beliefs about the practice of chemistry teaching and learning, as they are clearly represented in this right, upper and back part of the diagram.

b. Beliefs About the Nature of Good Education

Analyzing the results was done using SPSS 18. Figure 5 shows the results for the six groups. Here we found that all the six groups of student teachers and teachers support more Developmental Beliefs than the Transmissive Beliefs (Figure5). The differences between the mean scores within the Developmental Beliefs scale for the six groups are very small.

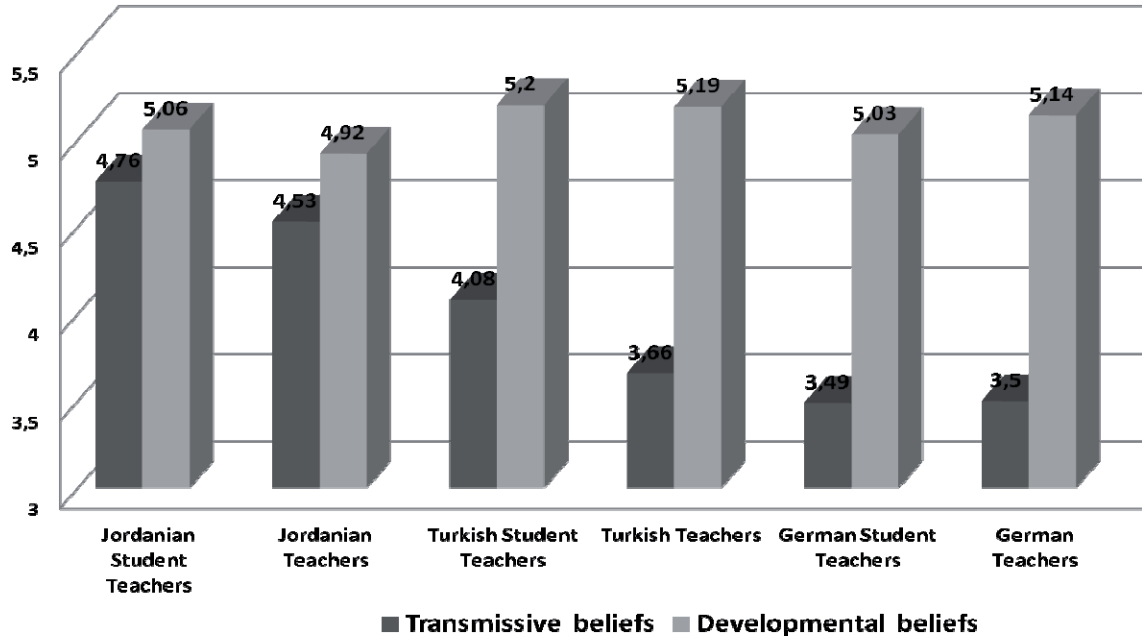


Fig 5: Student teachers and experienced teachers beliefs on the nature of good education

From the t-test there is no significant difference between the six groups concerning the DB scale. This means that the chemistry student teachers and experienced chemistry teachers of Jordan, Turkey and Germany in generally are open to support education that is oriented toward individual development within an open curriculum, and to the knowledge that should be acquired through construction. But, these beliefs seem to stand in concurrency to the transmissive beliefs. The TB scale, which supports the idea that education serves external goals and its outcome is oriented within a closed curriculum, shows clear difference between the groups. Such an orientation is supported most by the Jordanian student teachers and experienced teachers. It is less supported by the samples from Turkey and gets the lowest support from German chemistry student teachers and experienced teachers. Anyhow within the countries the results only indicate tendencies. From the t-test there was no significant difference between teachers and student teachers between the same country's samples. But, when comparing the samples from the three countries, a significant difference is present between them in respect to the TB scale. Although principally all the groups are open minded to education in the means of the DB the support for the concurrent TB is the strongest in Jordan, followed by the samples from Turkey, and having the lowest support among the participants from Germany.

4.3.3 Conclusions

This study compared beliefs of chemistry student teachers and experienced teachers form three different countries, namely Jordan, Turkey and Germany. There are many differences among the three countries, e.g. in the level of economic development from Jordan and Germany or between a traditional Arabic towards a central European Western society. Not only geographically Turkey is in different respect between these two poles. The many differences between the countries make it hard to come to easy and causal explanations for the findings described above.

We found that there is a range from very traditional beliefs of teaching and learning chemistry in Jordan, to be characterized by a strong domination of the teacher, a more or less exclusive focus on the structure of the discipline, and a perceptive understanding of learning. The same is true for Turkey, although the characteristic is not so homogeneous. It seems that teacher training in both countries, pre- and in-service, is not changing these beliefs substantially. The case of Germany shows the opposite picture. Teachers' and student teachers' beliefs are much more in line with modern educational theory, the theory of constructivistic learning, student-centeredness, and an orientation on scientific literacy for all. Anyhow, it would be an overhasty interpretation only addicting this finding to the socio-economic or cultural background of the German sample.

Maybe we should start with the educational system at a glance that might be the first and maybe most influential factor on the (prospective) teachers' beliefs. The teachers themselves experienced their educational system as being students in school themselves and later at the university. Traditional teaching practices will have much influence on the formation of their beliefs as well as the addiction of importance to external exams will have within their countries (Bean & Zulich, 1992; Cherland, 1989; Goodman, 1988). Especially the later aspect was and is much more emphasized in Jordan and Turkey than in Germany. The more selective educational systems in Jordan and Turkey, e.g. in the case of university entrance criteria, might be one explanation for the stronger support of Transmissive Beliefs than among the German sample where this is the case only for selected subjects. Also a hypothesis might be that the more developed a country is the one less the pressure is felt to climb up in society on the base of good formal education. That is why opening career chances by formal educational criteria might be emphasized stronger than contributing to a societal oriented science education with the central aim to allow for societal participation in the future.

Within the three countries presented here we have three very different approaches of training the future chemistry teachers. Additionally, reform asks for restructuring the systems

of the teacher training, but maybe even also the course content and pedagogy. University courses should wherever possible be structured taking the prevalent beliefs of the trainee teachers into account (Bryan & Atwater, 2002). Explicating (student) teachers' beliefs and confronting their beliefs with research findings, and modern educational theory can be made an important task in teacher education and in-service training programs (Tatto, 1998). A promising starting point might be an initial reflection upon one's *a priori* beliefs and prevalent ideas about teaching and learning. As suggested by Markic and Eilks (2008), tools like DASTT-C (or its modified version) can readily and easily applied for this purpose. Also beyond initial training connection of in-service training with teachers' beliefs, needs and practice is a demand. In the field of in-service training, research evidence suggests that effective change asks for long-term cooperation, external support and structured connectedness towards own experiences and reflection (Huberman, 1993). Using evidence-based Continuous Professional Development (CPD) programs for teachers connected to their authentic teaching practice can substantially change their beliefs and knowledge (Mamlok-Naaman & Eilks, 2011).

4-4 - Study 4

Jordanian experienced chemistry teachers` views on the practice of chemistry teaching in Jordan and on educational reform – an interview study (Paper 4)

4-4-1- Sample:

The participants in this study were twelve secondary chemistry teachers from ten different schools located in two different districts: Amman (the capital) and Mafraq (80 km north of Amman). All the teachers completed a Bachelor's degree in the chemistry and a teacher qualification based on pedagogical workshops during the first active year of teaching after the Bachelor. Three out of 12 teachers from this sample did a MEd-program. All teachers had more than 3 years of experience; their average number of teaching years was 12.6. See Table 6 for further details:

Table 6. Demographics data of the participants

Characteristic	**Gender**		***Age (years)***			**Experience *(years)***			**Study**	
	Female	*male*	*25-30*	*30-40*	*> 40*	3-10	10-20	20-30	BSc	BSc + Med
Sample number	8	4	3	7	2	5	5	2	9	3

4-4-2 Results

a. Teachers views on and explanation of the practice of chemistry teaching in Jordan

The teachers' description of their view of most chemistry classes in Jordan as using a frontal mode and being very teacher-centered. The prevalent teaching practices were characterized by (i) the teacher being the source of knowledge, (ii) a very passive role of the students, (iii) and the absence of student experiments and longer phases of student active pedagogies. From the teachers' perception the main reasons could be the kind of curriculum that is mainly focusing on the rote learning of chemistry as facts and theories. In addition to the chemistry books that are described to be so big and full of concepts, and lack the connections to everyday life and among different topics and levels of understanding. Additionally, students could be a reason as this is the style that they prefer to have, to be totally dependent on the teacher role in the classroom.

b. Teachers' views on current educational reform in Jordan

Most of the teachers mentioned having only a vague knowledge concerning recent educational reforms in Jordan, as most of them heard about the ongoing reform process, but they don't have a clear view concerning reform objectives, framework, application, and the state of implementation.

Teachers mentioned different reasons for the slow reform implementation such as feeling unprepared to innovate their teaching within a reform framework. Caused by lack of required knowledge for such reforms and the way to apply them. In other way, reforms are not well translated clearly to the teachers. From their perspective the reform doesn't include all the stakeholders in the educational arena needed to work in concert to make the reforms successful that are normally only directed to teachers.

The Jordanian teachers insisted that the improvement in the educational arena has to start with changes and development in teacher education. Additionally, they suggested to have better conditions in the schools, small classes, and the development of new teaching materials which will replace the exclusively content-focused old books. They also suggested to improve the lab facilities in schools to allow for chemistry lessons concentrating on problem solving method and inquiry skills, changing assessment towards assessing a broader range of skills in a variety of assessment techniques. Finally, they asked for reform on pedagogies making the students the active part in classes.

4.4.3 Conclusions

The findings from the interviews support a dominance of a traditional and teacher-centered style of chemistry teaching in Jordan as it was mirrored in the beliefs of chemistry student teachers and teachers described in Paper 1 and 3. Many reasons were named from problems in infrastructure and too big class sizes, via traditional curricula, textbooks and assessment systems, towards teacher education programs too less oriented at the later profession of being teachers. The study revealed also that despite many reform initiatives in Jordan took place in recent years, most of the teachers in Jordan are not very acquainted to the reforms and implementation is slow (see also Qablan et al., 2010). The study revealed that the majority of teachers from this case sample are not even very optimistic that neither the reform process is taking the teachers' needs sufficiently into account, nor that it will lead successfully to sustainable change. The teachers mention that the reform process should more thoroughly target the whole educational system and also involve the teachers with a more active role.

With the described findings, need for more effort in educational reform becomes clear. There are many suggestions that can be possibly recommended. Anyhow changing the whole system is a sophisticated and not easy step to start with. Because it might economically also not be easy to equip all schools with better facilities and lab or to give teachers better salaries and more money for the teaching, recommendations might concentrate first on the educational fields that are easier and cheaper to innovate. From the findings we see especially two fields where investment with considerable costs might result the most promising effects: implementing change in pre-service chemistry teacher education and connecting reform initiatives more thoroughly with teachers' needs, beliefs and practices.

Chemistry teacher training in Jordan seems not to achieve its full potential for getting the prospective teachers educated in the best way. One reason of the low success of the teacher training might be that the university teacher training is not objecting the training of teachers. Therefore, change seems to be necessary because one can assume that most teachers and student teachers have probably experienced exactly such teaching styles themselves in school and at university. For the profession of being a chemistry teacher a good understanding of chemistry is an unavoidable pre-requisit. Unfortunately, this is not enough. Knowledge in pedagogy within the domain-specific educational domain is similar important too. This is what today is conceptualized as PCK (Magnusson, Krajcik& borko, 1999) and what Shulman (1986) considered to be the most essential domain of a teachers' professional knowledge.

From our point of view, there is need for offering additional training courses in Jordan chemistry education that can help begin the process of long-term knowledge growth

concerning modern educational theory, pedagogies, and to improve the teachers' and prospective teachers' PCK. Also, teacher education should encompass scaffolding for beginning science teachers to develop their identities as reform-minded science teachers (Luehmann, 2007). Providing educational and domain-specific educational courses or placing individuals in schools already accompanying the Bachelor's programs might give the student teachers time for re-thinking and revising own assumptions and beliefs connected to own experience (Hubermann, 1993). Maybe the best way would be to think about a separate, self-standing, and profession-oriented bachelor and/or master track for future chemistry teachers. Such a track should contain educational and pedagogical courses, seminars, and school placements. Additionally, long-term Continuous Professional Development (CPD) programs also showed great potential for sustainable innovation. Long term interactive CPD proved to be effective in changing and developing science teachers' beliefs and PCK (Markic & Eilks, 2011; Mamlok-Naaman & Eilks, 2011) and could be applied more.

5- General discussion

In this study we described and compared the beliefs of (student) teachers about chemistry teaching and learning from Jordan, while taking Turkey and Germany as external references. From the first papers in this study, it is obvious that both the Jordanian and Turkish (student) teachers hold very traditional beliefs when it comes to teaching and learning chemistry. Their beliefs can be characterized by high level of teacher-centerdness, a transmission-oriented understanding of learning, and a strong focus on the pure learning of subject-matter. This is even slightly more the case for Jordan than in Turkey. On the other hand, we saw that the German (student) teachers hold modern beliefs concerning chemistry teaching and learning, such beliefs characterized by student-cenerdness, more scientific literacy oriented and more constructivist.

From the studies about the nature of good education, which reveals that all the groups that we have value modern beliefs more when it comes to teaching and learning in general, it seems that the teachers instinctively understand that learning is far more than rote memorization and that learning is a developmental process. Anyhow there seems to be a concurrency to transmissive beliefs among the Turkish and even more the Jordanian (student) teachers. Transmissive beliefs are most supported by the Jordanian student teachers and experienced teachers. It is less supported by the samples from Turkey and gets the lowest support from German chemistry student teachers and experienced teachers. Both the Turkish sample and even more the Jordanian sample tended to be more inconsistent in the overall

results comparing the beliefs about classroom organization, teaching objectives and epistemological beliefs on the one hand and the beliefs about the nature of good education on the other. This inconsistency could provide an evidence and confirm what Nespor (1987) proposed the belief system that could be non consensuality system with disagreement and disputable. Moreover, these ideas that are held by the Jordanian and Turkish (student) teachers was described by Eisenhart and her colleagues (1988) as multiple ideas that held simultaneously and probably incongruously by teachers. This inconsistency that could happen in different degrees between beliefs and practices can stem from varying psychological, social and environmental realities of the participants' related to school that could on one hand created an opportunity for teachers to implement their own beliefs , or constrained them from apply their beliefs in the instructional decision making (Davis, Konopak, & Keadence, 1993). But such inconsistent in the results between the first two methods' results and the third method results in the case of Jordan and Turkey needs more in-depth explanation and more research in the future.

Another interpretation for such results is that the teachers know or feel that learning is more than rote memorization of content and that learning is a process. Coming to their classes, this knowledge and understanding does not influence their acting in. A reason might be either the difficult circumstances of classroom practices in Turkey (Özden, 2007). One can refer to the fact that teachers don't possess the right repertoire of pedagogies of how to operate their generally developmental oriented beliefs in chemistry classes, as training programs in the case of Jordan were described to use theoretical methods, without an obvious training aims, and a weak relationship between the training materials and the trainers need (Al-Weher & Abu-Jaber, 2007).

Also, one can observe that in the three countries, both student teachers and teachers hold similar beliefs, traditional beliefs in the case of Jordan and Turkey, and modern ones in the German case about chemistry teaching and learning. Regarding the traditional beliefs hold by the (student) teachers of Jordan and Turkey, one can assume that student teachers beliefs have mainly been constructed due to their previous experience as learners in school - and possibly at the university. This means, this observation mirrors a picture of chemistry teaching practices in the Jordanian and Turkish school systems which demands more self-reflection on these practices using the lens of modern educational theory. But, also the teacher training itself, pre- and in-service seem not to change these beliefs substantially. Therefore, the question must be to whether the practice of teacher training sufficiently addresses modern educational theory and to whether the chosen pedagogical approaches are rightly chosen to

change teachers' beliefs as pre-requisite to implement the intended reforms in these two countries. This is the more the fact, as we know from other approaches that a strongly bottom-up and experience based teacher training program can have potential to substantially change prospective teachers' beliefs (Markic & Eilks, 2011).

Concerning the case in Jordan, the teacher education system and the in-service one have been criticized by the chemistry teachers as they described it as ineffective, as lecturing and discussion methods were frequently used in training.(Al-Weher & Abu-Jaber, 2007). On the other hand, a successful training program has advanced to target teachers' conception and beliefs within a reflective environment in which teachers were directly engaged in activities of the Global Education Program GEP, but such program was supported by UNICEF for small number of schools and to teachers of middle level (Hasan, 2000). As a result, if (student) teachers' beliefs are not taken into account when designing reforms or conducting research , then one can't be optimistic that good faith efforts to improve education will work (Eisenhart, et al., 1988).

The findings from the interviews which aimed to explain the situation thoroughly in Jordan support a dominance of a traditional and teacher-centered style of chemistry teaching in Jordan as it was mirrored in the beliefs of chemistry student teachers and teachers described in Paper 1. Many reasons were named from problems in infrastructure and too big class sizes, via traditional curricula, textbooks and assessment systems, towards teacher education programs too less oriented at the later profession of being teachers. The study revealed also that despite many reform initiatives in Jordan took place in recent years, most of the teachers in Jordan are not very acquainted to the reforms, and implementation is slow (Qablan et al., 2010). The study revealed that the majority of teachers from this case sample are not even very optimistic that neither the reform process is taking the teachers' needs sufficiently into account, nor that it will lead successfully to sustainable change. The teachers mention that the reform process should more thoroughly target the whole educational system and also involve the teachers with a more active role.

6- Implications

In summary, this study asks for reflecting the structure of chemistry teacher education in Jordan (and maybe also inTurkey). Perhaps offering additional courses on modern educational theory and pedagogies and to connect them more thoroughly with own teaching experiences might help. From recent studies in Germany (Markic & Eilks, 2011) there is evidence that educational seminars and school placements during the pre-service training

program do have great potential for substantial change in the student teachers' beliefs from traditional towards modern beliefs about teaching and learning.

Moreover, in the case of Jordan, based on the interview results, the need for more effort in educational reform becomes clear. There are many suggestions that can be possibly recommended. Anyhow changing the whole system is a sophisticated and not easy step to start with. Because it might economically also not be easy to equip all schools with better facilities and lab or to give teachers better salaries and more money for the teaching, recommendations might concentrate first on the educational fields that are easier and cheaper to innovate. From the findings we see especially two fields where investment with considerable costs might result the most promising effects: implementing change in pre-service chemistry teacher education and connecting reform initiatives more thoroughly with teachers' needs, beliefs and practices.

Pajares (1993) pointed that it is useful to investigate teachers' beliefs and make reasonable inferences from these findings to teacher candidates. Therefore, explicating agendas to make (student) teachers identifying and confronting their beliefs should be the first important task in the teacher education programs and in-service training programs. As constructivist educators conform that teacher change to help students develop their conceptual understanding of subject matters and a critical view of education should involve learning opportunities supporting in-depth examination of educational theories and practice in light of teachers' beliefs and experiences (Tatto, 1998). Bandura and Pajares (Bandura, 1986, 1997; Pajares, 1993) proposed the role of reflection to understand and help individuals evaluate and modify their own thinking. Therefore, including reflection and belief exploration within teacher education programs make graduate able to resist custodial influence of schools, and this what has been described as emphasis on reflection that marks a difference between education and learning (Fenstermacher & Soltis, 1986). In Richardson (2003) two hypothesis are addressed to change (student) teachers beliefs, the first one depends on their drawings of picture for a school teacher. And the second suggests that these programs that targets candidate beliefs should involve them in field work in classrooms, such that they experience the classroom and therefore develop beliefs on the basis of procedural and practical knowledge. Russell (1995) results supported the positive effect of experience classroom teaching on candidate beliefs. Coming to the fact that without changes in beliefs, changes in performance will be superficial (Tillema, 1997).

Both the structure of the educational seminars in initial teacher training might be reflected as well as the practice of in-service training. Concerning pre-service teacher training,

Luehmann (2007) found out that there is a need for creation of a safe place and scaffolding ways for beginning science teachers to try on and develop their identities as reform-minded science teachers. Teaching workshops should include self-reflection (Luehmann, 2007). The workshops should be optimized to more thoroughly present prospective teachers with concrete student-active methods, instructional tools and illustrating examples for the domain-specific learning environments they later on will work in. But the teachers and student teachers also need tools and competencies to reflect upon teaching objectives in the sense of scientific literacy, or different approaches to constructivistic learning. From our own experience, a promising starting point might be an initial reflection upon one's *a priori* beliefs and prevalent ideas about teaching and learning. A self-reflection session focusing on the question of teacher- or student-centeredness helps to initiate change. As suggested by Markic and Eilks (2008), tools like DASTT-C (or its modified version) can readily and easily apply for this purpose.

In the field of in-service training, research evidence suggests that effective change asks for long-term cooperation, external support and structured connectedness towards own experiences and reflection. Using Continuous Professional Development (CPD) programs for teachers can substantially change their beliefs and knowledge (Mamlok-Naaman & Eilks, 2011). Even this can be connected to processes of self-reflection on the prevalent beliefs and to contrast them with recent research findings.

In conclusion, the most potential strategy is to refer all three points of potential action in parallel: (I) integrating reflection on prevalent beliefs into prospective teachers learning about their later profession of being a chemistry teacher within their university studies, (II) re-organize the introductory seminars in the initial phase of teaching towards more connectedness with modern educational theory and own teaching experience, and (III) establish long-term CPD programs based e.g. on teacher collaboration, interactive workshops, or action research based innovations (Mamlok-Naaman & Eilks, 2011).

7-References

Abed, O. (2009). Class Teacher Students' Efficacy Beliefs Regarding Science Teaching and its Relation to their Understanding Level of Scientific Concepts. *Jordan Journal of Educational Sciences, 5*(3), 187-199.

Abell, S. K. (2007). *Research on science teacher knowledge*. Mahwah: Lawrence Erlbaum.: In S. K. Abell & N. G. Lederman (Eds.).

Aguirre, J., & Speer, N. M. (1999). Examining the relationship between beliefs and goals in teacher practice. *The journal of mathematical behavior, 18*(3), 327-356.

Al-Amoush, S., Markic, S., & Eilks, I. (2012). Jordanian chemistry teachers` views on the practice of chemistry teaching in Jordan and on educational reform .Unpublished manuscript.

Al-Amoush, S. A., Markic, S., Abu-Hola, I., & Eilks, I. (2011). Jordanian prospective and experienced chemistry teachers' beliefs about teaching and learning and their potential role for educational reform. *Science Education International, 22*(3), 185-201.

Al-Weher, M., & Abu-Jaber, M. (2007). The effectiveness of Teacher Preparation Programs in Jordan: A case study. *Handbook of Teacher Education*, 241-266.

Alexander, R. J. (2001). *Culture and pedagogy: International comparisons in primary education*: Wiley-Blackwell.

Alhawari, A., & Audeh, A. (2008). Psychometric properties for selected forms of International Computer Driving Licence Tests in Jordan, and equating their scores. *Jordan Journal of Educational Sciences, 4*(4), 297-319.

Bandura, A. (1986). Fearful expectations and avoidant actions as coeffects of perceived self-inefficacy.

Bandura, A. (1997). *Self-efficacy: The exercise of control*: Worth Publishers.

Bean, T. W., & Zulich, J. (1992). A case study of three preservice teachers' beliefs about content area reading through the window of student-professor dialogue journals. *Literacy research, theory, and practice: Views from many perspectives*, 463-474.

Beattie, M. (1995). New prospects for teacher education: Narrative ways of knowing teaching and teacher learning. *Educational Research, 37*(1), 53-70.

Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D., & Rad, E. (1988). Ideological Dilemmas: a social psychology of everyday thinking: London, Sage.

Bramald, R., Hardman, F., & Leat, D. (1995). Initial teacher trainees and their views of teaching and learning. *Teaching and Teacher Education, 11*(1), 23-31.

Brophy, J., & Good, T. (1986). Teacher behavior and student achievement. *Handbook of research on teaching, 3*, 328-375.

Bryan, L. (2003). Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching and learning. *Journal of Research in Science Teaching, 40*(9), 835-868.

Bryan, L. A., & Atwater, M. M. (2002). Teacher beliefs and cultural models: A challenge for science teacher preparation programs. *Science Education, 86*(6), 821-839.

Cakiroglu, J., Cakiroglu, E., & Boone, W. J. (2005). Pre-Service Teacher Self-Efficacy Beliefs Regarding Science Teaching: A Comparison of Pre-Service Teachers in Turkey and the USA. *Science Educator, 14*(1), 10.

Chai, C. S., Hong, H. Y., & Teo, T. (2009). Singaporean and Taiwanese pre-service teachers' beliefs and their attitude towards ICT use: A comparative study. *The Asia-Pacific Education Researcher, 18*(1), 117.

Cherland, M. R. (1989). The teacher educator and the teacher: When theory and practice conflict. *Journal of Reading, 32*(5), 409-413.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. *Handbook of research on teaching, 3*, 255-296.

Davis, M. M., Konopak, B. C., & Keadence, J. E. (1993). An investigation of two chapter I teachers' beliefs about reading and instructional practices. *Literacy Research and Instruction, 33*(2), 105-118.

De Jong, O. (2007). Trends in western science curricula and science education research: A bird's eye view. *Journal of Baltic Science Education, 6*(1), 15-22.

De Jong, O., Veal, W. R., & Van Driel, J. H. (2002). *Exploring chemistry teachers' knowledge base*. Dordrecht: Kluwer.: In J. K. Gilbert, O. de Jong, R. Justi, D. F. Treagust & J. H. Van Driel (Eds.)

Deng, Z. (2004). Beyond teacher training: Singaporean teacher preparation in the era of new educational initiatives. *Teaching Education, 15*(2), 159-173.

Eilks, I., Ralle, B., Markic, S., Pilot, A., & Valanides, N. (2006). *Ways towards research-based science teacher education* (*Towards research-based science teacher education* ed.). Aachen: Shaker: In I. Eilks and B. Ralle (Eds.),.

Eisenhart, M. A., Shrum, J. L., Harding, J. R., & Cuthbert, A. M. (1988). Teacher Beliefs. *Educational Policy, 2*(1), 51-70.

Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching, 15*(1), 13-33.

Fenstermacher, G. D. (1978). A philosophical consideration of recent research on teacher effectiveness. *Review of research in education, 6*, 157-185.

Fenstermacher, G. D., & Soltis, J. F. (1986). *Approaches to Teaching*: Teachers College Press, 1234 Amsterdam Ave., New York, NY.

Foss, D., & Kleinsasser, R. (1996). Preservice elementary teachers' views of pedagogical and mathematical content knowledge. *Teaching and Teacher Education, 12*(4), 429-442.

Goodman J., (1988), Constructing a practical philosophy of teaching: A study of pre-service teachers' professional perspectives, *Teach. Teach. Educ., 4(2), 121-137.*

Haritos, C. (2004). Understanding teaching through the minds of teacher candidates: a curious blend of realism and idealism. *Teaching and Teacher Education, 20*(6), 637-654.

Hasan, O. H. E. S. (2000). Improving the quality of learning: global education as a vehicle for school reform. *Theory into Practice, 39*(2), 97-103.

Hatcher, L., & Stephanski, E. J. (1994). *A step-by-step approach to using the SAS1 system for univariate and multivariate statistics:* : Cary: SAS Institute.

Hermans, R., Van Braak, J., & Van Keer, H. (2008). Development of the beliefs about primary education scale: Distinguishing a developmental and transmissive dimension. *Teaching and teacher education, 24*(1), 127-139.

Huberman M., (1993), Linking the practitioner and researcher communities for school improvement, *Sch. Effect. Sch. Improv., 4*, 1-16.

Justi, R., & Van Driel, J. H. (2006). The use of the Interconnected Model of Teacher Professional Growth for understanding the development of science teachers' knowledge on models and modelling. *Teaching & Teacher Education, 22*, 437-450.

Klassen, R. M., Bong, M., Usher, E. L., Chong, W. H., Huan, V. S., Wong, I. Y. F., & Georgiou, T. (2009). Exploring the validity of a teachers' self-efficacy scale in five countries. *Contemporary Educational Psychology, 34*(1), 67-76.

Luehmann, A. L. (2007). Identity development as a lens to science teacher preparation. *Science Education, 91*, 822-839. .

Luft, J. (2009). Beginning Secondary Science Teachers in Different Induction Programmes: The first year of teaching. *International Journal of Science Education, 31*, 2355-2384.

Lumpe, A., Haney, J., & Czerniak, C. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching, 37*(3), 275-292.

Magnusson, S., Krajcik, J. and Borko, H., (1999), Nature, source, and development of pedagogical content knowledge. In J. Gess-Newsome & N. G. Lederman (eds.), *Examining pedagogical content knowledge* (pp. 95-132), Dordrecht: Kluwer.

Mamlok-Naaman, R., & Eilks, I. (2011). Different types of action research to promote chemistry teachers' professional development: a joined theoretical reflection on two cases from Israel and Germany. *International Journal of Science and Mathematics Education*, 1-30.

Markic, S., & Eilks, I. (2008). A case study on German first year chemistry student teachers beliefs about chemistry teaching, and their comparison with student teachers from other science teaching domains. *Chemistry Education Research and Practice, 9*(1), 25-34.

Markic, S., & Eilks, I. (2011). Die Veränderung fachbezogener Vorstellungen angehender Chemielehrkräfte über Unterricht während der Ausbildung–eine Cross Level Studie. *CHEMKON, 18*(1), 14-19.

Markic, S., Eilks, I., & Valanides, N. (2008). Developing a tool to evaluate Differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains:a case study. *www. ejmste. com, 4*(2), 109-120

Mayring P. (2000). Qualitative content analysis. *Forum Qual. Soc. Res., 1,* Retrieved 01/02/2007, from www.qualitative-research.net/fqs <http://www.qualitative-research.net/fqs

Ministry of Education, J. (2010). ministry of education. Retrieved November,20, 2010, from ministry of education: http://www.moe.gov.jo/Projects/ProjectMenuDetails.aspx?MenuID=1&ProjectID=2>.

Minor, L. C., Onwuegbuzie, A. J., Witcher, A. E., & James, T. L. (2002). Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. *The Journal of Educational Research, 96*(2), 116-127.

Munby, H. (1982). The place of teachers' beliefs in research on teacher thinking and decision making, and an alternative methodology. *Instructional Science, 11*(3), 201-225.

Munby, H., Russel, T., & Martin, A. K. (Eds.). (2001). *Teachers' knowledge and how it develops.* Washington: AERA: In V. Richardson (Ed.),.

Nespor, J. (1987). The Role of Beliefs in the Practice of Teaching. *Journal of curriculum studies, 19*(4), 317-328.

Nisbett, R., & Ross, L. (1980). *Human Interferences: Strategies and Shortcomings of Social Judgement*: Englewood Cliffs: Prentice-Hall.

Oliamat, M. (2009). Science teachers' perceptions about their pedagogical knowledge and its relation with their teaching practices in the Basic Stage, *http://www.damascusuniversity.edu.sy/faculties/edu/images/stories/news/t/35.doc.*

Özden, M. (2007). Problems with science and technology education in Turkey. *Euraisa Journal of Mathematics, Science and Technology Education, 3*, 157-161.

Pajares, F. (1993). Preservice teachers' beliefs: A focus for teacher education. *Action in teacher education, 15*, 45-45.

Pajares, M. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of educational research, 62*(3), 307.

Qablan, A., Jaradat, S,. and Al-Momani, I. (2010). Elementary Science Teachers' Perceptions of Educational Reform in Relation to Science Teaching in Jordan. *Jordan Journal of Educational Sciences 6*(2), pp 161-173

Raths, J., & McAninch, A. R. (2003). *Teacher beliefs and classroom performance: The impact of teacher education* (Vol. 6): Information Age Pub Inc.

Richardson, V. (2003). Preservice teachers' beliefs. In J. Raths & A. C. McAninch (Eds.), *Teacher beliefs and classroom performance: The impact of teacher education* (Vol. 6, pp. 1-22).

Russell, T. (1995). Returning to the physics classroom to re-think how one learns to teach physics. In T. Russell & F. Korthagen (Eds.), *Teachers who teach teachers* (pp. 95-112). London: Falmer.

Samuelowicz, K., & Bain, J. (1992). Conceptions of teaching held by academic teachers. *Higher Education, 24*(1), 93-111.

Schoenfeld, A. H. (1998). Toward a theory of teaching-in-context. *Issues in Education, 4*(1), 1-94.

Shen, J. (1997). Structure of the Theoretical Concept of Educational Goals: A Test of Factorial Validity. *Journal of Experimental Education, 65*(4), 342-352.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher, 15*(2), 4-14.

Smith, K. (1993). Development of the primary teacher questionnaire. *The Journal of Educational Research*, 23-29.

Smith, K. E. (1997). Student teachers' beliefs about developmentally appropriate practice: Pattern, stability, and the influence of locus of control. *Early Childhood Research Quarterly, 12*(2), 221-243.

Swanborn, P. G. (1996). A common base for quality control criteria in quantitative and qualitative research. *Quality and Quantity, 30*(1), 19-35.

Tatto, M. T. (1998). The influence of teacher education on teachers' beliefs about purposes of education, roles, and practice. *Journal of Teacher Education, 49*(1).

Thomas, D. R. (2006). A general inductive approach for qualitative data analysis. *American Journal of Evaluation, 27*(2), 237-246.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2000). *Validating the Draw-A-Science-Teacher-Test checklist (DASTT-C): From images to beliefs*: *A paper presented at the Association for the Education of Teachers of Science annual meeting. Akron*.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the draw-a-science-teacher-test checklist (DASTT-C): exploring mental models and teacher beliefs. *Journal of Science Teacher Education, 12*(4), 295-310.

Tillema, H. (1997). Stability and change in student teachers' beliefs. *European Journal of Teacher Education, 20*(3), 209-212.

Tobin, K., Tippins, D. J., & Gallard, A. J. (1994). Research on instructional strategies for teaching science. *Handbook of research on science teaching and learning*, 45-93.

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education, 27*(1), 75-84.

Van Driel, J. H., Bulte, A. M. W., & Verloop, N. (2007). The relationships between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs. *Learning and Instruction, 17*(2), 156-171.

Woolfolk-Hoy, A., Davis, H., & Pape, S. J. (2006). Teacher knowledge and beliefs. *Handbook of educational psychology*, 715-737.

Woolley, S. L., Benjamin, W. J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64*(2), 319.

8-Appendices

8-1-Appendix 1: Modified DASTT Instrument.

8-2- Appendix 2: Primary Education Scale Instrument.

8-3-Appendix3: Interview Guide -Short version.

Appendix 8-1:

A- DASTT-C Instrument (Thomas 2000) in addition to the questions of the modified version(S Markic, et al., 2008)

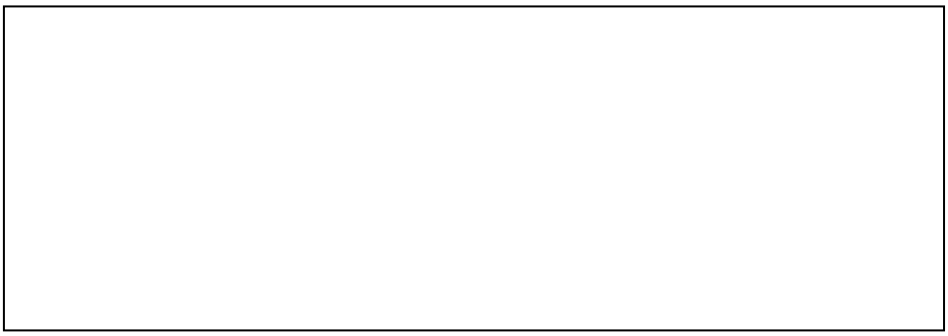
Date: _____ID #: _____ _____ _____ _____

-Draw a picture of yourself as a science teacher at work. Imagine you are a teacher and give one

lesson in science.

Select a class stage, to which your thoughts refer. Please indicate this stage. _____

1- Draw yourself and pupils during instruction. In the design you should play a role as teacher, the pupils, media, the area or other devices.



-What is the teacher doing? Can you describe your activity as teacher in the situation?

-What are the students doing? Can you describe the activities of your pupils in this instruction situation?

-Which goals are pursued in the represented situation? Modified DASTT instrument (S Markic, et al., 2008)

-What preceded the drawn situation? Modified DASTT instrument (S Markic, et al., 2008)

8-1 B-DASTT-C Score Sheet (Thomas, 2001)

I. TEACHER

Activity

Demonstrating Experiment/Activity.....

Lecturing/Giving Directions (teacher talking).....

Using Visual Aids (chalkboard, overhead, and charts) .....

Position

Centrally located (head of class) .....

Erect Posture (not sitting or bending down).....

II. STUDENTS

Activity

Watching and Listening (or so suggested by teacher behaviour).....

Responding to Teacher/Text Questions.....

Position

Seated (or so suggested by classroom furniture).....

III. ENVIRONMENT

Inside

Desks are arranged in rows (more than one row).....

Teacher desk/table is located at the front of the room.....

Laboratory organization (equipment on teacher desk or table).....

Symbols of Teaching (ABC's, chalkboard, bulletin boards, etc.).....

Symbols of Science Knowledge (science equipment, lab instruments, wall charts, etc.) ..

TOTAL SCORE = PARTS I + II + III

Appendix8-2:BPES (Hermans, et al., 2008)

- The content of a lesson has to be completely in line with the curriculum.
- Starting from the primary school experience, education has to be directed towards helping pupils get a position in the labour market. (i.e. get a job, or be 'employable').
- The school should be driven by the expectations of society.
- 'Good teaching' ultimately is aiming to raise economic productivity.
- A teacher must define, in advance of the lesson, the learning content of each individual lesson.
- Schools always have to focus on the acquisition of knowledge.
- An important task of schools is to prepare young people for the professional world.
- It is recommended that a teacher does not deviate from the content of an agreed learning program.
- The main task of a teacher is to transmit knowledge and skills to learners.
- Learners must get the opportunity to build up their own knowledge in a collaborative way or together with the teacher.
- During a lesson, we use resources and artefacts that the pupils bring to the classroom as well as those from the school (own books, etc.).
- The emphasis on cross-curricular goals is important in primary education.
- The school has to promote the total and harmonious development of young people .
- The learning process always has to start from the learning needs of the pupils .
- A shift from 'knowledge orientation' to 'skills orientation' is right for primary education.
- Good teaching always relates to the personal experiences of the pupils and to their own 'world'.
- The learning process has to be in line with what learners know and are able to do.
- It is important to follow broad themes and undertake the associated projects in a class even without being sure what the exact learning outcomes will be.

Appendix 8-3: Interview Guide (Short version, extended version included additional impulses if answers are considered by the interviewer to be too short and lacking information)

Topic	*Interview Questions*
Teachers' perception of the situation in Jordan chemistry education and reflection on own chemistry teaching practices	How would you describe the prevalent practice in the teaching of chemistry in Jordan general? How does your chemistry teaching look alike? What is your style of teaching chemistry? What are your main objectives while teaching chemistry? Are you happy with the situation or would you suggest any changes?
Teachers' knowledge on educational reform in Jordan	Currently there are several reform initiatives in education in Jordan. What do you know about them? Do you agree to them? Are they implemented in your school? Reports document that reform in Jordan goes on very slowly. What is your consideration about potential reasons?
Teachers` consideration on the findings from the study by Al-Amoush et al. (2011)	From an empirical survey we found that Jordanian teachers and student have a very traditional view in chemistry teaching, characterized by teacher-centered methods and a strong orientation on pure knowledge transfer. (Results in figures from Al-Amoush et al, 2011, are presented) What do you think about our results? Do you think that this description is representative? What are the reasons that this one style of teaching is so predominant? *Or:* Why is your consideration so different from our findings?
Teachers view on effects of educational reform in Jordan on chemistry teaching	On international level, reform asks for more student-active methods and a stronger focus on general educational skills. Why do you think is such an approach so rarely documented in reports and studies concerning Jordan chemistry classrooms? We also found, that the teachers have positive attitudes on more student-oriented learning, but are unable to create teaching situations where this is operated. What do you think about this finding? Do you have any explanation for this? Do you have any suggestions for more effective implementation of student-active and competency driven methods in the chemistry classroom?
Teachers look ahead	What is your vision about chemistry teaching in Jordan in general? How would you like chemistry education to be in Jordan in ten years?

Paper 1

Jordanian Prospective and Experienced Chemistry Teachers' Beliefs about Teaching and Learning and their Potential Role for Educational Reform

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Jordanian Prospective and Experienced Chemistry Teachers' Beliefs about Teaching and Learning and their Potential Role for Educational Reform

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Abstract

This paper presents an exploratory study of Jordanian chemistry student teachers` and experienced teachers' beliefs about teaching and learning. Different instruments were used, focusing on different aspects of teaching and learning. The first instrument is based on teachers' and students' drawings of teaching situations. It includes open questions evaluated by a grid describing educators' Beliefs about Classroom Organization, Beliefs about Teaching Objectives and Epistemological Beliefs. A second evaluation using the same data source is made by applying the 'Draw-A-Science-Teacher-Teaching'-Checklist (DASTT-C), which shows the teacher- or student-centeredness of educators` beliefs concerning science teaching. A third approach is composed of a Likert-questionnaire examining teachers' beliefs about what constitutes good education in general. The results indicate that both above-mentioned groups hold quite traditional beliefs, which are teacher- and content-centered when it comes to chemistry teaching practices. Student teachers profess ideas which are even more pronouncedly traditional. Nevertheless, the general educational beliefs are more open and promising. Implications for chemistry teacher education and educational reform in Jordan are also addressed.

Keywords: *chemistry education, chemistry teacher education, (student) teachers' beliefs, educational reform*

Framework and purpose of the study

Teachers´ beliefs have recently gained increased attention in both general educational research (Munby, Russell & Martin, 2001) and in the field of science education (Abell, 2007; De Jong, 2007). The latter field is expanding, with studies focusing on both in-service teachers (Smith, 1993; Woolley, Benjamin, & Woolley, 2004) and student teachers (Abed, 2009; Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003). Research on (student) teachers' beliefs has become an active field, since such studies provide promising approaches to better understanding teachers' learning processes and behavior in the classroom (Fenstermacher & Soltis, 1986; Nespor, 1987). Evidence of student teachers' beliefs is also valuable for teacher trainers, who can map out currently-held ideas about teaching and learning, then see how they can be applied and/or changed (Nisbett, 1980). Such knowledge also shows potential for improving university teacher education programs in order to better facilitate candidates' personal learning and professional development (Bryan, 2003). Finally, research on beliefs is seen as useful for curriculum innovators and planners, who can more effectively implement curriculum changes by taking existing teachers` beliefs into consideration (De Jong, Veal & Van Driel, 2002; Eilks, Markic, Valanides, Pilot & Ralle, 2006; Justi & Van Driel, 2006).

In Pajares' (1992) research review, the author argued that teachers' beliefs are a long-neglected field of educational research. He stated that they should, however, be developed into a proper construct for investigating and improving teacher education and classroom practices. One example of the link between teachers' beliefs and changes within teacher training programs was presented in the study published by Haritos (2004). Haritos examined the relationship between teacher concerns and personal beliefs about one's own role in teaching. The results revealed three areas of concern which a teacher must overcome: concern about pupils, issues dealing with the teaching situation itself, and survival concerns. Such research offers focal points for training measures (pre- and in-service), including making teacher educators explicitly aware of these areas so they can address them during teacher training.

Becoming aware of one's own beliefs about teaching and learning is an important first step. Self-reflection on one's actions in the classroom is very necessary, because personal beliefs act as filters for interpreting new experiences, selecting new information, and choosing innovative instructional approaches (e.g. Goodman, 1988; Nespor, 1987; Pajares, 1992; Putnam & Borko, 1997). Bandura (1997) defined beliefs as the best indicator of why people make specific decisions throughout their lifetimes and how they will act in a given situation. This is also the case for teachers when it comes to their decisions and actions in the classroom. It is also why paying increased attention to both teachers` beliefs and their effects may potentially enhance

educational effectiveness through a better understanding of teachers' conceptual frameworks, beliefs, and belief systems (Brophy, 1988). Tobin, Tippins and Gallard (1994) have also recognized the importance of knowledge about teachers' beliefs with respect to science education. They recommended that further research should not only expose relevant beliefs, but also enrich our understanding of the relationship between beliefs and their impact on educational reform in science education. Their argument is that successful reforms must take teachers` beliefs into account if they aim at overall change in classroom practices (see also Lumpe, Haney & Czerniak, 2000). Furthermore, Trigwell, Prosser & Taylor. (1994) point out that educational reform is doomed to failure if it limits its emphasis to the development of specific skills without taking teachers' beliefs, intentions and attitudes into account. For instance, many innovations are viewed as impractical by teachers, since these changes are unrelated to familiar routines and also do not fit with teachers' personal beliefs about educational goals, etc. (Brown & McIntyre, 1993). Van Driel, Bulte and Verloop (2007) have already emphasized that addressing teachers` beliefs must be the first step when planning and changing teaching practice.

From previous research we know that different factors influence and shape existing teachers` beliefs. These include a teacher's own learning experiences in school, his/her educational background, the quality of pre-service experiences in the classroom, opportunities for self-reflection (or the lack therof) during pre-service training, and the influence of discipline-related and domain-specific subject matter training (Bean & Zulich, 1992; Cherland, 1989; Goodman, 1988; Markic & Eilks, 2008). The larger context of national policies and the context of cultural norms and values also play an important role in affecting teachers` beliefs (Isikoglu, Basturk & Karaca, 2009). Markic and Eilks (2008) have demonstrated the influence of educational domain and the level of education on the formation of educational beliefs. In their study of freshman student teachers in Germany, primary school science and secondary biology teacher trainees showed themselves to be very student-centered in their views and approaches. Their colleagues with a comparable educational and cultural background preparing to teach secondary school chemistry and physics proved to be much more teacher-centered, holding extremely content structure-driven beliefs.

Increasing numbers of studies about teachers' beliefs are now being published. Starting from trainees' general educational beliefs, Van Driel et al. (2007) were able to distinguish between two different ideologies which form a continuous dimension visible within various belief studies. These ideologies occur as a common feature repeated in various studies. The first system has been called *teacher-centered* (Bramald, Hardman, & Leat, 1995) or, alternately, *subject-matter oriented* (Billig et al., 1988). On the opposite end of the spectrum we find the *personal* (Shen, 1997), also called *student-supported* (Samuelowicz & Bain, 1992; Trigwell et.al., 1994)

or *learner-centered* (Bramald et al., 1995) learning. Markic and Eilks (2008) suggest viewing this spectrum as a range between traditional beliefs (transmission-oriented beliefs of learning with a focus on pure subject-matter knowledge) and modern beliefs (beliefs based on constructivistic learning, student-oriented classroom structures, and an orientation on more general educational skills, including Scientific Literacy for all). This dichotomy is in line with other studies, e.g. Thomas, Pederson and Finson (2001). It also parallels discussions about educational reform and differences between traditional practices and the reform movement in science education in general (see Van Driel et al., 2007), including the present situation in Jordan (Qablan, Jaradat, & Al-Momani, 2010).

In addition to these two orientations themselves, the relationship linking them together is also of great importance. Do these viewpoints represent the opposite extremes of a continuous scale with intermediate ideologies between them as suggested by Van Driel et al. (2007)? Can individuals hold different beliefs with respect to different subtopics or domains? Do these beliefs always have to be coherent within themselves? Minor, Onwuegbuzie, Witcher, and James (2002) described pre-service teachers' beliefs as representing a seemingly contradictory mix of ideas. In their study, some student teachers supported both transmissive and constructivistic beliefs of teaching simultaneously. Although such beliefs about teaching and learning appear to be contradictory and dichotomous (Chai, Hong, & Teo, 2009), the presence of both beliefs might be understood as a continuum of positions, thus allowing teachers to adapt to a situation depending on both the content and their view of the context (Samuelowicz & Bain, 1992). However, it also has become clear that beliefs can be changed by educational programs, thus moving candidates away from more teacher- and content-structured beliefs to more open, student-orientated contents and methods (Luft, 2009; Markic & Eilks, 2011).

The timeframe in which pre- and in-service teachers` beliefs are recorded also seems to be of particular relevance. Luft (2009) considered the first year of practical teaching as the most difficult period for a teacher and therefore crucial for more detailed research efforts. This study went on to describe the effect of induction programs on the professional development process of first year teachers in the US. Analysis of the results revealed that teachers participating in science-specific induction programs significantly abandoned their teacher-centered beliefs and practices in favor of more student-supportive ones. Jordan has outlined a similar system for preparing teachers using post-Bachelor's training. Nevertheless, the influence of training in Jordan seems to be more restricted or at the least less clear, as Qablan et al. (2010) described for primary science teachers. Nevertheless, Alqaderee (2009) concluded that various effects are possible. Changes concerning teachers' epistemological beliefs on the learning of scientific concepts were described for a course on science curricula and methodologies. This observation

shows that such courses can be both effective and potentially advantageous for improving teachers' epistemological perceptions. But questions about the depth, penetration and sustainability of changes in teachers' beliefs and knowledge base remain open.

Markic and Eilks (2011) compared student teachers' beliefs at different stages of their pre-service teacher training in Germany. The German system is based on a bottom-up teacher training style, where courses on education and domain-specific learning accompany a five year university program, including school internships. Three different groups of chemistry student teachers were studied. A substantial change in candidates' beliefs about teaching and learning was indicated as a result of the teacher training program. The data showed that student teachers` beliefs swung dramatically during their university education from very traditional, teacher-centered beliefs in the beginning to more modern, learner-oriented educational beliefs based on constructivistic theories of learning by the end.

Observing the present situation, it is clear that research on science teachers' beliefs is an expanding field. The growing body of research has shed light on many aspects of science teachers' beliefs. Nevertheless, beliefs are context-bound and thus related to the educational and cultural circumstances in which teachers live, the institutions in which they were educated, and the places where they currently work (Alexander, 2001; Woolfolk-Hoy, Davis, & Pape, 2006). In the case of Jordan, evidence concerning secondary chemistry (student) teachers' beliefs about teaching and learning is relatively scarce in the literature. Unfortunately, research in this area remains underdeveloped and is currently lagging behind.

Despite this fact, educational innovations are being planned and implemented in Jordan. Currently, the country is going to great efforts to develop and expand its educational system (Jordan Ministry of Education, 2010). Many reforms have already been elaborated upon and tested (early childhood education, school to career measures, etc.). However, teachers' beliefs are not included in the focus of these innovations, whose implementation remains unsatisfactory as recently described in the case of primary school teachers (Qablan et al. 2010). The purpose of the current study was, therefore, to investigate different aspects of (student) teachers` beliefs about secondary chemistry in order to pinpoint any differences between Jordanian in-service and pre-service teachers. The focal points selected were quite general. They dealt primarily with achieving a general overview of chemistry teachers' beliefs about teaching and learning, the aims and objectives of chemistry lessons, and classroom culture and activities.

This study attempts to answer the following questions:

1. What beliefs do Jordanian teacher trainees and in-service teachers hold regarding chemistry teaching and learning, including student- and teacher-centeredness, overall

teaching objectives, understanding the learning process, and the nature of good education?

2. What are the similarities and/or differences in beliefs about teaching and learning for these two groups regarding the above-mentioned fields?

Background and sample

Jordan's teacher education system uses a layered model, which begins with students completing a Bachelor's degree in the subject to be taught. Secondary teacher qualifications are based on pedagogical workshops during the first active year of teaching after the Bachelor's. Teacher trainers must possess a Master's degree and some teachers have also obtained this level of education (e.g. Qablan et al., 2010). The pedagogical workshops accompanying the initial stage of a teacher's career concentrate on teaching methodology, different types of assessment, performing experiments within the educational context, and other educational issues. These workshops are conducted once a week for five hours. Additionally, a computer workshop focuses on the use of information technology in education. The International Computer Driver's License (ICDL) and Intel for the future are among the things learned (Alhawari, 2008; Jordan Ministry of Education, 2010). Jordan started offering its science teachers manuals for improving their practices and methodology in a 2003 reform project called "Educational Reform for Knowledge Economy" (ERFKE, 2008). Some chemistry teachers also have the chance to continue postgraduate studies in the field of science education; however, this is not an obligatory component.

The sample in this study consists of two groups: Jordanian chemistry student teachers (N=23) and in-service chemistry teachers (N=44). A second group (N=35) of teacher trainees was added to the quantitative part of the study to better support the findings (see description below). The student teachers all attended different government universities with secondary school programs, but had not yet completed their Bachelor's degree. They had not had any courses related to teaching and learning prior to this study. This meant that they had not yet been influenced by the teacher training program normally given to teachers during the first year of their teaching career. The in-service chemistry teachers sample consisted of teachers from various schools in Jordan. All of these teachers possess at least a Bachelor's degree and have completed the workshop-based training unit. Eight of these forty-four teachers had finished a Master's of Education program. Some of the characteristics of both groups are presented in Table 1.

Table 1: Characteristics of the sample

Characteristic		***Student Teachers (N=23)***		***Teachers (N=44)***	
		Number	***Percentage***	***Number***	***Percentage***
Gender	*Female*	13	56	25	57
	Male	10	44	19	43
Age	*19-25*	11	48	4	9
	26-36	11	48	20	45
	37-47	1	4	17	39
	48-58	0	0	3	7

Methods

Traditional vs. modern beliefs on chemistry education

The first part of the study is qualitative in nature and is based on a modified version of the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C). The original DASTT-C (Thomas, Pedersen & Finson, 2000; 2001) requests the participant to draw him/herself and learners in a typical classroom situation. The drawing is followed up by two open-ended questions asking about the activities of teacher and students. Markic, Eilks, and Valanides (2008) added another two open-ended questions to this to gain a more detailed overview of the situation. The added questions inquire into the teaching and learning objectives of the situation depicted and the approach chosen towards the drawn situation. An evaluation grid was also developed (Markic et al., 2008) based on Grounded Theory. This grid categorizes a range stretching from traditional beliefs to more modern beliefs in line with current educational theory. Traditional beliefs are characterized by teacher-centered classroom organization, strong orientation on the structure of the subject matter, and transmission-oriented beliefs about teaching and learning. Conversely, modern beliefs are characterized by student-oriented classroom organization, an orientation on problem-solving and scientific literacy objectives, and constructivistic learning theories. The evaluation pattern analyzes participants` beliefs in three qualitative categories: 1) *Beliefs About Classroom Organization*, 2) *Beliefs about Teaching Objectives*, and 3) *Epistemological Beliefs*. Each category was evaluated using a range from -2 to +2 to describe beliefs in the above-mentioned dimensions along an ordinary, but non-linear scale. An overview of the categories is presented in Table 2. A full description of the categories can be found in Markic et al. (2008).

Data was encoded by two independent raters. The agreement rate using this grid remained continuously above 80%. In cases of disagreement, joint rating was carried out by searching for inter-subjective agreement (Swanborn, 1996).

Table 2: An overview of the scales in the qualitative part of the study (Markic & Eilks, 2008)

	Traditional beliefs		*Modern beliefs*
Beliefs About Classroom Organization	Classroom activities are mostly teacher-centered, -directed, -controlled and dominated by the teacher.	↔ -2, -1, 0, 1, 2	Classes are dominated by student activity and students are (at least partially) able to choose and control their activities.
Beliefs About Teaching Objectives	The focus of science teaching is more-or-less exclusively focused on content learning.	↔ -2, -1, 0, 1, 2	Learning of competencies, problem solving or thinking in relevant contexts are the main focus of teaching.
Epistemological Beliefs	Learning is passive, top-down and controlled by the dissemination of knowledge.	↔ -2, -1, 0, 1, 2	Learning is a constructivistic, autonomous and self-directed activity.

Beliefs about teacher- and student-centeredness

The second focus of this study applied the original evaluation pattern from the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C) by Thomas et al. (2000; 2001). In DASTT-C, (student) teachers` drawings and the open-ended questions about the activities of teacher and learners (see above) are evaluated using a checklist. The total score depends on the presence or absence of thirteen attributes in three main areas: the teacher, the students, and the environment. The complete checklist can be found in Thomas et al. (2000). The accompanying questions in our case are only used to better understand the drawings. The presence of any of the thirteen attributes within a section is scored with a "1", an absence with "0". Thus, the total score can fall between 0 and 13. Scores of 0-4 indicate student-centered teaching, while values between 7 and 13 represent teacher-centeredness. For scores of 5 or 6 no decision can be made (Thomas et al., 2000). The data was rated by two independent raters according to the checklist; inter-rater reliability was moderately high ($\kappa = 0.74$ for teachers and $\kappa = 0.76$ for student teachers).

Beliefs About What Good Education Really Is

A third source of information is provided by a Likert questionnaire on (student) teachers' beliefs about the nature of good education. The questionnaire asks about how teaching practices should be organized (Hermans, Van Braak, & Van Keer, 2008). It consists of eighteen Likert items describing two dimensions: *Transmissive Beliefs* (TD) and *Developmental Beliefs* (DB). Transmissive Beliefs cover ideas that education satisfies external goals which can be met using closed, curriculum-oriented outcomes. The extent of knowledge acquisition can be viewed as

being achieved through transmission. Developmental Beliefs identifies education as oriented toward individual development within an open curriculum, including to what degree knowledge should be acquired through constructivistic means. The core concept of this dimension is the presence of students as active participants in the education process (Smith, 1997). In our study, we evaluated both dimensions using a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Data was interpreted by calculating mean scores, standard deviations and missing values. Pearson correlations and t-tests between the scales and between the two groups were also explored. Cronbach's alpha for both scales (seven developmental items, and nine transmissive items) was between α=0.50-0.74 (see Table 4) and thus can be considered acceptable (Hatcher & Stephanski, 1994).

Results and discussion

Traditional vs. modern beliefs in science education

The three categories in this part of the study were interpreted along the traditional-modern spectrum on the basis of current educational theory (see Markic & Eilks 2008). The results are presented in Table 3 and Figure 1. We can see that the Jordanian chemistry teachers in this sample hold a wide variety of beliefs concerning teaching and learning. Nevertheless, clear tendencies can also be recognized.

Table 3: Distribution of traditional vs. modern beliefs about chemistry education

		Student teachers (N=23)		**Teachers (N=44)**	
		Frequency	**Percent**	**Frequency**	**Percent**
Beliefs About Classroom Organization	*-2*	13	62	12	27
	-1	7	33	23	51
	0	0	0	8	18
	1	1	5	2	4
	2	0	0	0	0
	not coded	2	9	0	0
Beliefs About Teaching Objectives	*-2*	14	67	21	47
	-1	2	9	13	29
	0	0	0	9	20
	1	3	14	2	4
	2	0	0	0	0
	not coded	2	9	0	0
Epistemological Beliefs	*-2*	14	67	13	29
	-1	6	28	25	56
	0	1	5	5	11
	1	0	0	2	4
	2	0	0	0	0
	not coded	2	9	0	0

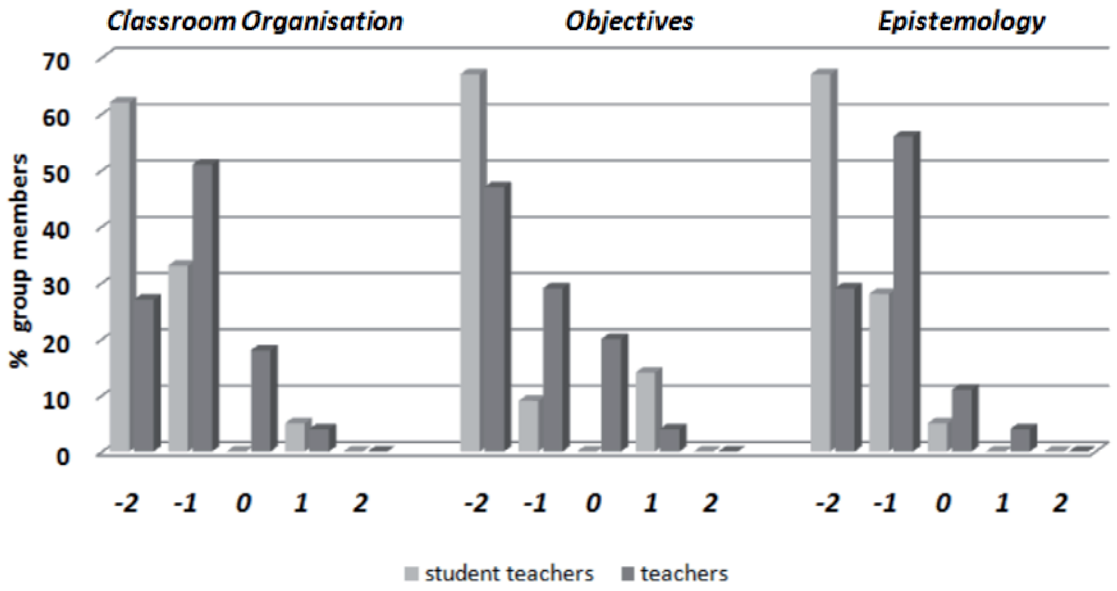

Figure 1: Distribution of traditional vs. modern beliefs about chemistry education

In the category *Beliefs about Classroom Organization* strong tendencies towards teacher-centered beliefs can be recognized in both groups. Over 90% of the student teachers and almost 80% of experienced teachers described a classroom dominated by the teacher, where student activity plays only a minor role and is completely dominated by the teacher. The same can be said for *Beliefs about Teaching Objectives*. A dominant majority (about 80%) of student teachers expressed traditional beliefs about the objectives of chemistry lessons. The more-or-less exclusive goal of chemistry lessons in their estimation is the learning of subject-matter content. This is in line with Qablan et al. (2010), whose findings described Jordanian primary school teachers' attitudes towards educational reform. These teachers discussed reforms primarily by referring to developments in more effective methods of pure knowledge transfer. The same can be said for the group of in-service chemistry teachers, by the number are being a bit less extreme but the tendency towards the most strongly traditional beliefs was more pronounced. For *Epistemological Beliefs* both groups draw situations with chemistry teaching being quite strongly as a transmission of knowledge organized by the teacher (scores "-2" and "-1"). About 70% of the student teachers expressed strong traditional beliefs about teaching (score "-2"). The in-service teachers were not as traditional as the student teachers in this regard. The majority received a score of "-1" in this category, which can be interpreted as being "rather transmission-oriented". No student teacher professed beliefs which could be rated as either modern or quite modern; even among experienced teachers there were only about 5% (scores "2" and "1") of participants who expressed relatively modern ideas.

Markic and Eilks (2008) suggest that the interdependence of the three categories is important. If a teacher has similar replies in each of the three categories, the combination of codes will appear

on or near the diagonal stretching from (-2/-2/-2) to (2/2/2). Placement of (student) teachers` replies within the respective 3D-diagram using this system of evaluation allows us an overall consideration of the data. The closer a given code combination comes to the upper, right, back part of the 3D-diagram, the closer these beliefs are to modern educational theory. Conversely, code combinations appearing in the lower, left, front part of a 3D-diagram represent more traditional beliefs. Figure 2 gives the code combinations for all of the participants. Most Jordanian teachers` code combinations appear close to the 3D diagonal, thus supporting Markic and Eilks' (2008) interpretation. Beliefs about teaching, learning, and teaching objectives are also interdependent upon one another in both samples. Figure 2 reveals that Jordanian student teachers in general hold beliefs which can be considered very traditional. The ideas expressed by experienced, in-service chemistry teachers show more scattering, but also evidence a tendency towards more traditional beliefs. Both groups professed more-or-less strongly teacher-centered, content-structure, and transmission-oriented beliefs when it comes to teaching and learning, with student teachers being pronouncedly stronger in their convictions than the experienced teachers.

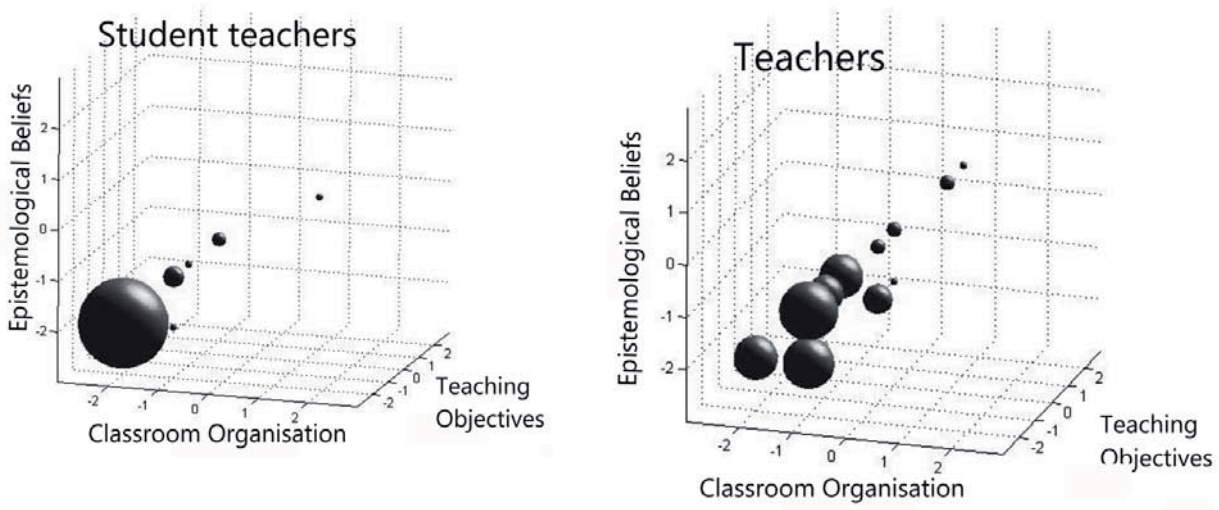

Figure 2. Results of Jordanian educators with respect to traditional vs. modern beliefs about chemistry education

Beliefs about teacher- and student-centeredness

Two examples from the sample are given in Figure 3 (see also Markic & Eilks, 2008). Figure 3a represents an example of teacher-centered beliefs, whereas Figure 3b gives a student-centered viewpoint. The teacher in Figure 3a appears in the center of classroom activity. The students are either responding to the teacher by answering his questions or simply listening to him; the blackboard is the focus of all student attention. This classroom is a traditional one without any

indicators of student activity (experimental equipment, etc.). The drawing in Figure 3b shows students in the lab performing an experiment. Typical teacher-centered indicators are not present, for example, the teacher standing in the center of the classroom or media centralizing the students' attention.

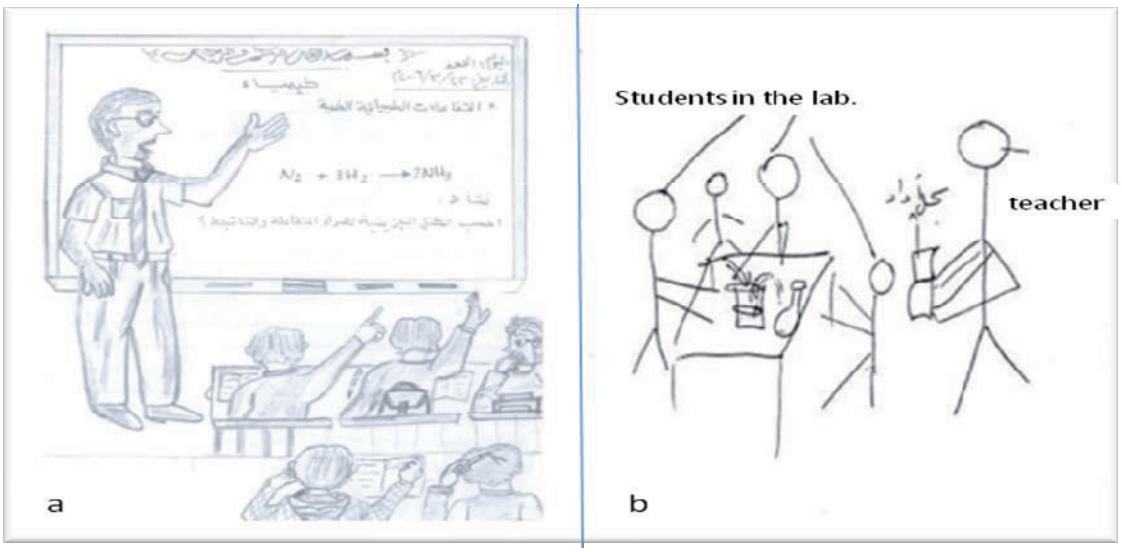

Figure 3. Drawings of two Jordanian teachers of a typical chemistry lesson, (a) traditional/teacher-centered and (b) modern/student-centered

Table 4: The number and percentage of teachers according to DASTT-C

	Student teachers (N=23)		*Teachers (N=44)*	
DASTT-C Checklist Score	**Frequency**	**Percent**	**Frequency**	**Percent**
0	0	0	0	0
1	0	0	1	2
2	0	0	1	2
3	0	0	2	5
4	1	4	3	7
Subtotal: Student-centered scores (0-4)	**1**	**4**	**7**	**16**
5	0	0	2	5
6	2	9	4	9
Subtotal: Neither student-centered nor teacher-centered scores (5-6)	**2**	**9**	**6**	**14**
7	3	13	4	9
8	6	26	13	29
9	5	22	4	9
10	5	22	4	9
11	1	4	6	14
12	0	0	0	0
13	0	0	0	0
Subtotal: Teacher-centered scores (7-13)	**20**	**87**	**31**	**70**
Sum	**23**		**44**	

Table 4 and Figure 4 present the results of DASTT-C. The data show that Jordanian chemistry teachers and teacher trainees both hold predominantly teacher-centered beliefs. According to the categories defined by Thomas et al. (2001) we see that 87% of student teachers fall into the teacher-centered area (a score of 7-13). The majority of experienced teachers also achieved scores of 7-13, but this group is 70% smaller than that of the student teachers. Only 4% of student teachers and 16% of the in-service teachers attained a score which showed them to be student-centered.

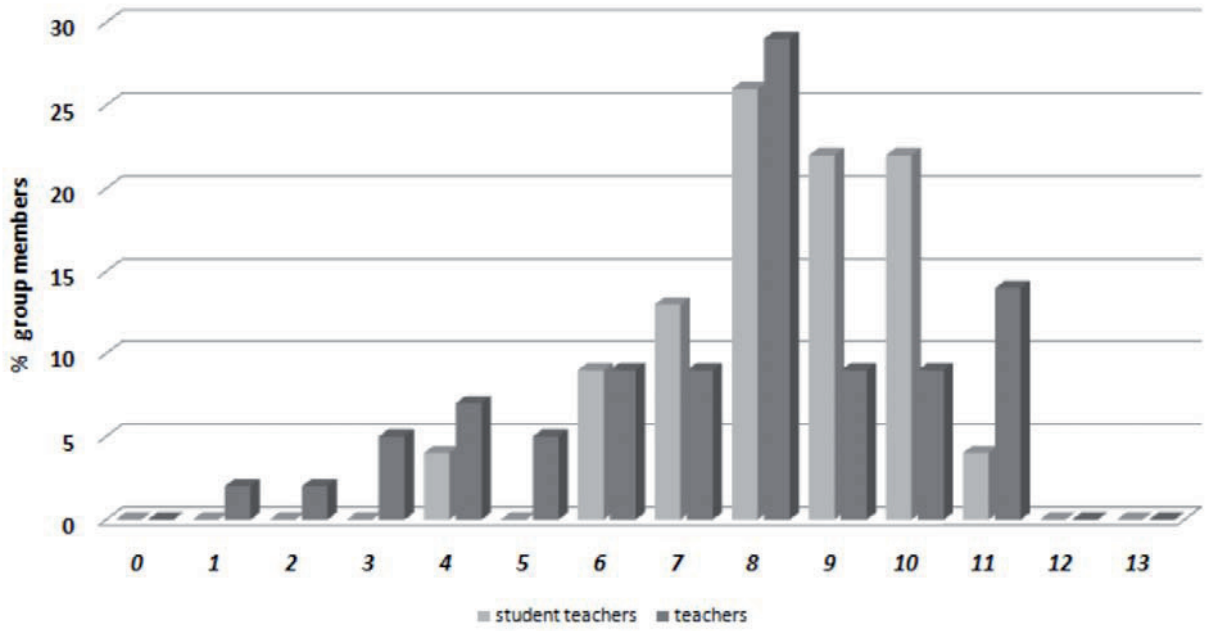

Figure 4. Distribution of student and in-service teachers according to DASTT-C

Beliefs about the Nature of Good Education

Table 5 documents the results of Jordanian teachers` beliefs about the nature of good education. On the transmissive scale, both groups supported the idea that education serves external goals and is outcome oriented within a closed curriculum. Student teachers, however, expressed this beliefs more strongly (mean 4,76) than in-service teachers (mean 4,53). Stronger support by both groups appeared on the more modern dimension of Developmental Beliefs than it did on the transmissive scale. In both groups are these differences statistical significant on a 1% level (2-tailed). This area states that education should be oriented towards broad and individual development, be process oriented within an open curriculum, and that knowledge should be largely acquired through constructivistic means. Expanding the sample of student teachers by another 35 participants confirmed that both differences were significant. Both groups of teachers

favored developmental beliefs when it comes to the nature of good education. But transmissive beliefs also received high levels of support.

Table 5: Mean scores, standard deviation and scale homogeneity for beliefs about the nature of good education.

		Developmental beliefs	*Transmissive beliefs*
Student teachers[+]	M	5.06	4.76
	SD	0.33	0.28
	α	0.50	0.74
Teachers	M	4.92	4.53
	SD	0.242	0.15
	α	0.56	0.74

[+] Differences for the original sample of student teachers (N=23) were not statistically significant. The results presented here use an expanded sample (N=58).

Interpretation and conclusions

This study describes the beliefs of Jordanian student teachers and teachers about chemistry teaching and learning. The first two parts of the study investigated domain-specific beliefs about teaching chemistry in very concrete teaching situations. Judging from the resulting drawings representing concrete classroom practices, we can conclude that both Jordanian in-service teachers and student teachers hold very traditional beliefs when it comes to teaching and learning chemistry. Such traditional beliefs can be characterized by high levels of teacher-centeredness, a transmission-oriented understanding of learning, and a strong focus on the pure learning of subject-matter. On the other hand, the third part of the study reveals that both groups of teachers value more modern beliefs when it comes to teaching and learning in general. It seems that the teachers instinctively understand that learning is far more than rote memorization and that learning is a developmental process. Unfortunately, it seems that such positive beliefs about developmentally-oriented teaching and learning are forgotten as soon as teachers are asked to picture concrete situations in their chemistry classrooms. Most probably the teachers imagination does not last enough, because own experiences in a different style of learning are as well missing as the repertoire of student-activating teaching methods might be.

A second observation is that student teachers' beliefs tend to be much more traditional than those of experienced teachers. This might stem from the fact that Jordanian chemistry teachers attend a workshop-based training program, which encompasses various educational courses. Nevertheless, beliefs and ideas expressed about chemistry teaching practice still remain very traditional. Only in rare instances are they connected with modern, theory-driven characteristics of chemistry education. Reasons for this might include the lack of appropriate in-service training

in Jordan, the content level of courses offered, the amount of total training available and an extremely short training duration of only one year. Strongly bottom-up teacher training programs, e.g. those found in Germany (Markic & Eilks, 2010), have already shown that substantial and sustainable changes are possible in the long run by combining educational courses with domain-specific education. Another important consideration is the fact that nearly all of the student teachers expressed very strong, traditional beliefs. These beliefs have mainly been constructed due to their previous experience as learners in school - and possibly at the university. This interpretation yields a picture of the prevalent practices in the Jordanian educational system which demands more self-reflection on these practices using the lens of modern educational theory.

However, the structure of chemistry teacher education in Jordan in general also requires further scrutiny. Jordanian teachers are prepared to become a scientist first and a chemistry teacher only secondarily. Changes in such fundamental areas as beliefs about teaching styles and ideas about learning theories is difficult and will not occur overnight (see Oliamat, 2009). The inclusion of a limited number of workshops during the initial phase of active teaching may not be enough to lead to substantial, sustainable changes away from transmission-oriented styles of teaching and learning. This is i.e. relevant, because one can assume that most teachers and student teachers have probably experienced exactly such teaching styles themselves in school and at university. Perhaps offering additional courses can help begin the process of long-term, far-ranging changes in prospective teachers' beliefs. For example, providing educational and domain-specific educational courses, or placing individuals in schools which already accompany Bachelor's programs. Long-term programs such as Continuous Professional Development (CPD) for teachers also show great potential, since they have already proved effective in changing and developing science teachers' beliefs and Pedagogical Content Knowledge (Eilks, Markic & Witteck, 2010).

In any case, the situation described here demands new innovations in teacher training. This falls in line with Oliamat (2009), who recommended a more thorough concentration on the elaboration of teacher training programs to develop both teachers' pedagogical knowledge and teaching practices. Systems and structures are notoriously hard to change. Perhaps it would be easier and more effective to simply change the content within already existing courses. Teaching workshops should include self-reflection. The workshops should be optimized to more thoroughly present prospective teachers with concrete student-active methods, instructional tools and illustrating examples for the domain-specific learning environments they later on will work in. But the teachers and student teachers also need tools and competencies to reflect upon teaching objectives in the sense of scientific literacy, or different approaches to constructivistic

learning. This is in line with Al-Doulat and Abu Hola (2009), who recommend that science teacher education programs should be developed and improved in Jordan. From our own experience, a promising starting point might be an initial reflection upon one's *a priori* beliefs and prevalent ideas about teaching and learning. A self-reflection session focusing on the question of teacher- or student-centeredness often helps to plant the seeds of change. As suggested by Markic and Eilks (2008), tools like DASTT-C (or its modified version) can readily and easily applied for this purpose, especially for science education programs in which the initial stage of teacher training is over.

References

Abed, O. (2009). Class teacher students' efficacy beliefs regarding science teaching and its relation to their understanding level of scientific concepts. *Jordan Journal of Educational Sciences, 5*, 187-199

Abell, S. K. (2007). Research on science teacher knowledge. In S. K. Abell & N. G. Lederman (Eds.), *Research on science education* (pp. 1105-1150). Mahwah: Lawrence Erlbaum.

Al-Doulat, A., & Abu-Hola, I. R. (2009). Science teachers' perceptions about Learning. theories and its relation with their teaching practices. *Journal of the Associate of Arab Universities, 52*, 159-211

Alhawari, A., & Audeh, A. (2008). Psychometric properties for selected forms of International Computer Driving Licence Tests in Jordan, and equating their scores. *Jordan Journal of Educational Sciences, 4*, 297-319.

Alqaderee, S. (2009). The effects of the science curricula and teaching methods course in improving the epistemological views of learning scientific concepts of students in the class teacher program at Al al- Bayt University. *Jordan Journal of Educational Sciences, 5*, 277 - 291

Alexander, R. J. (2001). *Culture and pedagogy: International comparisons in primary education.* Osford: Wiley-Blackwell.

Bean. T.W., & Zulich. J. (1992). A case study of three preservice teachers' beliefs about content area reading through the window of students-professor dialogue journals. In C.K. Kinzer & D. J. Leu (eds.). *Literacy research. theory, and practice: Views from many perspectives* (p. 463-474). The National Reading Conference. Inc.

Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D., & Rad, E. (1988). *Ideological dilemmas: a social psychology of everyday thinking*. London, Sage.

Bramald, R., Hardman, F., & Leat, D. (1995). Initial teacher trainees and their views of teaching and learning. *Teaching and Teacher Education, 11*, 23-31.

Brophy, J. (1988). Research linking teacher behavior to student achievement: Potential implications for instruction of Chapter 1 students. *Educational Psychologist, 23*, 235-286.

Brown, S., & McIntyre, D. (1993). *Making sense of teaching*: Milton Keynes: Open University.

Bryan, L. (2003). Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching and learning. *Journal of Research in Science Teaching, 40*, 835-868.

Chai, C. S., Hong, H. Y., & Teo, T. (2009). Singaporean and Taiwanese pre-service teachers' beliefs and their attitude towards ICT use: A comparative study. *The Asia-Pacific Education Researcher, 18*, 117.

Cherland, M. R. (1989). The teacher educator and the teacher: When theory and practice conflict. *Journal of Reading, 32*, 409-413.

De Jong, O. (2007). Trends in western science curricula and science education research: A bird's eye view. *Journal of Baltic Science Education, 6*, 15-22.

De Jong O., Veal W. R., & Van Driel J. H. (2002). Exploring chemistry teachers' knowledge base. In J. K. Gilbert, O. de Jong, R. Justi, D. F. Treagust & J. H. Van Driel (Eds.): *Chemical Education: Towards Research-based Practice* (pp. 369-390), Dordrecht: Kluwer.

Eilks, I., Markic, S. & Witteck, T. (2010). Collaborative innovation of the science classroom by participatory action research—theory and practice in a project of implementing cooperative learning methods in chemistry education. In M. Valenčič Zuljan & J. Vogrinc (Eds.), *With the teacher's innovation and research to student's quality knowledge*. Ljubljana, Slovenia: University of Ljubljana.

Eilks I., Ralle B., Markic S., Pilot A., & Valanides N, (2006), *Ways towards research-based science teacher education.* In I. Eilks and B. Ralle (Eds.), *Towards research-based science teacher education* (pp. 179-184). Aachen: Shaker.

ERFKE (2008). *EQUIP2/Jordan program of support for the education reform for the knowledge economy (ERfKE) intiative*. Retrieved February 01, 2011, from www.equip123.net.

Fenstermacher, G. D., & Soltis, J. F. (1986). *Approaches to teaching.* New York: Teachers College Press.

Foss, D., & Kleinsasser, R. (1996). Preservice elementary teachers' views of pedagogical and mathematical content knowledge. *Teaching and Teacher Education, 12*, 429-442.

Goodman J., (1988), Constructing a practical philosophy of teaching: A study of pre-service teachers' professional perspectives, *Teaching and Teacher Education,* 4, 121-137.

Haritos, C. (2004). Understanding teaching through the minds of teacher candidates: a curious blend of realism and idealism. *Teaching and Teacher Education, 20*, 637-654.

Hatcher, L., & Stephanski, E. J. (1994.). *A step-by-step approach to using the SAS1 system for univariate and multivariate statistics*: Cary: SAS Institute.

Hermans, R., Van Braak, J., & Van Keer, H. (2008). Development of the beliefs about primary education scale: Distinguishing a developmental and transmissive dimension. *Teaching and Teacher Education, 24*, 127-139.

Isikoglu, N., Basturk, R., & Karaca, F. (2009). Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective. *Teaching and Teacher Education, 25*, 350-356.

Jordan Ministry of Education (2010). Retrieved, November 20, 2010, from http://www.moe.gov.jo/Projects/ProjectMenuDetails.aspx?MenuID=1&ProjectID=2.

Justi R., & Van Driel J. H. (2006). The use of the Interconnected Model of Teacher Professional Growth for understanding the development of science teachers' knowledge on models and modelling. *Teaching & Teacher Education*, 22, 437–450.

Luft, J. (2009). Beginning secondary science teachers in different induction programs: The first year of teaching. *International Journal of Science Education, 31*, 2355-2384.

Lumpe, A. T., Haney, J. J., & Czerniak, C. M. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching, 37*, 275-292.

Markic, S., & Eilks, I. (2008). A case study on German first year chemistry student teachers beliefs about chemistry teaching, and their comparison with student teachers from other science teaching domains. *Chemistry Education Research and Practice, 9*, 25-34.

Markic, S., & Eilks, I. (2011). Die Veränderung fachbezogener Vorstellungen angehender Chemielehrkräfte über Unterricht während der Ausbildung – eine Cross Level Studie [The change in domain-specific beliefs about teaching and learning of prospective chemistry teachers during their teacher education - a cross level study]. *Chemie konkret, 18*, 14-19.

Markic, S., Eilks, I., & Valanides, N. (2008). Developing a tool to evaluate differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains:a case study. *Eurasia Journal of Mathematics, Science and technology Education, 4*, 109-120.

Minor, L. C., Onwuegbuzie, A. J., Witcher, A. E., & James, T. L. (2002). Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. *The Journal of Educational Research, 96*, 116-127.

Munby, H., Russel, T., & Martin, A.K. (2001). Teachers' knowledge and how it develops. In V. Richardson (Ed.), *Handbook of research on teaching* (pp. 877-904). Washington: AERA.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*, 317-328.

Nisbett, R. & Ross, L. (1980). *Human Interferences: Strategies and Shortcomings of Social Judgement*: Englewood Cliffs: Prentice-Hall.

Oliamat, M. (2009). Science teachers' perceptions about their pedagogical knowledge and its relation with their teaching practices in the Basic Stage, *http://www.damascusuniversity.edu.sy/faculties/edu/images/stories/news/t/35.doc.*

Pajares M. F., (1992), Teachers` beliefs and educational research: cleaning up a messy construct, *Reviews in Educational Research,* 62, 307-332.

Putnam, R., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good & I. F. Goodson (eds.), *International handbook of teachers and teaching* (S. 1223-1296). Dordrecht: Kluwer.

Qablan, A., Juradat, S., & Al-Momani, I. (2010). Elementary science teachers' perceptions of educational reform in relation to science teaching in Jordan. *Jordanian Journal of Educational Sciences*, 6, 161-173.

Richardson, V. (2003). Preservice teachers' beliefs. In J. Raths (ed.), *Teacher beliefs and classroom performance: The impact of teacher education* (pp. 1-22). Greenwich, Connecticut: Information Age Publishing.

Samuelowicz, K., & Bain, J. (1992). Conceptions of teaching held by academic teachers. *Higher Education, 24*, 93-111.

Shen, J. (1997). Structure of the theoretical concept of educational goals: A test of factorial validity. *Journal of Experimental Education, 65*, 342-352.

Smith, K. (1993). Development of the primary teacher questionnaire. *The Journal of Educational Research*, *87*, 23-29.

Smith, K. E. (1997). Student teachers' beliefs about developmentally appropriate practice: Pattern, stability, and the influence of locus of control. *Early Childhood Research Quarterly, 12*, 221-243.

Swanborn, P. G. (1996). A common base for quality control criteria in quantitative and qualitative research. *Quality and Quantity, 30*, 19-35.

Thomas, J. A., Pederson, J. E., & Finson, K. (2000). *Validating the draw-a-science-teacher-test checklist (DASTT-C): From images to beliefs*. Paper presented at the annual meeting of the Association for the Education of Teachers of Science, Akron, US.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the draw-a-science-teacher-test checklist (DASTT-C): exploring mental models and teacher beliefs. *Journal of Science Teacher Education, 12*, 295-310.

Tobin, K., Tippins, D. J., & Gallard, A. J. (1994). Research on instructional strategies for teaching science. In D. L. Gabel (ed.), *Handbook of research on science teaching and learning* (pp. 45-93). New York: Macmillan.

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education, 27*, 75-84.

Van Driel, J., Bulte, A., & Verloop, N. (2007). The relationships between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs. *Learning and Instruction, 17*, 156-171.

Woolfolk Hoy, A., Davis, H. & Pape, S. J. (2006). Teacher knowledge and beliefs. In P. A. Alexander & P. H. Winne (eds.), *Handbook of educational psychology* (pp. 715-737). Mahwah: Lawrence Erlbaum.

Woolley, S. L., Benjamin, W. J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64*, 319.

Paper 2

Pre- and In-Service Teachers' Beliefs about Teaching and Learning Chemistry in Turkey

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Pre- and In-Service Teachers' Beliefs about Teaching and Learning Chemistry in Turkey

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Abstract

This paper describes beliefs held about teaching and learning Chemistry by Turkish teachers and student teachers. The study investigated different aspects of pre- and in-service teachers` belief structures. Part of the study examined teachers` overall beliefs, based on participants' drawings of classroom situations. A qualitative evaluation was employed to offer information on (student) teachers` beliefs about classroom organization, their beliefs about teaching objectives, and their stance on epistemological beliefs. Beliefs ranged from very traditional, teacher-centered ideas to modern, student-centered ones. Data evaluation was triangulated using a quantitative approach, which focused on whether beliefs were characterized by either teacher- or learner-centeredness. Additionally, a Likert questionnaire was used to evaluate the educators` beliefs about the nature of good education. The results for the group of participants are presented and compared. Implications for Chemistry teacher education in Turkey will also be addressed.

Keywords: chemistry education, teachers' and student teachers' beliefs, teacher education

Introduction

For almost four decades, construction of a better understanding of teachers' beliefs about teaching and learning has been posited as a valuable tool for enhancing educational effectiveness (Brophy & Good, 1974). Ever since the 1970s, knowledge about educators' conceptual basis, beliefs, and beliefs systems has been viewed as a valuable pre-requisite for better understanding both teachers' learning processes and their later actions in classroom settings (Fenstermacher & Soltis, 1986; Nespor, 1987; Brophy, 1988). Fenstermacher (1978) pointed out that identifying and assessing teacher candidates and their ideas in relation to classroom practices is an important function of every teacher education program. Pajares (1992) and, more recently, Richardson (2003) have also discussed a pressing need to better

understand teachers' beliefs and gain insight into changes of beliefs in order to improve both teacher education and classroom practice. Bryan (2003) suggested that teacher trainers can benefit from knowledge about their students' beliefs and use such knowledge to better facilitate trainees' learning and professional development. Nevertheless, Pajares (1992) has also argued that teachers' beliefs unfortunately remained a neglected field of educational research until the 1990s.

In the last two decades, teachers' cognition and beliefs have gained increased attention in educational research in general, and in science education in particular (De Jong, 2007). In every discipline, studies on teacher knowledge and beliefs have focussed both on experienced in-service teachers (Smith,1993; Woolley, Benjamin, & Woolley, 2004) and pre-service teachers with little to no experience (Markic & Eilks, 2008; Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003). Studies also exist which have compared teacher beliefs in different contexts (Al-Amoush, Markic, Abu Hola & Eilks, 2011; Pigge & Marso, 1997; Tatto, 1996; Yildirim, 2000).

Yet even in the last few years, Deng (2004) has again suggested that teachers' beliefs should be more deeply researched. The reasoning behind this was a more thorough focus on educators' ideas, which would aid teacher training programs to move potential candidates in the direction of more modern theories about learning and instruction. One important justification of this latest plea for the recognition of teachers' beliefs in educational research hinges upon the fact that personal beliefs act as filters through which all relevant learning and information used to prepare teachers to act in the classroom is influenced (Nisbett & Ross, 1980). Beliefs filter the interpretation of new information about innovative instructional approaches and influence the selection of 'lessons learned' gained through new experiences (Putnam & Borko, 1997). Bandura (1997) defined beliefs in general as the best indicators of the decisions people make throughout their lives. The same also holds true for teachers. For instance, Haritos (2004) examined the relationship existing between teaching concerns and teacher role beliefs. In his approach, such research offers focal points for action in teacher training by addressing aspects of teacher trainees' personal beliefs during the university training program.

Tobin, Tippins and Gallard (1994) have also recognized the importance of knowledge about and further research into teachers' beliefs in science education. Such research should reveal relevant, widely-held beliefs and should enrich our understanding of the relationship between teacher beliefs and their impact on science education reform. It has been argued that successful reforms must take teachers' beliefs into account, if the aim is to bring about overall, sustainable change in the classroom (Lumpe, Haney, & Czerniak, 2000). Educational

innovation is doomed to failure if it does not give any weight to teachers' beliefs, intentions and attitudes (Trigwell et al., 1994). Thus, addressing teacher beliefs must necessarily be the first step, if any attempt to change current teaching practices is to be attempted (Van Driel, Bulte, & Verloop, 2007).

In the case of Turkey, there is widespread dissatisfaction when it comes to science teaching, classroom practices and overall teacher performance (Özden, 2003). In response, current educational reforms in Turkey are seeking to bring about major curricular and methodological changes (Aksit, 2007). But these reforms have encountered many difficulties. One possible reason for this is that teachers' beliefs have not been adequately addressed before, during, and after the reforms. In many cases, teacher beliefs might remain totally unexamined (Aksit, 2007). A growing emphasis on empirical research into Turkish teachers' fundamental knowledge and beliefs when it comes to teaching and learning has started emerging (e.g. Sunar & Geban, 2011; Usak, Özden & Eilks, 2011). But hard evidence still remains a rare commodity.

From this starting point, the purpose of the current study was to elaborate different aspects of teacher beliefs in Turkey in the case of Chemistry education, including any differences existing between in-service and pre-service teachers. The focal points of the research were quite general. They attempted to construct a picture of 1) pre- and in-service teachers' beliefs about how Chemistry teaching in Turkey is taking place, 2) the overall objectives of Chemistry instruction, and 3) classroom culture and activities. Therefore, this study attempted to answer the following questions:

1. *Which beliefs do pre- and in-service Chemistry teachers in Turkey hold with regard to teaching and learning, i.e. when it comes to the student- or teacher-centeredness of lessons, specific teaching objectives to be reached, and the nature of 'good education'?*
2. *What are the similarities and differences in beliefs existing among Chemistry student teachers and experienced teachers when it comes to teaching and learning chemitry in Turkish schools?*

Theoretical framework

Nespor (1987), Pajares (1992), and Bandura (1997) all researched the eminent role beliefs play in determining one's actions, especially when it comes to classroom practices in the specific case of professional teachers. As we saw above, understanding beliefs may provide teacher trainers with crucial information for better understanding their candidates' actions, not just in classroom situations, but also when planning and structuring pre- and in-

service teacher education units (Brophy, 1988; Bryan, 2003). For example, many teaching strategies presented to teachers during either their preliminary education or later educational reforms appear to be quite impractical to the teachers themselves. This is because new ideas and strategies are often unrelated to well-established, familiar routines or they do not fit in with teachers' beliefs about educational goals (Brown & McIntyre, 1993).

Personal beliefs about teaching and learning interact with every action a teacher takes in his or her professional life (Bean & Zulich, 1992; Cherland, 1989). For example, the quality of pre-service experiences in the classroom, the number of opportunities provided for reflecting upon pre-service experience, and the influence of discipline- and domain-specific subject matter during training, which includes the larger context of national policies and the surrounding context of cultural norms and values, all play an important role in affecting an individual's beliefs. Isikoglu, Basturk and Karaca (2009) have researched student teachers' beliefs in Turkey. Teacher trainees showed a positive trend in their belief structure when it came to examining their personal ideas concerning student-centered education. Conversely, Markic & Eilks (2008) showed that this factor might also depend on the educational domain studied and the learner's overall level of education. In the latter study, German student teachers in the areas of primary school science and secondary school Biology were found to be very learner-centered. Their colleagues in secondary school Chemistry and, even more so, in Physics tended to be very teacher-centered and driven by content-structure concerns.

The study by Markic & Eilks (2008) confirmed that there is a range of teacher beliefs, which spans the gap between student-centered and teacher-centered approaches. This is exactly the situation which was previously described by Van Driel et al. (2007). Both studies distinguished between two different philosophies, which form a continuous dimension observable in most beliefs studies. The first philosophy is a *teacher-centered* paradigm (Bramald, Hardman, & Leat, 1995) which is also linked to a *subject-matter oriented* manner of thinking (Billig, Condor, Edwards, Gane & Middleton, 1988). At the opposite end of the spectrum is the *personal* paradigm (Shen, 1997), which also called the *student-supported* (Trigwell, Posser, & Taylor, 1994) or *learner-centered* (Bramald et al., 1995) approach. Markic and Eilks (2008) suggest viewing this spectrum as a range exisiting between traditional beliefs (transmission-oriented beliefs of learning with a focus on rote memorization of subject-matter knowledge) and modern beliefs (beliefs based on constructivist learning, student-oriented classroom structures, and an orientation on more general educational skills, including Scientific Literacy for all). This dichotomy falls in line with the ideas expressed by Thomas, Pederson and Finson (2001), Van Driel et al. (2007), and Qablan, Jaradat and Al-Momani (2010).

We might ask whether such beliefs must always be coherent by themselves. Minor, Onwuegbuzie, Witcher, and James (2002) have shown that pre-service teachers often profess beliefs which are seemingly contradictory. Some student teachers support both transmissive and constructivist views of teaching. This means that the relationship linking different beliefs together is of great importance. Do the ideas represent opposite extremes on a continuous scale? Are there intermediate or hybrid ideologies existing between them (as found by Markic & Eilks, 2008)? Or can the beliefs be ordered in a hierarchical way (Samuelowicz & Bain, 1992)? Although many beliefs about teaching appear to be contradictory and dichotomous (Chai, Hong, & Teo, 2009), the presence of confusing belief structures may be understood by viewing them as a continuum of positions which allows teachers to adapt and maneuver, depending on the situational context and their view of it (Samuelowicz & Bain, 1992).

Empirical evidence concerning Turkish science teachers remains elusive. Boz & Uzuntiryaki (2006) described that prospective chemistry teachers in Turkey hold intermediate beliefs between constructive and traditional views (Boz & Uzuntiryaki, 2006), whereas Yilmaz, Turkmen, Pedersen, & Cavas (2007) have shown that Turkish pre-service teachers tend to hold to an image of teaching style which is dominated more by teacher-centeredness. Özden (2007) has supported the latter conclusion. That means, we do need to be aware that teacher beliefs are context-defined. This means that they are related to the educational circumstances in which the teachers live, were educated, and work. The teaching domain in which they are active is a very important factor (Markic & Eilks, 2008). That is why the current paper will focus on a specific domain: The domain of Chemistry teaching. It will also offer insight into whether or not parallels with and/or shifts towards the style of practicing teachers exist among student teachers. This is an important factor, since evidence has emerged that properly constructed educational programs can potentially move prospective teachers' beliefs away from more teacher- and content-structured ideas towards more learner-oriented content and methods (Luft, 2009; Markic & Eilks, 2011a).

Method

This study combines two questionnaires and uses different approaches for data evaluation. The first part of the study is qualitative in nature and is based on a modified version of the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C) (Thomas, Pedersen & Finson, 2000; 2001). This tool requires the participants to draw themselves and their learners in a typical classroom situation in their subject. To provide the reader with a better notion of the nature of the data collected, two actual examples are given in Figure 1. Within DASTT-C,

two open-ended questions are included to delve more deeply into the activities being performed by both teacher and students in the picture. Within the framework of this study we also added two further open-ended questions in order to gain even more detailed insight into the classroom objectives and contents (Markic, Eilks, & Valanides, 2008). These further additions inquire about the teaching and learning objectives in the depicted situation and the teaching approach chosen. The results from the combination of the classical DASTT-C with the additional questions are evaluated by a grid developed based on Grounded Theory (Markic et al., 2008). The grid evaluates the data using a scale ranging between traditional, teacher-centered beliefs to modern, student-centered beliefs. Traditional beliefs express ideas of teacher-centered classroom organization, an exclusive orientation on the structure of subject matter, and transmission-oriented beliefs about teaching and learning. On the other side of the spectrum, modern beliefs are characterized by student-oriented classroom organization, an orientation on both problem-solving and scientific literacy objectives, and constructivist learning. The evaluation grid analyzes participants` beliefs qualitatively within the described range with the help of three categories: 1) *Beliefs about Classroom Organization*, 2) *Beliefs about Teaching Objectives*, and 3) *Epistemological Beliefs*. Each category is expanded to a five-step scale with values from -2 to +2 and describes beliefs along an ordinary, but non-linear, scale. An overview of the three categories and their expansion is presented in Table 1. A full description of the scales can be found in Markic et al. (2008). Data was encoded by two independent raters. The agreement rate using this grid remained continuously above 85%. In the few cases of disagreement, a second joint rating was carried out through a search for inter-subjective agreement (Swanborn, 1996).

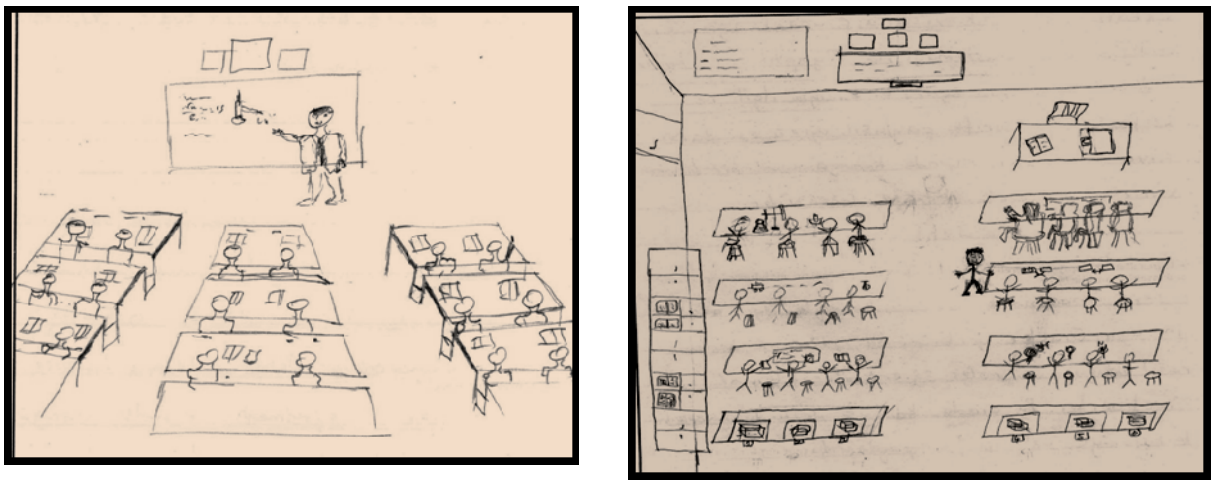

Figure 1. Two examples of Turkish teachers` drawings (left: traditional, teacher-centered beliefs; right: modern, modern/student-centered beliefs)

Table 1: An overview of the scales used in the qualitative part of the study (Markic & Eilks, 2008)

	Traditional beliefs		*Modern beliefs*
Beliefs About Classroom Organization	Classroom activities are mostly teacher-centered, -directed, -controlled and are dominated by the teacher.	↔ -2, -1, 0, 1, 2	Classes are dominated by student activity and students are (at least partially) able to choose and control their activities.
Beliefs About Teaching Objectives	The focus of science teaching is more-or-less exclusively focused on content learning.	↔ -2, -1, 0, 1, 2	Learning of competencies, problem solving or thinking in relevant contexts are the main focus of teaching.
Epistemological Beliefs	Learning is passive, top-down and controlled by the dissemination of knowledge.	↔ -2, -1, 0, 1, 2	Learning is a constructivistic, autonomous and self-directed activity.

The original evaluation pattern from the "Draw-A-Science-Teacher-Test Checklist" (DASTT-C) by Thomas et al. (2000; 2001) was applied for triangulation. Although both patterns do not completely focus on the same concepts, there is sufficient overlap to use them to achieve at least partial triangulation, which also helps to enrich the findings (Markic & Eilks, 2011b). In DASTT-C, participants' drawings are analyzed using a checklist of characteristics. Scoring is carried out by noting the presence or absence of each of thirteen attributes in three main areas: the teacher, the students, and the learning environment. The checklist can be found in Thomas et al. (2000). The presence of any of the thirteen attributes is scored with a "1". The total score can therefore fall between values of 0 and 13. Scores of 0-4 indicate student-centered teaching and values of seven or higher represent teacher-centeredness. For scores of 5 or 6 no decision can be made, since both views are evenly expressed (Thomas et al., 2000). In the DASTT-C-based study, only the first two open-ended questions about the activities of teacher and learners are taken into consideration (see above) and are only used to better understand the drawings. Data was evaluated by two independent raters according to the checklist and the inter-rater reliability was moderately high ($\kappa = 0.74$ for teachers and $\kappa = 0.71$ for student teachers).

A third source of information on the same sample is based on the information gathered by a second questionnaire. This questionnaire asks about (student) teachers' beliefs

in the area of the nature of good education. It also asks how teaching practices should be organized (Hermans, Van Braak, & Van Keer, 2008). The questionnaire consists of eighteen Likert items describing two dimensions: *Transmissive Beliefs* (TB) and *Developmental Beliefs* (DB). The TB dimension is characterized by ideas stating that education satisfies external goals, which can be met using closed, curriculum-oriented outcomes. The extent of knowledge acquisition is viewed as being achieved through rote, transmission-oriented learning. The DB dimension understands education as being oriented toward individual development within an open curriculum, including to what degree knowledge should be acquired through constructivist learning. The core idea behind this dimension is learning taking place with the students being active participants in the education process (Smith, 1993). Both scales are composed of a six-point Likert evaluation ranging from answers of 1 (strongly disagree) to 6 (strongly agree). Data was analyzed by calculating the mean scores, standard deviations and missing values. Pearson correlations and t-tests between the scales and between the two groups were explored. Cronbach's alpha test for both scales (6 items in DB; 8 items in TB) calculated values between .55-.82 and thus can be considered acceptable (Hatcher & Stephanski, 1994).

Sample

Teacher education in Turkey has been planned and carried out by institutions of higher education since 1982. Before this, teacher education was overseen by the National Ministry of Education. Several reform attempts and restructuring studies of teacher education have been undertaken in Turkey since 1982. One of the most comprehensive arrangements occurred in 1997 and included the restructuring of teacher education programmes into education faculties (HEC, 1998). The concurrent model used until 1997 was then shifted to a consecutive model. Students completing secondary education programs were considered to be graduates of a Master's program, as well as secondary school teachers (Kavak & Baskan, 2009). A consecutive model is now applied for secondary education programmes (e.g. Chemistry, Biology, and History teaching). Student teachers study subject area courses in the faculty of science during their first seven semesters (3.5 years). Then they move on to pedagogy coursework for their last three semesters (1.5 years). A recent reform in 2006-2007 implemented a new, concurrent model for teacher training (HEC, 2007). Within this model pedagogical courses are embedded in all five years of the secondary school teacher training program. Courses on general culture, the chosen subject area and pedagogy (e.g. classroom management, curriculum development) are offered at the same time. Currently, a consecutive model exists in addition to the concurrent model. It is accepted for teacher trainees who either

graduated from - or are currently in at least the third year of training for - any relevant scientific program in science, communications, or theology (EURYDICE, 2009).

Our sample of the study was comprised of two separate groups: in-service teachers (n=29) and pre-service teachers (n=27). The in-service teachers were randomly selected from various schools in Istanbul, Turkey. Most of them work as Chemistry teachers in secondary schools. A few of them also work also as science and technology teachers in elementary schools. All in-service teachers had graduated, either from a department of Chemistry or a department of Chemistry teaching. All of them were trained in a consecutive model. The pre-service teachers were all last-year student teachers in a department of Chemistry teaching. They came from one of several universities providing Chemistry teacher training in Istanbul. Some selected characteristics of the sample are summarized in Table 2.

Table 2. Selected demographics of the participants

Demographics characteristics	Pre-service teachers (n=27)		In-service teachers (n=29)	
	f	%	*f*	%
Gender				
Female	19	70	14	48
Male	8	30	15	52
Age				
19 - 25	9	33	3	10
26 - 36	18	67	17	59
37 – 47	-	-	4	14
48 – 58	-	-	3	10
58 and above	-	-	2	7

Findings

From the first part of the study (Fig. 2), we can see that the Turkish Chemistry teachers and teacher trainees in this sample held a wide diversity of beliefs about teaching and learning in Chemistry. Nevertheless, clear tendencies can also be recognized. Both groups show strong tendencies toward teacher-centered beliefs when it has to do with ideas about classroom organization. Specifically, almost 80% of the student teachers and more than 70% of in-service Chemistry teachers described classroom situations which are mainly led by the teacher, dominated by teacher activity, and in which student activity is described as minor. On the other side of the continuum, roughly one-fifth of both groups expressed beliefs with student activity at the core, with the teacher present as a facilitator (initiator) of the activities. Similar trends were detectable for the dimension of beliefs about teaching objectives. A majority of the student teachers evidenced strongly traditional beliefs with regard to the objectives of Chemistry lessons. In their view, the more-or-less exclusive goal

of Chemistry lessons should be the rote learning of subject matter content. The same held true for the practicing teachers concerning this category. Only about 15% of Turkish student teachers and roughly 10% of practicing teachers expressed ideas about the objectives of teaching and learning which fell in line with modern educational theory. In the third category of epistemological beliefs, both groups emphasized fairly strongly that Chemistry learning is rote transmission of knowledge organized by the teacher (scores "-2" and "-1"). Only about 20% of student teachers and 25% of in-service teachers professed beliefs describing learning as an autonomous, self-directed process which begins with students' ideas and initiatives.

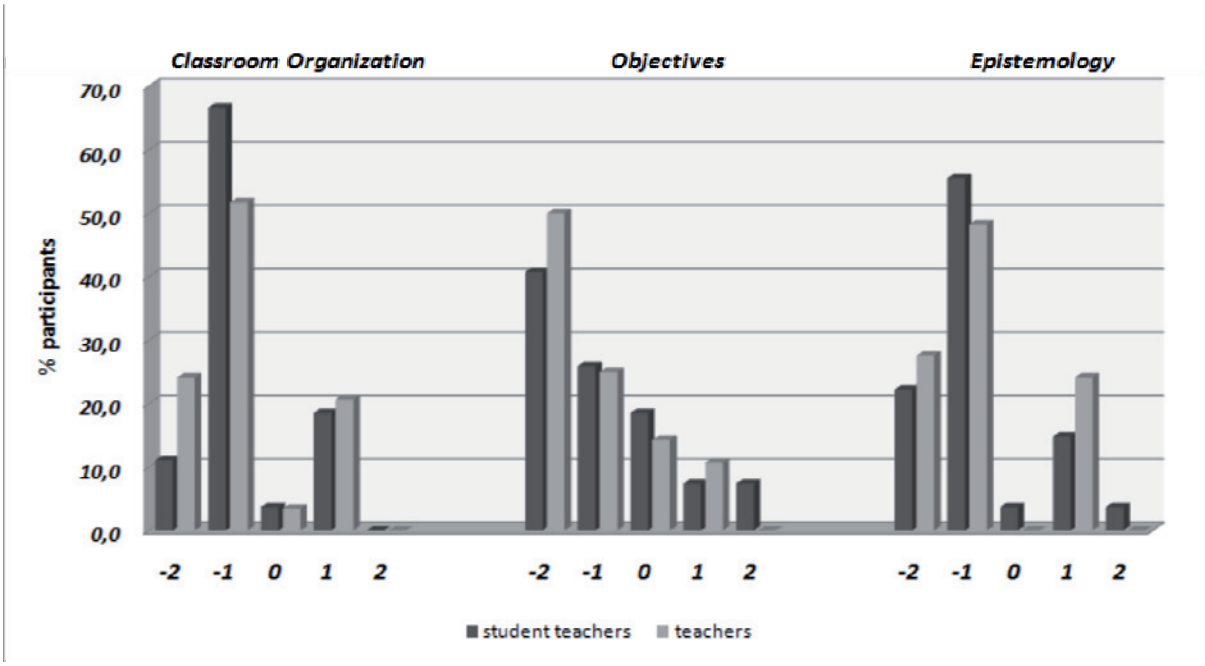

Figure 2. Turkish student teachers and teachers` beliefs about teaching and learning

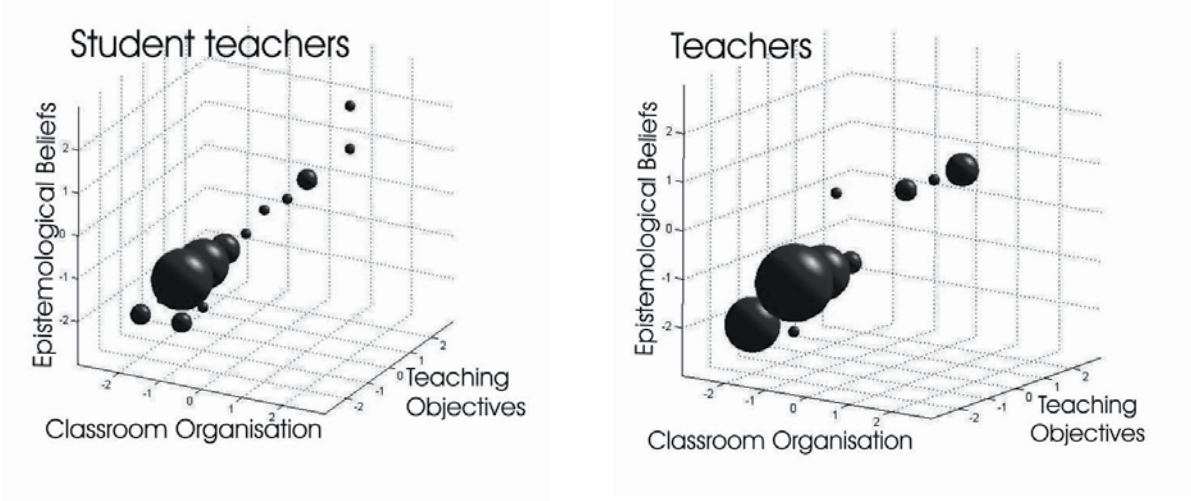

Figure 3. 3d-representation of the code combination of Turkish student teachers and teachers` beliefs

Markic and Eilks (2008) described an interdependence which exists between the beliefs in the three categories. They showed that (student) teachers evidencing similar responses in all three categories will have a combination of codes appearing on or along the diagonal running from (-2/-2/-2) to (2/2/2). This was also the case for most of the Turkish teachers and trainees in this sample (see Fig. 3). This suggests that the placement of any of the current participants on the 3D-diagram will reveal much about the person's underlying belief system (Markic & Eilks, 2008). The closer any code combinations land to the upper, right, rear portion of the diagram would indicate personal beliefs which are in line with modern educational theory. Contrary to this, any code combinations lying in the lower, left, front corner of the diagram would indicate more traditional beliefs. Figure 3 reveals that the overall beliefs of the teachers in this sample generally tend to be quite traditional. The same seems to hold true for the group of student teachers. Both groups generally have strongly traditional beliefs when it comes to the teaching and learning of Chemistry.

The DASTT-C checklist (Thomas et al., 2001) was used to triangulate the evaluation. The results differentiate between two different teaching styles, which are characterized as being either teacher-centered or student-centered (Thomas et al. 2001). Table 3 indicates that both groups of participants hold predominantly teacher-centered beliefs about teaching and learning (student teachers 74%; in-service teachers 86%). Only 14% of the experienced teachers and 7% of pre-service teachers can be described as having student-centered beliefs when it comes to the teaching and learning of Chemistry. These findings support the overall considerations listed above in the first part of this study.

Table 3: Number and percentage of student and teacher scores from the DASTT-C checklist

	Students (N=27)		**Teachers (N=29)**	
DASTT-C Checklist category	**Students frequency**	**% students**	**Teachers frequency**	**% teachers**
Student-centered scores (1-4)	2	7	4	14
Balanced scores (5-6)	5	19	0	0
Teacher-centered scores (7-13)	20	74	25	86
Total sum	**27**		**29**	

To better understand Turkish teachers' ideas of what learning and teaching should look like, we also inquired into the participants' beliefs on the exact nature of good education (Table 4). The results indicate that student teachers more thoroughly support Developmental Beliefs rather than Transmissive Beliefs. Pre-service teachers support both education that is oriented toward individual development within an open curriculum and higher degrees of knowledge acquisition through constructivist theory. They view their pupils as active participants in the education process. Contrary to this, Turkish in-service teachers in this sample preferred education satisfying external goals provided by closed, curriculum-oriented outcomes. They expressed beliefs that knowledge acquisition can generally be achieved through transmission, thus resulting in higher scores on the Transmissive Beliefs scale. Both groups had differences which were statistically significant at the 1% level (2-tailed) on each of the scales. However, there are no significant differences between the two groups.

Table 4: Mean scores, standard deviations and scale homogeneity for beliefs about the nature of good education.

		Developmental Beliefs	*Transmissive Beliefs*
Student teachers	M	5,20	4,08
	SD	0,67	0,67
	α	.55	.82
Teachers	M	5,20	3,66
	SD	0,14	1,03
	α	.42	.60

Discussion and implications

Özden (2007) described the major problems of Turkish science education as a failure to become student-centered, overcrowded classrooms, missing skills-developing practices, insufficient lab equipment for performing practical work, and deficits in science teacher education. He also listed a lack of understanding of the nature of science among Turkish science teachers. This was supported by Sunar and Geban (2011), who found that many teachers possessed undeveloped views of the science-technology-society interface. Each of these points may help us to better understand the findings described above.

Our results showed that both pre- and in-service teachers in Turkey hold very traditional views when it comes to the teaching and learning of Chemistry. These beliefs are characterized by high levels of teacher-centeredness, a transmission-oriented understanding

of learning, and a strong focus on pure subject-matter learning. On the other hand, the part of the study examining the nature of good education showed that both groups of teachers value more modern ideas when it comes to teaching and learning in general.

One interpretation of the data is that teachers instinctively know that learning is more than rote memorization of content matter and that learning represents a process. However, such knowledge and understanding does not necessarily influence the teachers' actions in the classroom. One reason for this might be the difficult classroom circumstances found in Turkish schools (Özden, 2009). Another may be that the teachers don't have a sufficient repertoire of pedagogies, which allows them to carry out their generally developmentally-oriented beliefs in the Chemistry classroom.

A second observation is that both groups of teachers hold quite similar traditional beliefs. One can assume that such beliefs in student teachers are mainly a construct resulting from the learners' previous experiences as school children - and quite possibly as university students. In this sense, these observations present a picture of Chemistry teaching practices in the Turkish school system demanding higher levels of self-reflection with the aid of modern educational theories. Yet teacher training for both pre- and in-service teachers does not seem to substantially change these beliefs. Therefore, the question remains whether teacher training practices in Turkey sufficiently address modern educational theory. This includes the question of whether or not the pedagogical approaches selected have been rightly chosen, if their aim is to change teachers' beliefs as a pre-requisite for implementing new reforms in Turkey. This is important, since we know from other educational approaches that a strongly bottom-up, experience-based teacher training program has the potential to substantially change prospective teachers' beliefs (see Markic & Eilks, 2011a).

In summary, this study indicates that the structure of Chemistry teacher education in Turkey needs to be changed. One possibility might be offering additional courses on modern educational theory and pedagogy in order to connect them more thoroughly with teachers' personal teaching experiences. From recent studies in Germany (Markic & Eilks, 2011a), we have evidence that educational seminars and school internships during pre-service training have great potential for substantial change in student teachers' beliefs, thus shifting them from traditional towards more modern beliefs about teaching and learning.

Reflection upon both the structure of educational seminars offered during initial teacher training and the practices incorporated into in-service training may prove valuable. For pre-service teacher training, Luehmann (2007) found that a need exists for both the creation of a perceived "safe place" and for a scaffolded structure which beginning science teachers can test out in order to develop their identities as reform-minded teachers. Teaching

workshops should also include self-reflection. Such workshops need to be optimized in order to more thoroughly present prospective teachers with concrete, learner-active methods in the classroom, more instructional tools, and increased levels of illustrative examples in the domain-specific learning environments they will later face. But teachers also need tools and abilities which allow them to reflect upon teaching objectives in the sense of scientific literacy, including different approaches to constructivist learning. In our own experience, one promising starting point is an initial reflection upon one's *a priori* belief structure and any prevalent ideas about teaching and learning. A period of self-reflection focusing on the question of teacher- or student-centeredness also helps to initiate change. As Markic and Eilks (2008) have suggested, tools like DASTT-C (or its modified version) can readily and easily be applied for this purpose.

In the field of in-service training, research evidence suggests that effective change necessarily demands long-term cooperation, external support and structured connectedness, which takes into account the individual's own experiences and reflections. Employing Continuous Professional Development (CPD) programs for teachers can substantially change their beliefs and knowledge levels (e.g. Eilks, Markic & Witteck, 2009; Mamlok-Naaman & Eilks, 2011). This can also be connected to processes of self-reflection on prevalent beliefs, including explicitly contrasting them with recent research findings in the literature.

In conclusion, the strategy having the highest potential for promoting change includes handling all three action points in parallel: 1) integrate in-depth reflection on prevalent beliefs into prospective teachers' professional learning process within the university study program, 2) reorganize introductory seminars in the initial teacher training phase, so that a more thorough connection between modern educational theory and personal teaching experience exists, and 3) establish long-term CPD programs firmly based on teacher collaboration, interactive workshops, and/or action research-based innovations (Mamlok-Naaman & Eilks, 2011).

References

Akşit, N. (2007). Educational reform in Turkey. *International Journal of Educational Development*, *27*, 129–137.

Al-Amoush, S., Markic, S., Abu Hola, I., & Eilks, I. (2011). Jordanian prospective and experienced chemistry teachers' beliefs about teaching and learning and their potential role for educational reform. *Science Education International, 22*, 185-201.

Bandura, A. (1986). *Social foundation of thought and action: A social cognitive theory.* Englewood: Prentice-Hall.

Bean, T. W., & Zulich, J. (1992). A case study of three preservice teachers' beliefs about content area reading through the window of student-professor dialogue journals. *Literacy research, theory, and practice: Views from many perspectives*, 463-474.

Billig, M., Connor, S., Edwards, D., Gane, M., Middleton, D., & Rad, E. (1988). *Ideological dilemmas: a social psychology of everyday thinking.* London, Sage.

Boz, Y., & Uzuntiryaki, E. (2006). Turkish prospective chemistry teachers' beliefs about chemistry teaching. *International Journal of Science Education, 28*(14), 1647-1667.

Bramald, R., Hardman, F., & Leat, D. (1995). Initial teacher trainees and their views of teaching and learning. *Teaching and Teacher Education, 11*(1), 23-31.

Brophy, J. (1988). Research linking teacher behavior to student achievement: Potential implications for instruction of Chapter 1 students. *Educational Psychologist, 23*(3), 235-286.

Brown, S., & McIntyre, D. (1993). *Making sense of teaching*: Open University.

Bryan, L. (2003). Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching and learning. *Journal of Research in Science Teaching, 40*(9), 835-868.

Chai, C. S., Hong, H. Y., & Teo, T. (2009). Singaporean and Taiwanese pre-service teachers' beliefs and their attitude towards ICT use: A comparative study. *The Asia-Pacific Education Researcher, 18*(1), 117.

Cherland, M. R. (1989). The teacher educator and the teacher: When theory and practice conflict. *Journal of Reading, 32*(5), 409-413.

De Jong, O. (2007). Trends in western science curricula and science education research: A bird's eye view. *Journal of Baltic Science Education, 6*, 15-22.

Deng, Z. (2004). Beyond teacher training: Singaporean teacher preparation in the era of new educational initiatives. *Teaching Education, 15*, 159-173.

EURYDICE (2009). Organization of Turkish education system, 2009/2010. [Türk eğitim sisteminin örgütlenmesi]. European Commission.

Fenstermacher, G. D. (1978). A philosophical consideration of recent research on teacher effectiveness. *Review of Research in Education, 6*, 157-185.

Fenstermacher, G. D., & Soltis, J. F. (1986). *Approaches to teaching.* New York: Teachers College Press.

Foss, D., & Kleinsasser, R. (1996). Preservice elementary teachers' views of pedagogical and mathematical content knowledge. *Teaching and Teacher Education, 12*, 429-442.

Haritos, C. (2004). Understanding teaching through the minds of teacher candidates: a curious blend of realism and idealism. *Teaching and Teacher Education, 20*, 637-654.

Hatcher, L., & Stephanski, E. J. (1994.). *A step-by-step approach to using the SAS1 system for univariate and multivariate statistics*: Cary: SAS Institute.

Hermans, R., Van Braak, J., & Van Keer, H. (2008). Development of the beliefs about primary education scale: Distinguishing a developmental and transmissive dimension. *Teaching and Teacher Education, 24*(1), 127-139.

Higher Education Council (1998). Re-arrangement of teacher education programmes in faculties of education. [Eğitim fakülteleri öğretmen yetiştirme programlarının yeniden düzenlenmesi]. Ankara: Yüksek Öğretim Kurumu.

Higher Education Council (1998). Teacher training and faculties of education (1982-2007). [Öğretmen yetiştirme ve eğitim fakülteleri (1982-2007)]. Ankara: Yüksek Öğretim Kurumu

Irez, S. (2006). Are we prepared?: An assessment of preservice science teacher educators' beliefs about nature of science. *Science Education, 90*(6), 1113-1143.

Isikoglu, N., Basturk, R., & Karaca, F. (2009). Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective. *Teaching and Teacher Education, 25*(2), 350-356.

Kavak, Y., & Baskan, G.A. (2009). Restructuring studies of teacher education in recent years in Turkey. *Procedia Social and Behavioral Sciences, 1*(2009), 364-367.

Luft, J. (2009). Beginning secondary science teachers in different induction programs: The first year of teaching. *International Journal of Science Education, 31*, 2355-2384.

Luehmann, A. L. (2007). Identity development as a lens to science teacher preparation. *Science Education,* 91, 822-839.

Lumpe, A. T., Haney, J. J., & Czerniak, C. M. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching, 37*(3), 275-292.

Mamlok-Naaman, R., & Eilks, I. (2011). Action research to promote chemistry teachers' professional development – Cases and experiences from Israel and Germany. *International Journal of Mathematics and Science Education* published online first July 01, 2011.

Markic, S., & Eilks, I. (2008). A case study on German first year chemistry student teachers' beliefs about chemistry teaching and their comparison with student teachers from other science teaching domains. *Chemistry Education Research and Practice, 8*, 25-34.

Markic, S., & Eilks, I. (2011a). Die Veränderung fachbezogener Vorstellungen angehender Chemielehrkräfte über Unterricht während der Ausbildung – eine Cross Level Studie [The change in domain-specific beliefs about teaching and learning of prospective chemistry teachers during their teacher education - a cross level study]. *Chemie konkret, 18*, 14-19.

Markic, S., & Eilks, I. (2011b). Using a mixed methods design for characterising freshman science student teachers` beliefs about science teaching and learning - A comparison of student teachers` beliefs from four different science teaching domains. *International Journal of Science Education* published online first September 2011.

Markic, S., Eilks, I., & Valanides, N. (2008). Developing a tool to evaluate Differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains: a case study. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(2), 109-120

Minor, L. C., Onwuegbuzie, A. J., Witcher, A. E., & James, T. L. (2002). Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. *The Journal of Educational Research, 96*(2), 116-127.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*, 317-328.

Nisbett, R. & Ross, L. (1980). *Human Interferences: Strategies and Shortcomings of Social Judgement*: Englewood Cliffs: Prentice-Hall.

Özden, M. (2007). Problems with science and technology education in Turkey. *Eurasia Journal of Mathematics, Science and Technology Education, 3,* 157-161.

Pajares, M. F. (1992). Teachers` beliefs and educational research: cleaning up a messy construct. *Review of Educational Research, 62*, 307-332.

Pigge, F. L., & Marso, R. N. (1997). A seven year longitudinal multi-factor assessment of teaching concerns development through preparation and early years of teaching. *Teaching and Teacher Education, 13*(2), 225-235.

Putnam, R., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good, & I. F. Goodson (Eds.), *International Handbook of Teachers and Teaching, 2*, 1223-1296.

Qablan, A., Juradat, S., & Al-Momani, I. (2010). Elementary science teachers' perceptions of educational reform in relation to science teaching in Jordan. *Jordanian Journal of Educational Sciences*, 6, 161-173.

Richardson, V. (2003). Preservice teachers' beliefs. In J. Raths & A. C. McAninch (Eds.), *Teacher beliefs and classroom performance: The impact of teacher education* (Vol. 6, pp. 1-22).

Samuelowicz, K., & Bain, J. (1992). Conceptions of teaching held by academic teachers. *Higher Education, 24*(1), 93-111.

Shen, J. (1997). Structure of the Theoretical Concept of Educational Goals: A Test of Factorial Validity. *Journal of Experimental Education, 65*(4), 342-352.

Smith, K. E. (1997). Student teachers' beliefs about developmentally appropriate practice: Pattern, stability, and the influence of locus of control. *Early Childhood Research Quarterly, 12*(2), 221-243.

Sunar, S., & Geban, Ö. (2011). Turkish pre-service science teachers' views on science-technology-society issues. *Eurasian Journal of Physics and Chemistry Education*, *3*, 9-24,

Swanborn, P. G. (1996). A common base for quality control criteria in quantitative and qualitative research. *Quality and Quantity, 30*(1), 19-35.

Tatto, M. T. (1996). Examining values and beliefs about teaching diverse students: Understanding the challenges for teacher education. *Educational Evaluation and Policy Analysis, 18*(2), 155.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2000). *Validating the Draw-A-Science-Teacher-Test checklist (DASTT-C): From images to beliefs*. *A paper presented at the Association for the Education of Teachers of Science annual meeting. Akron*.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the draw-a-science-teacher-test checklist (DASTT-C): exploring mental models and teacher beliefs. *Journal of Science Teacher Education, 12*(4), 295-310.

Tobin, K., Tippins, D. J., & Gallard, A. J. (1994). Research on instructional strategies for teaching science. In D. L. Gabel (Ed.), *Handbook of Research on Science Teaching and Learning* (pp. 45-93). New York: MacMillan.

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education, 27*(1), 75-84.

Usak, M., Ozden, M. & Eilks, I. (2011). A case study of beginning science teachers' subject matter (SMK) and pedagogical content knowledge (PCK) of teaching chemical reaction in Turkey. *European Journal of Teacher Education*, *34* (4), 407-429.

Van Driel, J., Bulte, A., & Verloop, N. (2007). The relationships between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs. *Learning and instruction, 17*(2), 156-171.

Woolley, S. L., Benjamin, W. J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64* (2), 319-331.

Yalvac, B., Tekkaya, C., Cakiroglu, J., & Kahyaoglu, E. (2007). Turkish pre-service science teachers' views on science–technology–society Issues. *International Journal of Science Education, 29*(3), 331-348.

Yildirim, S. (2000). Effects of an educational computing course on preservice and inservice teachers: A discussion and analysis of attitudes and use. *Journal of Research on Computing in Education, 32*(4), 479-496.

Yilmaz, H., Turkmen, H., Pedersen, J., & Huyuguzel Cavas, P. (2007). Evaluation of preservice teachers' images of science teaching in Turkey. *Asia-Pacific Forum on Science Learning and Teaching*, Vol. 8, Issue 1. Available via Internet: http://www.ied.edu.hk/apfslt/v8_issue1/turkmen/index.htm#con

Paper 3

Beliefs about chemistry teaching and learning – A comparison of teachers' and student teachers' beliefs from Jordan, Turkey and Germany

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Abstract

This paper discusses beliefs about teaching and learning chemistry. The sample includes chemistry student teachers and in-service teachers from Jordan, Turkey and Germany. Two test instruments were used to investigate (student) teachers' beliefs. A qualitative instrument was used to explore Beliefs about Classroom Organization, Beliefs about Teaching Objectives and Epistemological Beliefs. A quantitative instrument was added to evaluate participants' beliefs concerning the Nature of Good Education. The results show that Jordanian chemistry teachers and teacher trainees held the most traditional, teacher-centered and transmission-oriented beliefs, while the German sample showed the most modern beliefs towards teaching and learning. Turkish (student) teachers evidenced moderate beliefs, which tended to be between the two extremes, but still could be positioned more closely to the traditional way of thinking. The results are discussed in the context of chemistry teacher education in the three respective countries.

Keywords*:* chemistry education, educational reform, international comparison (student) teachers' beliefs, teacher education

Introduction

A better understanding of pre- and in-service teachers' beliefs on teaching and learning is considered valuable when it comes to enhancing educational effectiveness (Brophy, 1988; Brophy & Good, 1986). This has already been acknowledged for training both pre- and in-service teachers (Bryan & Atwater, 2002; Fenstermacher, 1978; Markic & Eilks, 2008) and

for implementing educational reform (Lumpe, Haney, & Czerniak, 2000; Trigwell, Prosser, & Taylor, 1994; Van Driel, Bulte, & Verloop, 2007). That is why teachers' beliefs have attracted increasing attention in recent years in educational research in general (Deng, 2004) and science education research in particular (Abell, 2007; De Jong, 2007).

Despite a growing body of research evidence on science teachers' beliefs, generalizations concerning the overall picture still need to be investigated in detail. In this field, international comparisons seem to offer valuable reference points. This point considers the fact that teachers' beliefs can be context-bound and highly dependent on both the socio-economic and cultural circumstances in which the educational system is embedded, as well as the specific educational and teacher training system (Alexander, 2001; Woolfolk-Hoy, Davis, & Pape, 2006). Anyhow, international comparisons of (student) teachers' beliefs remain rare. In the case of chemistry education such studies are almost nonexistent. The current study intends to help close this gap as being an exemplary case study. The paper provides an international comparison of (student) teachers' beliefs when it comes to teaching and learning chemistry, including the nature of what is considered "good" education. The data was collected with random samples in three different countries: Jordan, Turkey and Germany. The questions researched in this study include:

1. What beliefs do pre- and in-service teachers in the above-named countries have regarding chemistry teaching and learning with respect to teacher-centeredness, overall teaching objectives, understanding the learning process, and the nature of good education?
2. What similarities/differences exist in beliefs among candidates from Jordan, Turkey and Germany when it comes to chemistry teaching and learning in the above-mentioned fields of interest?

Theoretical Framework

In the 1970s Fenstermacher (1978) highlighted the function of identifying and assessing prospective teachers' beliefs with regard to their potential classroom actions during teacher training. Personal beliefs have been variously described as filters for interpreting experiences, selecting information, and choosing instructional approaches (Goodman, 1988; Nespor, 1987). Following this idea up, Pajares (1992) argued that more thorough consideration of the construct of teacher educational beliefs was necessary in the 1990s. He described such beliefs as a long-neglected field of educational research. Since this time, the

importance of teacher beliefs has experienced a period of intense debate among researchers. Various studies have revealed how invaluable knowledge concerning teachers' beliefs can be to better understanding teachers' learning processes. This includes both their actions in classroom situations and their learning during teacher training courses (Fenstermacher & Soltis, 1986; Nespor, 1987, Nisbett & Ross, 1980). It has now become widely recognized that knowledge about (student) teachers' beliefs has great potential for improving teacher education programs, thereby bettering and facilitating candidates' personal learning and professional development (Bryan, 2003; Putnam & Borko, 1997).

Parallel to this development, the importance of recognizing teachers` beliefs during educational reforms has also been increasingly discussed and accepted as an important factor (De Jong, Veal, & Van Driel, 2002; Justi & Van Driel, 2006). Research is currently geared towards revealing relevant beliefs, which can enrich our understanding of the relationship between teachers' beliefs and their impact on reforms in science education. Any successful reform must take teachers' beliefs into account if it wishes to implement sustainable changes in the classroom (Lumpe et al., 2000). Trigwell et al. (1994) have stated that any educational innovation is doomed to failure if it does not take teachers' beliefs, intentions and attitudes into account. Therefore, addressing teachers' beliefs is a necessary first step if any attempt to change teaching practices is being planned (Van Driel et al., 2007).

From both points-of-view claims have been made that teachers' beliefs should be researched in a more in-depth fashion when it comes to education in general (Deng, 2004) and in science education in particular (Tobin, Tippins & Gallard 1994). Due to this, research in (student) teachers' belief structures has gained increased momentum since the 1990s in both general education and science education (Abell, 2007; De Jong, 2007). Recent studies have inquired into the effects of teachers' beliefs on their actions and classroom practices (Brickhouse, 1990; Briscoe, 1991; Clark & Peterson, 1986; Tobin & LaMaster, 1995). They have also explored the beliefs of both in-service teachers (Smith, 1993; Woolley, Benjamin, & Woolley, 2004) and student teachers (Al-Amoush, Markic, Abu-Hola & Eilks, 2011; Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003). Comparisons of teacher trainees and experienced teachers have also been made in different contexts (Al-Amoush et al., 2011; Pigge & Marso, 1997; Tatto, 1996; Yildirim, 2000).

Based on the increasing number of studies on teachers' beliefs, Van Driel et al. (2007) have suggested two different overriding ideologies, which make a continuous dimension visible among the various case studies. These ideologies occur as a common feature repeated in the

various studies. One end of the spectrum can be called *teacher-centered* (Bramald, Hardman, & Leat, 1995) or *subject-matter oriented* (Billig et al., 1988). The opposite end can be described as the *personal* (Shen, 1997), which has also been referred to as the *student-supported* (Samuelowicz & Bain, 1992; Trigwell et.al., 1994) or *learner-centered* (Bramald et al., 1995) paradigm in teaching beliefs. Basing their approach on Grounded Theory, Markic and Eilks (2008) suggested viewing this spectrum as a range stretching between traditional beliefs (transmission-oriented beliefs of learning with a focus on pure subject-matter knowledge) and modern beliefs (beliefs based on constructivistic learning, student-oriented classroom structures, and an orientation on more general educational skills, including Scientific Literacy for all). This distinction agrees with several other studies, e.g. that of Thomas, Pedersen and Finson (2001). This spectrum also parallels educational reform movements for science education in many different countries (Van Driel et al., 2007), among which are Jordan (Qablan, Jaradat, & Al-Momani, 2010), Turkey (Aksit, 2007), and Germany (Di Fuccia, Markic, Witteck & Eilks, 2012).

But this spectrum is not the sole factor of interest when it comes to educational reform. More questions can easily be added: Are such viewpoints dichotomous? What does a continuous scale also showing intermediate ideologies look like? Can individuals hold different beliefs with respect to different subtopics or domains? Must such beliefs always be coherent within themselves? Are allocations between the extremes a question of culture, socio-economic background or the level of educational system development? All of these questions remain unanswered. However, initial results are already available. Minor, Onwuegbuzie, Witcher, and James (2002) described pre-service teachers' beliefs as representing a seemingly contradictory mix of ideas. They found that some student teachers in their study supported both transmissive and constructivistic beliefs of teaching simultaneously. Also Chai, Hong, and Teo (2009) described that single beliefs can appear simultaneously and might be contradictory. Samuelowicz and Bain (1992) have given the explanation that teachers adapt their beliefs to a specific situation, depending on both the content matter and their view of the context. Nevertheless, there also seem to be quite coherent belief frameworks in the case of a specific teaching domain (Markic & Eilks, 2008; 2012). Such belief structures can nevertheless be changed by educational programs, moving them from more teacher-centered, purely content-structured forms to more open, student-orientated contexts and methods (Luft, 2009). The structure and stage of training also seems to be of particular relevance when it comes to (prospective) teachers' beliefs. In the case of Germany, Markic and Eilks (2011)

have described substantial changes in chemistry teachers' beliefs during their university pre-service training program and ensuing teacher training. They were able to show a connection to practical teaching experiences which had been embedded in the training program. It appears that teacher training, especially the first phases of teaching experience in school, are of crucial importance for changes in teachers' belief structures. Luft (2009) described large changes during an induction program for first year teachers. This study revealed that teachers who participated in their kind of science-specific induction programs significantly abandoned teacher-centered beliefs and practices in favor of more student-supportive ones. Although Jordan operates a similar system when preparing its post-Bachelor teachers, the influence there seems to be either more restricted in effect or less clearly observable (Qablan et al., 2010). Nevertheless, there are various possibilities. For example, Alqaderee (2009) has discussed changes in teachers' epistemological beliefs on the learning of scientific concepts in the context of a course about science curricula and methodologies. However, questions about the depth, penetration and sustainability of such changes in teachers' beliefs and knowledge base still remain open.

Overall, different factors have been found which influence and shape student teachers' and teachers' beliefs. These include the educator's personal learning experiences as a child in school, his/her educational background, the quality of pre-service experiences provided in the classroom, the number of opportunities for self-reflection (or the lack thereof) during pre-service training, and the influence of discipline-related and domain-specific subject matter training (Bean & Zulich, 1992; Cherland, 1989; Goodman, 1988). The educational domain and the level of education have also been shown to have an effect on the formation of educational beliefs (Markic & Eilks, 2010). This includes the larger context of national educational policies and the context of cultural norms and values in the society in which the teachers work (Isikoglu, Basturk & Karaca, 2009). It seems clear that (student) teachers' beliefs are context-bound and thus related to the educational and socio-cultural circumstances in which teachers live, the institutions in which they were educated, and the places where they currently work (Alexander, 2001; Woolfolk-Hoy et al., 2006).

Evidence for Jordanian teachers' beliefs is relatively rare when compared to that already gathered for Germany or Turkey. Qablan et al. (2010) found that Jordanian primary school teachers' beliefs were predominantly teacher-centered and very difficult to change. This claim has been supported by Al-Amoush et al. (2011) for secondary school chemistry teachers. Turkey has been able to go a step beyond this in its research. Isikoglu et al. (2009)

showed that Turkish teacher trainees possess positive trends in their belief structures when it comes to examining their personal ideas concerning student-centered education. Boz and Uzuntiryaki (2006) found that prospective chemistry teachers in Turkey hold intermediate beliefs between constructive and traditional views (Boz & Uzuntiryaki, 2006). Yilmaz, Turkmen, Pedersen, & Cavas (2007) have shown that Turkish pre-service teachers tend to hold a view of teaching style which is dominated by teacher-centeredness. The latter finding agrees with Özden (2007), who has shown that Turkish teacher trainees hold predominantly traditional beliefs when it comes to the practice of chemistry teaching. Several studies are also available for Germany, too. Koballa et al. (2000) described the beliefs of German chemistry grammar school teacher trainees as transmission-oriented rather than constructivistic. A similar situation was described by Fischler (1999) for student teachers of physics. These student teachers normally refer to a very dominant teacher, extremely passive pupils, and bad personal memories of their own physics education in school. Markic and Eilks (2008; 2012) revealed that this is also the case for student teachers of chemistry and physics at the beginning of their university training. Anyhow, they also showed that beliefs among biology and primary science students tend to be much more modern and in line with current educational theories of learning.

Comparing the studies from Jordan, Turkey and Germany, we find differences in the beliefs of (student) teachers about teaching and learning in the domain of chemistry. That such differences exist from country to country can be also seen in the studies by Klassen et al. (2009) and Cakiroglu, Cakiroglu, and Boone (2005), which deal with teachers' beliefs about self-efficacy. But, direct comparisons of teacher beliefs stemming from different countries with respect to the nations' level of educational development, their educational systems and teachers' cultural backgrounds still remain very rare for education in general and chemistry education in particular.

Sample

In Jordan, teachers are trained using a layered model. Teacher training begins with earning a Bachelor's degree in the subject a teacher wishes to teach. Some chemistry teachers also get a chance to continue postgraduate studies in the field of science education; however, this is not an obligatory component of the program. The formal qualifications for becoming a teacher after the Bachelor degree are fulfilled by a series of pedagogical workshops, which are conducted once a week for five hours during the first active year of teaching in school. These

pedagogical workshops concentrate on teaching methodology, different types of assessment, performing experiments within the educational context, and other educational issues. Al Weher and Abu Jaber (2007) and Al-Amoush, Markic and Eilks (2012) describe these workshops as being very theoretical in nature, characterized by weak correspondence between the training materials and the trainees' actual needs and not very effective. Our sample from Jordan encompasses 23 student teachers and 44 experienced secondary chemistry teachers. In the Jordanian sample all of the student teachers had attended different government universities with secondary school programs, but they had not yet completed their Bachelor's degree. They had not taken any courses related to teaching and learning prior to this study. This meant that any influence exerted by the Jordanian teacher training program, which is normally attended by teachers during the first year of their teaching career, was not yet a factor. The in-service chemistry teacher sample consists of randomly-selected teachers coming from various schools in Jordan. All of these teachers possess at least a Bachelor's degree and have completed the workshop-based training unit. Eight of these forty-four teachers had also finished a Master's of Education program. More details about the teachers are given in Table 1.

In Turkey, prospective chemistry teachers traditionally earn their degree through a five-year university program. In the case of Turkish secondary school educators, two models are widely used: the consecutive and the concurrent model. In the consecutive model, the first seven semesters (3.5 years) of study are dedicated to subject area courses exclusively within the faculty of science. After this, students begin with pedagogical courses in the faculty of education and learn about teaching during their last three semesters (1,5 years). The student teachers attending these university programs are selected through a nation-wide entrance examination, which is used to assign students to the different programs (Cakiroglu et al., 2005). In the concurrent model, pedagogical courses are scattered throughout the five years of university education. The sample from Turkey was composed of 27 student teachers and 29 experienced secondary chemistry teachers. The student teachers all came from the concurrent model of teacher training. The in-service teachers were randomly selected from various schools in Istanbul, Turkey, where they work in secondary schools. All were formally trained in the traditional consecutive model. See Table 1 for more details.

Germany operates a system of bottom-up teacher training. University students have the option of deciding to become a teacher from the beginning of their tertiary education. They earn a Bachelor's, then a Master's degree in a program which teaches them two school

subjects, one of which can be chemistry. The program includes both courses in education, pedagogy, didactics and domain-specific, subject-matter education from the very beginning. It also includes regular internships in schools. After completing their Master's degree, graduates enter a compulsory teacher training program (the 'Referendariat'), which ranges from 12-18 months, depending on the sixteen differing German States' educational requirements. Completion of this program, which is ended by the second German State exam, leads to full qualification as a secondary school teacher.

Table 1: Characteristics of the sample

Demographics characteristics		*Jordan*		*Turkey*		Germany	
		Student teachers N=23	In-service teachers N=44	Student teachers N=27	In-service teachers N=29	Student teachers N=28	In-service teachers N=32
Gender	Female	13	25	19	14	20	18
	Male	10	19	8	15	8	14
Age	19-25	11	4	9	3	16	0
	26-36	11	20	18	17	12	19
	37-47	1	17	-	4	-	9
	48-58	-	3	-	3	-	3
	Over 58	-	-	-	2	-	1
Years of study	1-2	7	-	9	-	4	-
	3-4	16	-	18	-	24	-
Academic Degree achieved	Bachelor	-	30	-	26	-	-
	Post graduate studies	-	14	-	3	-	-
	State examination (5 years) and 'Referendariat'	-	-	-	-	-	32
Teaching experience	1-5 Y.	-	16	-	8	-	19
	5-10Y.	-	9	-	7	-	9
	10-20Y.	-	18	-	10	-	3
	20-30Y	-	1	-	4	-	1

The sample from Germany consists of 28 student teachers and 32 experienced secondary chemistry teachers. All student teachers were currently halfway through their university program and had collected some teaching experience through their school internships. All of the experienced teachers had also obtained their five-year university degree and completed the compulsory teacher trainee program. They all work in secondary schools in the Northwest of Germany. For more details see Table 1.

Method

This study combined two questionnaires. The first instrument aimed to evaluate (student) teachers' beliefs about the practice of chemistry teaching. The instrument is a modified version of the Draw-A-Science-Teacher-Test Checklist (DASTT-C) from Thomas et al. (2001). The form requests participants to draw themselves and their learners in a typical classroom situation in their subject. The original version was followed up by open-ended questions asking about the activities of the teacher and the student in the situation depicted. Markic, Eilks and Valanides (2008) suggested adding another two open-ended questions in order to expand upon the information collected. These added questions ask about the teaching and learning objectives of the situation drawn and the approach selected for the situation represented. Markic et al. (2008) also suggested the use of an evaluation grid developed using Grounded Theory. This grid analyzes participants` beliefs qualitatively within the above-mentioned range reaching from traditional to modern beliefs along three main categories: 1) Beliefs about Classroom Organization, 2) Beliefs about Teaching Objectives, and 3) Epistemological Beliefs. Traditional beliefs express teacher-centered classroom organization, an exclusive orientation on the structure of the subject matter, and transmission-oriented beliefs about teaching and learning. On the other end of the spectrum, modern beliefs are characterized by student-oriented classroom organization, an orientation on problem-solving and scientific literacy objectives, and constructivist learning theories. Each category was therefore expanded into a five-step scale from -2 to +2 in order to more fully describe beliefs along an ordinary, but non-linear scale. An overview of the categories and their expansion is presented in Table 2. A full description of the scales can be found in Markic et al. (2008).

Markic and Eilks (2012) showed that their new DASTT-C application measures very similar constructs to those described by Thomas et al. (2001), even though both evaluation methods do not fully overlap. However, application of either of these evaluation pathways will allow for sufficient consideration of (student) teachers' beliefs along the spectrum between

traditional and modern beliefs. The second method does, however, allow for a more detailed differentiation among and within the three dimensions: Beliefs about Classroom Organization, Beliefs about Teaching Objectives, and Epistemological Beliefs.

Using the evaluation grid developed by Markic et al. (2008), the data was encoded by two independent raters. The agreement rates using the grid remained consistently above 85%. In cases of disagreement, a second joint rating was carried out in the means of search for inter-subjective agreement as suggested by Swanborn (1996).

Table 2: An overview of the scales in the qualitative part of the study (Markic et al., 2008)

	Traditional beliefs		*Modern beliefs*
Beliefs About Classroom Organization	Classroom activities are mostly teacher-centered, -directed, -controlled and dominated by the teacher.	↔ -2, -1, 0, 1, 2	Classes are dominated by student activity and students are (at least partially) able to choose and control their activities.
Beliefs About Teaching Objectives	The focus of science teaching is more-or-less exclusively focused on content learning.	↔ -2, -1, 0, 1, 2	Learning of competencies, problem solving or thinking in relevant contexts are the main focus of teaching.
Epistemological Beliefs	Learning is passive, top-down and controlled by the dissemination of knowledge.	↔ -2, -1, 0, 1, 2	Learning is a constructivistic, autonomous and self-directed activity.

A second questionnaire was also administered to allow comparison of participants' beliefs with respect to the practice of chemistry teaching and more general educational beliefs. This questionnaire evaluated the (student) teachers' beliefs about the Nature of Good Education. It required participants to elaborate on how teaching practices in general should be organized (Hermans, Van Braak, & Van Keer, 2008). The questionnaire consists of a total of eighteen Likert items describing two dimensions: *Transmissive Beliefs* (TB) and *Developmental Beliefs* (DB). The TB dimension is characterized by ideas that education satisfies external goals which can be met using closed, curriculum-oriented outcomes. The extent of knowledge acquisition is viewed as being achieved through rote, transmission-oriented learning. The DB dimension understands education to be oriented toward individual development within an open curriculum, including to what degree knowledge should be acquired through constructivist learning. The core idea behind this dimension is learning with

students being active participants in the educational process (Smith, 1993). Both scales were expanded a six-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Cronbachs` alpha for the TB scale was between □=0.60 and □=0.82 (average □=0.71) and between □=0.42 and □=0.82 (average □=0.57) for the DB scale. Thus the reliability of this instrument can be considered to fall between acceptable and good (see Hatcher & Stephanski, 1994). Data was analyzed by calculating mean scores, standard deviations and missing values. Pearson correlations and t-tests between the scales and between the groups were also run.

Findings

In all three countries the participants held a variety of beliefs ranging along the spectrum from traditional towards modern beliefs in all three dimensions. Nevertheless, some clear tendencies can be seen.

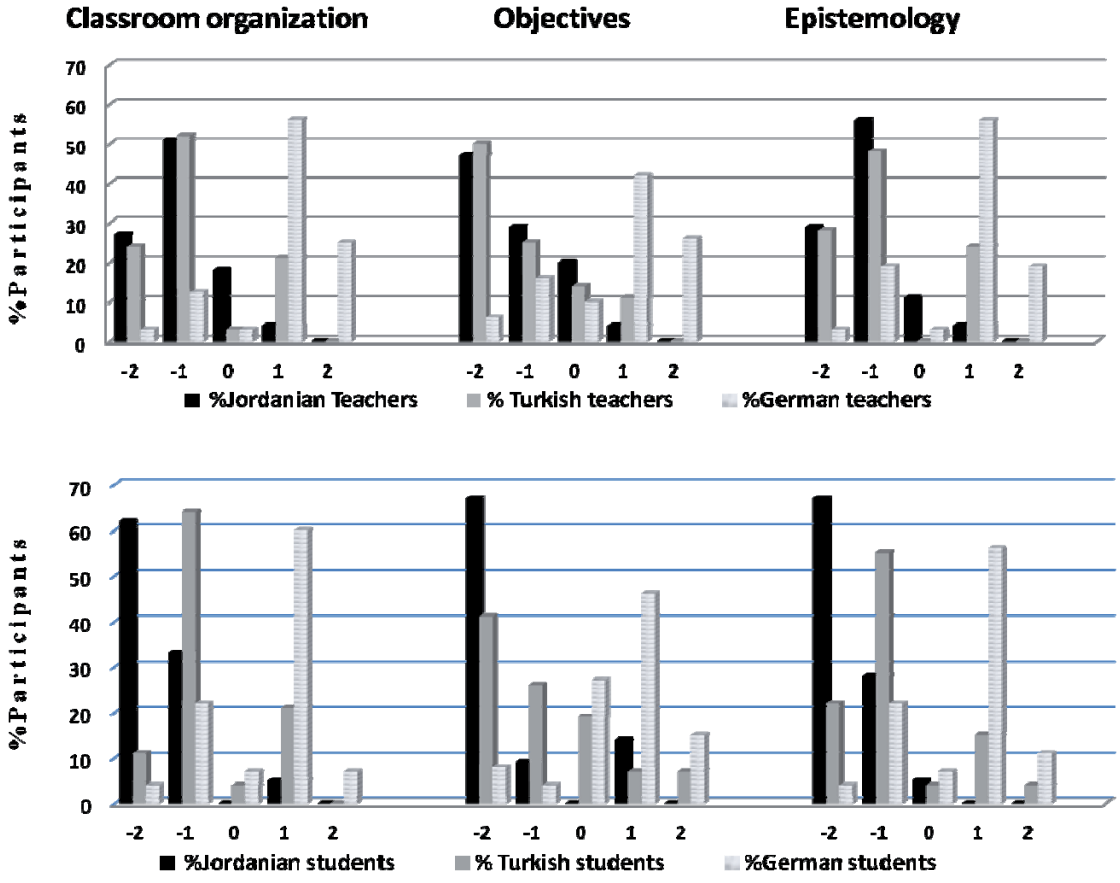

Figure 1: Distribution of traditional vs. modern beliefs about chemistry education for the six sample groups.

Starting with the *Beliefs about Classroom Organization*, and comparing the samples (both student and teacher groups) from the three countries, the results reveal two distinct clusters. Members of the first cluster profess beliefs that are teacher-centered and can be seen in the Jordanian and Turkish samples. Specifically, over 90% of chemistry student teachers and 80% of experienced teachers in the Jordanian sample drew a classroom dominated by the teacher's activity, where student activity plays only a minor role. For the two possible ratings in the traditional student teachers' beliefs showed themselves to be even more traditional than those of in-service teachers. Similarly, about 75% of Turkish educators believed in a dominant role of the teacher during chemistry classes. However, the difference between students and in-service teachers in the traditional categories was smaller and ran in the opposite direction. In contrast, all participants in the German sample tended to be strongly student-centered. Among this group, student activity was at the core and the participants consistently described teachers as facilitators (initiators) of student activity. These beliefs were expressed by 67% of the student teachers and 81% of experienced German teachers.

We see a similar picture with regard to *Beliefs about Teaching Objectives*. The dominant majority (about 80%) of all Jordanian participants expressed very traditional beliefs about the objectives of chemistry lessons. In their estimation the more-or-less exclusive goal of chemistry lessons is the learning of subject-matter content. The beliefs of the student teachers once again proved themselves to be even more traditional than those of the experienced teachers. The same is true for 67% of Turkish student teachers and 75% of Turkish teachers with respect to this category. Only 12% and 22% of the German chemistry student teachers and experienced teachers, respectively, held such an opinion. Viewed from the opposite direction, 61% of German student teachers and 68% of in-service teachers expressed beliefs in line with modern educational theories such as the learning of competencies, problem-solving, and thinking in relevant contexts.

We see similar trends in the third dimension *Epistemological Beliefs*. Both groups of Jordanian and Turkish teachers emphasized chemistry learning (more or less) strongly as the rote transmission of knowledge, which is provided by the teacher. The total numbers in the traditional belief categories look quite similar. Again, Jordanian student teachers evidence the most traditional beliefs. In both cases 80-90% of the Turkish and Jordanian sample falls into these categories. Conversely, more modern beliefs which can be described as autonomous, self-directed learning with an emphasis on students' ideas and initiatives were addressed by 67% of German student teachers and 75% of experienced teachers. These categories were

selected by almost none of the Jordanian participants and only a small minority of the participants in the Turkish sample.

As described in Markic and Eilks (2008) there often is an interdependence of the three categories. If this is the case the resulting combination of codes from all three dimensions will appear on or near the diagonal stretching from (-2/-2/-2) to (2/2/2). Following Markic and Eilks (2008), placement of (student) teachers` replies within a 3D-diagram based on the three scales will allow for an overall consideration of the data. The closer the code combination comes to the upper, right, back portion of the 3D-diagram, the more closely such beliefs conform to modern educational theory. Conversely, code combinations appearing in the lower, left, front part of a 3D-diagram represent more traditional beliefs.

Figure 2 shows the results for the six groups of Jordanian, Turkish and German participants. From this figure we can recognize that both Jordanian groups tend to be very traditional in their beliefs about teaching and learning chemistry. The same holds true for both Turkish groups, however, their data is a bit more scattered throughout the diagram. Still, both groups show strong traditional beliefs about chemistry teaching and learning in general. Compared to both of these countries, the German participants hold more modern beliefs about the practice of chemistry teaching and learning, since most of the participants codings are clearly represented in the right, upper, back part of the diagram.

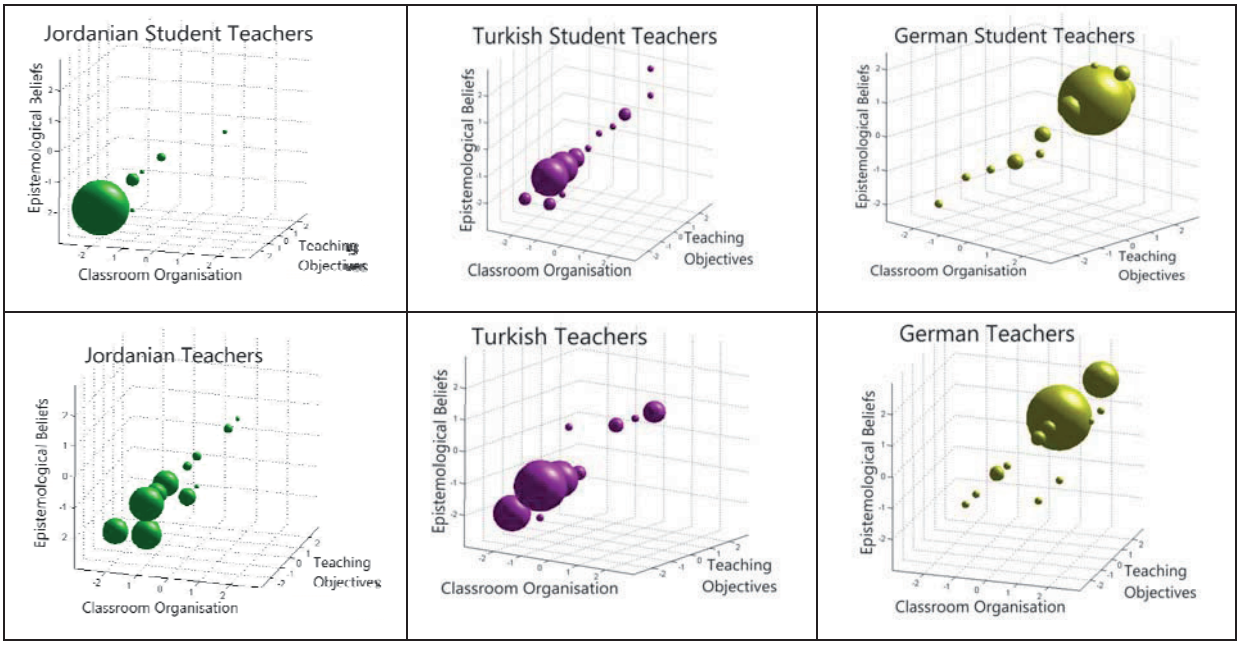

Figure 2. Results of Jordanian, Turkish and German chemistry student teachers` and chemistry teachers` beliefs about teaching and learning

To add more general information about chemistry (student) teachers' beliefs, the second questionnaire evaluated their beliefs regarding the Nature of Good Education. Here we found that all six groups of teachers support Developmental Beliefs more than the Transmissive Beliefs (see Figure 3). The differences between the mean scores within the Developmental Beliefs scale between all the six groups are very small and not significant. All of the participants from all three countries are generally open to supporting education which is oriented toward individual development within an open curriculum and dedicated to knowledge acquisition through constructivistic techniques. Yet the beliefs on the transmissive beliefs are not that homogeneous. The TB scale, which supports the idea that education serves external goals and is outcome-oriented within a closed curriculum, shows clear differences between the groups. Such a transmissive orientation is most supported by the Jordanian participants. Support for this approach wanes among Turkish teachers and receives the lowest support from German teachers. However, the results only indicate general tendencies within the different countries. The t-test revealed no significant differences between teachers and student teachers within the sample for a given country. But comparing the samples from the three countries shows significant differences between them with respect to the TB scale. Although all of the groups are open-minded with respect to DB education, the support for the concurrent TB is strongest in Jordan, followed by the samples from Turkey. The lowest levels of TB support among the participants came from Germany.

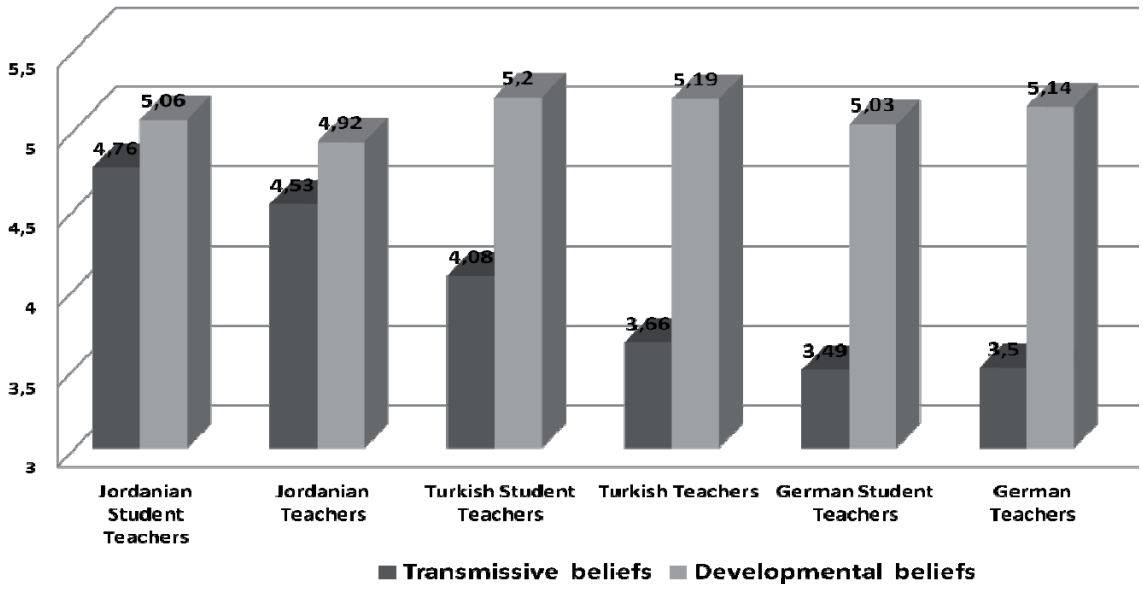

Fig 3: Means of the student teachers and experienced teachers beliefs on the nature of good education (six-point Likert scale ranging from 1=strongly disagree to 6=strongly agree).

Discussion and conclusions

This study evaluated and compared the beliefs of student teachers and experienced teachers of chemistry in three different countries: Jordan, Turkey and Germany. Many differences exist among the three countries, e.g. their levels of economic development or their cultural worldviews from traditional Arabic in Jordan towards European Western in Germany. Turkey lies geographically between the other two countries, but also with respect to socio-economic development or culture. The many differences between the three countries make it difficult to find easy, causal explanations for the findings described above.

Jordanian student teachers and teachers proved to have very traditional beliefs of teaching and learning chemistry: domination by the teacher, a more-or-less exclusive focus on subject matter structure, and a receptive understanding of learning. The same holds generally true for Turkey, although the characteristics are not as homogeneously spread throughout the teacher population. It seems that both pre- and in-service teacher training in these countries is not changing participants' beliefs to any substantial extent. In the case of Germany, we see the opposite trend. Teachers' beliefs fall much more in line with modern educational theory, including constructivistic ideas of learning, student-centeredness, and an orientation on Scientific Literacy for all. It would, however, be an overhasty interpretation if we attempted to explain this finding based on the socio-economic or cultural background of the German sample.

Markic and Eilks (2008; 2010; 2012) documented that student teachers of chemistry in Germany are not very modern by principle. Their survey revealed very traditional beliefs among freshman student teachers comparable to those found in the Jordanian and Turkish samples of the current study. The results found by this paper are different, since they examined student teachers halfway through their teacher education program and experienced, in-service teachers who are finished with their education. As Markic and Eilks (2011) have also shown, teacher training programs can actually lead to a complete shift in participants' belief structure, away from very traditional notions towards very modern ones. Therefore, the educational system and teacher training program may serve as the primary factors explaining the varying results recorded by the current study.

Beginning with the overall educational system, the first and possibly most influential factor affecting (prospective) teachers' beliefs is the teacher him- or herself. Every participant in this study experienced their country's educational system firsthand, initially as a pupil in school, then later at university. Traditional teaching practices will have widely influenced the

formation of their beliefs, including the importance of external exams in their countries (Bean & Zulich, 1992; Cherland, 1989; Goodman, 1988). The more selective educational systems found in Jordan and Turkey, e.g. the existence of university entrance and selection criteria, may explain these candidates' stronger support of Transmissive Beliefs than that revealed by the German sample. The latter group shows TB to be less supported among the German participants. Another hypothesis might be that in more developed countries there is less pressure felt by teachers and trainees to socially climb society's ladder through formal (science) education. This is why opening career chances through formal educational criteria may be emphasized more strongly in lesser-developed nations. The temptation might exist to largely ignore contributing to society-oriented science education, whose central aim is to promote skills for potential societal participation on socio-scientific issues in the future rather than preparation for further education and careers in science and technology.

However, the above-mentioned thoughts can only explain part of the findings in this study. Learning subject matter and achieving high levels of success in education are also among the important goals of modern educational theory. But the path suggested is different. Modern educational theory aims at more skill-oriented learning. Even the subject matter domain suggests that teachers should take societal and everyday life contexts more fully into account (Hofstein, Eilks & Bybee, 2011), since these areas have proven that they yield more effective situations for achieving applicable knowledge (Greeno, 1998). This again comes full circle to the culture of assessment and exams. As long as central exams are very important and the educational focus is primarily on the rote memorization of facts and theories, learning by drill and practice may be the most promising way to keep your career chances open.

This means that the decision of whether or not to implement change will be a question of educational policy. As was the case after the PISA studies in Germany, current educational reform has attempted to make science education more modern as discussed above (Di Fuccia et al., 2012). This is also the trend for current reform initiatives in Jordan and Turkey (Qablan et al., 2010; Aksit, 2007). For proposed reforms to be successful, however, the key remains the teachers themselves. Educational reform must take the teachers' beliefs into account (De Jong et al., 2002). If the beliefs do not fit the planned changes, then pre- and in-service training should offer trainees chances to change their viewpoints (Markic & Eilks, 2008).

We see three very different approaches to teacher training represented by the three countries presented in this study. Prospective Jordanian teachers have earned a chemistry degree, but are provided with only a limited set of workshop-based training exercises afterwards. In

Turkey there are one and a half years of pedagogical training after the subject matter courses are completed. Turkey is currently shifting its teacher education programs to a more integrated form, in which subject matter and pedagogy courses run in parallel from the beginning. This model has already been applied in Germany. The German system also includes the integration of a substantial number of school internships, allowing undergraduate trainees to gain firsthand teaching experience from the beginning of their university program. The case study by Markic and Eilks (2011) showed that such integrated training can improve the chances for a substantial shift in prospective teachers' beliefs, aiding them in moving from traditional to more modern views of teaching and learning.

Thus, we can see that reform might be needed not only for course content and pedagogy, but also in the area of restructuring teacher training systems. Wherever possible, university courses should be restructured so that they take the prevalent beliefs among teacher trainees into account (Bryan & Atwater, 2002). Educational courses in Jordan therefore might be restructured in a more user-friendly and practical fashion and should answer the real needs of the trainees (Al-Amoush et al., 2012; Al-Weher & Abu-Jaber, 2007). Teaching workshops should include self-reflection as part of the training (Luehmann, 2007). These workshops need to be optimized so that they more thoroughly provide prospective teachers with concrete, student-activating methods, instructional tools and illustrative examples, which have been custom-designed for the domain-specific learning environments in which the participants will later work. Pre- and in-service teachers also require tools and competencies allowing them to reflect upon teaching objectives in the sense of scientific literacy, including different approaches to constructivistic learning. The workshops could start explicitly exploring and addressing participants' deeply-held beliefs as the basis for joint reflection upon and learning about them (Pajares, 1993), whenever possible in direct connection with practical experience (Richardson, 2003). Explicating (student) teachers' beliefs and comparing them to current research findings and modern educational theory can add depth to teacher education and in-service training programs (Tatto, 1998). A promising starting point might be an initial reflection upon one's *a priori* beliefs and prevalent ideas about teaching and learning. As suggested by Markic and Eilks (2008), tools like DASTT-C (or its modified version) can readily and easily be applied for this purpose.

Markic and Eilks (2011) also used their findings to begin the integration of practical teaching experiences and teacher training programs. Richardson (2003) addressed (student) teachers` learning explicitly, looking at their prevalent beliefs in their role as teachers. The final

suggestion is in line with Russell's (1995) conclusion. The latter stated that change is necessary which involves trainees in field work in their classrooms, thus pushing participants to experience the classroom more deeply, thereby developing their beliefs on the basis of personal procedural and practical knowledge. The needs and practices of teachers after their university time is one further area of demand which is not being addressed sufficiently at present. In the field of in-service training, research evidence has suggested that effective change can only come about under conditions of long-term cooperation, external support systems and structured connectedness with regard to one's own personal experiences and self-reflection (Huberman, 1993). Combining evidence-based Continuous Professional Development (CPD) programs with teachers' authentic teaching practices can substantially change educators' beliefs and knowledge basis (Mamlok-Naaman & Eilks, 2011).

In conclusion, we suggest for all the three countries to invest in powerful strategies for making teacher education effective and changing teachers' beliefs to be more thoroughly in line with modern educational theory, e.g.: (I) integrating pedagogy courses explicitly reflecting upon teachers' prevalent beliefs into teacher training programs, (II) reorganizing teacher training as an integrated coursework approach combining subject matter, pedagogy and internships in school from the very beginning, and (III) establishing long-term CPD programs for in-service teachers, based on teacher collaboration, or evidence-based interactive workshops (Mamlok-Naaman & Eilks, 2011).

References

Abell, S. K. (Ed.). (2007). *Research on science teacher knowledge*. In S. K. Abell & N. G. Lederman (eds.). *International Handbook on Research in Science Education* (pp. 1105-1150). Mahwah: Lawrence Erlbaum.

Aksit, N. (2007). Educational reform in Turkey. *International Journal of Educational Development, 27*(2), 129-137.

Al-Amoush, S. A., Markic, S., Abu-Hola, I., & Eilks, I. (2011). Jordanian prospective and experienced chemistry teachers' beliefs about teaching and learning and their potential role for educational reform. *Science Education International, 22*(3), 185-201.

Al-Amoush, S., Markic, S., & Eilks, I. (accepted). Jordanian chemistry teachers` views on the practice of chemistry teaching in Jordan and on educational reform. *Chemistry Education Research and Practice*.

Al-Amoush, S. A., Usak, M., Erdogan, M., Markic, S., & Eilks, I. (under review). Turkish chemistry student teachers and experienced teachers' beliefs about teaching and learning chemistry.

Alqaderee, S. (2009). The effects of the science curricula and teaching methods course in improving the epistemological views of learning scientific concepts of students in the class teacher program at Al al- Bayt University. *Jordan Journal of Educational Sciences, 5(3), 277 - 291.*

Al-Weher, M., & Abu-Jaber, M. (2007). The effectiveness of teacher preparation programs in Jordan: A case study. In T. Townsend & R. Bates (eds.), *Handbook of Teacher Education* (pp. 241-266). Dordrecht: Springer.

Alexander, R. J. (2001). *Culture and pedagogy: International comparisons in primary education*: Wiley-Blackwell.

Bean, T. W., & Zulich, J. (1992). A case study of three preservice teachers' beliefs about content area reading through the window of student-professor dialogue journals. In C. K. Kinzer & D. J. Leu (eds.), *Literacy research, theory, and practice: Views from many perspectives (pp. 463-474).* Forty-First Yearbook of the National Reading Conference.

Boz, Y., & Uzuntiryaki, E. (2006). Turkish prospective chemistry teachers' beliefs about chemistry teaching. *International Journal of Science Education, 28*(14), 1647-1667.

Brickhouse, N. W. (1990). Teachers' beliefs about the nature of science and their relationship to classroom *practice. Journal of Teacher Education, 41(3), 53-62.*

Briscoe, C. (1991). The dynamic interactions among beliefs, role metaphors, and teaching practices: A case study of teacher change. *Science Education, 75(2), 185-199.*

Billig, M., Condor, S., Edwards, D., Gane, M., Middleton, D., & Rad, E. (1988). Ideological dilemmas: a social psychology of everyday thinking. London: Sage.

Bramald, R., Hardman, F., & Leat, D. (1995). Initial teacher trainees and their views of teaching and learning. *Teaching and Teacher Education, 11, 23-31.*

Brophy, J. (1988). Research linking teacher behavior to student achievement: Potential implications for instruction of *Chapter 1 students. Educational Psychologist, 23, 235-286.*

Brophy, J., & Good, T. (1986). Teacher behavior and student achievement. In M. C. Wittrock (ed.), *Handbook of Research on Teaching* (pp. 328-375). New York: MacMillan.

Bryan, L. (2003). Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching and learning. *Journal of Research in Science Teaching, 40*(9), 835-868.

Bryan, L. A., & Atwater, M. M. (2002). Teacher beliefs and cultural models: A challenge for science teacher preparation programs. *Science Education, 86*(6), 821-839.

Cakiroglu, J., Cakiroglu, E., & Boone, W. J. (2005). Pre-Service teacher self-efficacy beliefs regarding science teaching: A comparison of pre-service teachers in Turkey and the USA. *Science Educator, 14*(1), 31-40.

Chai, C. S., Hong, H. Y., & Teo, T. (2009). Singaporean and Taiwanese pre-service teachers' beliefs and their attitude towards ICT use: A comparative study. *Asia-Pacific Education Researcher, 18(1), 117-128.*

Cherland, M. R. (1989). The teacher educator and the teacher: When theory and practice conflict. *Journal of Reading, 32*(5), 409-413.

Clark, C. M., & Peterson, P. L. (1986). Teachers' thought processes. In M. C. Wittrock (ed.), *Handbook of Research on Teaching* (pp. 255-296). New York: MacMillan.

De Jong, O. (2007). Trends in western science curricula and science education research: A bird's eye view. *Journal of Baltic Science Education, 6*(1), 15-22.

De Jong, O., Veal, W. R., & Van Driel, J. H. (Eds.). (2002). *Exploring chemistry teachers' knowledge base*. In J. K. Gilbert, O. de Jong, R. Justi, D. F. Treagust & J. H. Van Driel (eds.), *Chemistry education: Towards research-based practice* (pp. 369-390). Dordrecht: Kluwer.

Deng, Z. (2004). Beyond teacher training: Singaporean teacher preparation in the era of new educational initiatives. *Teaching Education, 15*(2), 159-173.

Di Fuccia, D., Witteck, T., Markic, S., & Eilks, I. (2012). Current trends in practical work in German science education. *Eurasia Journal of Mathematics, Science and Technology Education, 8(1), 59-72.*

Fenstermacher, G. D. (1978). A philosophical consideration of recent research on teacher effectiveness. *Review of Research in Education, 6, 157-185.*

Fenstermacher, G. D., & Soltis, J. F. (1986). *Approaches to teaching. New York: Teachers College Press*.

Fischler H., (1999), The Impact of teaching experiences on student-teachers' and beginning teachers' conceptions of teaching and learning science. *In J. Loughran (Ed.): Researching Teaching. London, Falmer Press, pp. 172-197.*

Foss, D., & Kleinsasser, R. (1996). Preservice elementary teachers' views of pedagogical and mathematical content knowledge. *Teaching and Teacher Education, 12(4), 429-442.*

Goodman, J. (1988). Constructing a Practical Philosophy of Teaching: A Study of Preservice Teachers. *Teaching and Teacher Education, 4*(2), 121-137.3

Greeno, J. (1998). The situativity of knowing, learning, and research. *American Psychologist,* 53(1), 5-26.

Haritos, C. (2004). Understanding teaching through the minds of teacher candidates: a curious blend of realism and idealism. *Teaching and Teacher Education, 20*(6), 637-654.

Hatcher, L., & & Stephanski, E. J. (1994). *A step-by-step approach to using the SAS1 system for univariate and multivariate statistics.* Cary: SAS Institute.

Hermans, R., Van Braak, J., & Van Keer, H. (2008). Development of the beliefs about primary education scale: Distinguishing a developmental and transmissive dimension. *Teaching and Teacher Education, 24*(1), 127-139.

Hofstein, A., Eilks, I., & Bybee, R. (2011). Societal issues and their importance for contemporary science education: a pedagogical justification and the state of the art in Israel, Germany and the USA. *International Journal of Science and Mathematics Education, 9 (6), 1459-1483*.

Huberman M., (1993), Linking the practitioner and researcher communities for school improvement, Sch. Effect. Sch. Improv., 4, 1-16.

Isikoglu, N., Basturk, R., & Karaca, F. (2009). Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective. *Teaching and Teacher Education, 25*(2), 350-356.

Justi, R., & Van Driel, J. H. (2006). The use of the Interconnected Model of Teacher Professional Growth for understanding the development of science teachers' knowledge on models and modelling. *Teaching & Teacher Education, 22(4), 437-450.*

Klassen, R. M., Bong, M., Usher, E. L., Chong, W. H., Huan, V. S., & Wong, I. Y. F. (2009). Exploring the validity of a teachers' self-efficacy scale in five countries. *Contemporary Educational Psychology, 34(1), 67-76.*

Koballa T., Gräber W., Coleman D.C.& Kemp A.C., (2000): Prospective gymnasium teachers' conceptions of chemistry learning and teaching, *International Journal of Science Education, 22(2), 209-224.*

Luehmann, A. L. (2007). Identity development as a lens to science teacher preparation. *Science Education, 91(5)*, 822-839.

Luft, J. (2009). Beginning secondary science teachers in different induction programs: The first year of teaching. *International Journal of Science Education, 31(17), 2355-2384.*

Lumpe, A. T., Haney, J. J., & Czerniak, C. M. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching, 37*(3), 275-292.

Mamlok-Naaman, R., & Eilks, I. (2012). Different types of Action Research to promote chemistry teachers' professional development - A joined theoretical reflection on two cases from Israel and Germany. *International Journal of Science and Mathematics Education*, published online first.

Markic, S., & Eilks, I. (2008). A case study on German first year chemistry student teachers beliefs about chemistry teaching, and their comparison with student teachers from other science teaching domains. *Chemistry Education Research and Practice, 9*(1), 25-34.

Markic, S., & Eilks, I. (2010). First-Year science education student teachers' beliefs about student-and teacher-centeredness: Parallels and differences between chemistry and other science teaching domains. *Journal of Chemical Education, 87*(3), 335-339.

Markic, S., & Eilks, I. (2012). A comparison of student teachers` beliefs from four different science teaching domains using a mixed-methods design. *International Journal of Science Education*, 34 (4), 589-608.

Markic, S., & Eilks, I. (2011). Die Veränderung fachbezogener Vorstellungen angehender Chemielehrkräfte über Unterricht während der Ausbildung–eine Cross Level Studie. *Chemie konkret, 18*, 14-19.

Markic, S., Eilks, I., & Valanides, N. (2008). Developing a tool to evaluate Differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains:a case study. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(2), 109-120.

Minor, L. C., Onwuegbuzie, A. J., Witcher, A. E., & James, T. L. (2002). Preservice teachers' educational beliefs and their perceptions of characteristics of effective teachers. *Journal of Educational Research,* 96(2), 116-127.

Nespor, J. (1987). The Role of Beliefs in the Practice of Teaching. *Journal of curriculum studies, 19*(4), 317-328.

Nisbett, R., & Ross, L. (1980). *Human Interferences: Strategies and Shortcomings of Social Judgement*. Englewood Cliffs: Prentice-Hall.

Özden, M. (2007). Problems with science and technology education in Turkey. *Euraisa Journal of Mathematics, Science and Technology Education, 3*(2), 157-161.

Pajares, F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Pajares, F. (1993). Preservice teachers' beliefs: A focus for teacher education. *Action in Teacher Education, 15*, 45-45.

Pigge, F. L., & Marso, R. N. (1997). A seven year longitudinal multi-factor assessment of teaching concerns development through preparation and early years of teaching. *Teaching and Teacher Education, 13*(2), 225-235.

Putnam, R., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good, & I. F. Goodson (eds.), *International Handbook of Teachers and Teaching* (Vol. II, pp. 1223-1296). Dordrecht: Kluwer.

Qablan, A., Jaradat, S., & Al-Momani, I. (2010). Elementary Science Teachers' Perceptions of Educational Reform in Relation to Science Teaching in Jordan *Jordan Journal of Educational Sciences 6*(2), 161-173.

Richardson, V. (2003). Preservice teachers' beliefs. In J. Raths & A. C. McAninch (Eds.), *Teacher beliefs and classroom performance: The impact of teacher education* (Vol. 6, pp. 1-22). Greenwich: Information Age Publishing.

Russell, T. (1995). Returning to the physics classroom to re-think how one learns to teach physics. In T. Russell & F. Korthagen (Eds.), *Teachers who teach teachers (pp.95-112)*. London:Falmer.

Samuelowicz, K., & Bain, J. (1992). Conceptions of teaching held by academic teachers. *Higher Education, 24(1)*, 93-111.

Shen, J. (1997). Structure of the theoretical concept of educational goals: A test of factorial validity. *Journal of Experimental Education*, 65(4), 342-352.

Smith, K. (1993). Development of the primary teacher questionnaire. *Journal of Educational Research*, 87(1), 23-29.

Swanborn, P. G. (1996). A common base for quality control criteria in quantitative and qualitative research. *Quality and Quantity, 30*(1), 19-35.

Tatto, M. T. (1996). Examining values and beliefs about teaching diverse students: Understanding the challenges for teacher education. *Educational Evaluation and Policy Analysis, 18*(2), 155.

Tatto, M. T. (1998). The influence of teacher education on teachers' beliefs about purposes of education, roles, and practice. *Journal of Teacher Education, 49*(1), 66-77.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the draw-a-science-teacher-test checklist (DASTT-C): exploring mental models and teacher beliefs. *Journal of Science Teacher Education, 12*(4), 295-310.

Tobin, K., & LaMaster, S. U. (1995). Relationships between metaphors, beliefs, and actions in a context of science curriculum change. *Journal of Research in Science Teaching, 32*(3), 225-242.

Tobin, K., Tippins, D. J., & Gallard, A. J. (1994). Research on instructional strategies for teaching science. In D. L. Gabel (ed.), *Handbook of research on science teaching and learning* (pp. 45-93). New York: MacMillan.

Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education, 27*(1), 75-84.

Van Driel, J., Bulte, A., & Verloop, N. (2007). The relationships between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs. *Learning and instruction, 17*(2), 156-171.

Woolfolk-Hoy, A., Davis, H., & Pape, S. J. (2006). Teacher knowledge and beliefs. In P.A. Alexander & P.H. Winne (eds.), *Handbook of Educational Psychology* (pp. 715-737). Mahwah, NJ: Lawrence Erlbaum.

Woolley, S. L., Benjamin, W. J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64*(2), 319-331.

Yildirim, S. (2000). Effects of an educational computing course on preservice and inservice teachers: A discussion and analysis of attitudes and use. *Journal of Research on Computing in Education, 32*(4), 479-496.

Yilmaz, H., Turkmen, H., Pedersen, J. E., & Huyuguzel Cavas, P. (2007). Evaluation of pre-service teachers' images of science teaching in Turkey. *Asia Pacific Forum on Science Learning and Teaching*, 8(1),01-14.

Paper 4

Jordanian chemistry teachers` views on the practice of chemistry teaching in Jordan and on educational reform

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Jordanian chemistry teachers` views on the practice of chemistry teaching in Jordan and on educational reform

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Abstract

This study evaluates Jordanian experienced chemistry teachers` views about chemistry teaching and learning and about educational reform. The focus was to investigate the teachers' consideration of the actually applied teaching practices in chemistry education and their perception of intentions and effects within ongoing educational reform. The study bases on semi-structured interviews among 12 experienced chemistry teachers from 10 different schools. The interviews were inspired by the theoretical framework of the reform process in Jordan, but also by an earlier study on Jordanian chemistry teachers' and student teachers' beliefs about the pedagogies and goals of chemistry teaching and learning. The views and experiences of the teachers evaluated in this study don't differ much from the beliefs described in the previous study: Teacher-centered practices dominate. Nevertheless, within this study teachers described intentions for change, but also obstacles: They don't feel able to develop and implement change and they don't see themselves to be a recognized and active part within the ongoing reform process. Implications for teacher training and educational reform in Jordan will be addressed.

Keywords: chemistry education, teachers' beliefs, teacher training, educational reform

Introduction

In a wave of educational reform efforts around the world, Jordan as a small, middle-income developing country is trying to improve efficiency of educational processes too. In the last decades Jordan has invested quite heavily on its educational system and on its human resources compared to other Middle East Asian countries (The World Bank, 2008). Jordan is trying to forge a competitive educational system throughout several reforms. The *Jordan*

Education Initiative (JEI, 2009; 2011) and *Education Reform for a Knowledge Economy* (ERfKE, 2008) represent the two major recent efforts within this framework. The ERfKE project, which has 10 years duration, was emerged from the Vision Forum for the Future of Education in Jordan (2002). This forum was attended by experts in the field of education from Jordan, the World Bank, the Canadian Agency for International Development, the USAID and Japan. ERfKE concentrates on lifelong learning, responsiveness to the economy, access to information and communications technology, and quality learning (Resalat Al Mo'alem, 2010). ERfKE also has a curriculum component. Manuals for improving educational practices and methodology were distributed to the teachers. Erickson (2009) believes that these initiatives are expected to create highly educated, broadly skilled, adaptable, and motivated citizens who readily acquire new skill sets and access, create, and share knowledge.

Within all these reform initiatives changes are touching the practice of science teaching in general and in chemistry education in particular. Anyhow, for initiating change in chemistry teaching within educational reform, first taking into account the beliefs of the practicing teachers is crucial (Trigwell, Prosser & Taylor, 1994). For illustration the case of implementing ICT more thoroughly in Jordanian schools might serve as an example. Although schools in Jordan are relatively well provisioned with technology infrastructure and computers, Light (2009) described that teachers are unaware of how to use them within their style of teaching. In spite of many training courses as part of reform initiatives, Abuhmaid (2011) pointed out that knowledge about the use of ICT in teaching only develops if the teachers' beliefs are taken into account when planning the teacher courses. And this was not always the case. The problem of not taking teachers' pre-knowledge, beliefs and attitudes into consideration when planning educational reform, seems to be a general one. Trigwell et al. (1994) point out that any educational reform is doomed to fail if it does not take teachers' knowledge, beliefs, and attitudes into account. For instance, many innovations are viewed as impractical by teachers, since these changes are unrelated to familiar routines and do not fit with teachers' personal beliefs and experiences (Brown & McIntyre, 1993). Maybe only taking the teachers pre-knowledge and beliefs into account is not enough. Van Driel, Bulte and Verloop (2007) emphasized that addressing teachers` beliefs even must be the first step when intending and planning change in teaching practices.

Unfortunately, the body of knowledge about Jordanian chemistry teachers' or student teachers' knowledge, beliefs and attitudes is rare (Al-Amoush, Markic, Abu-Hola & Eilks, 2011), as knowledge is about the impact of the reform on the chemistry teachers and chemistry education. This study intends to help closing the gap by evaluating experienced

Jordanian chemistry teachers views on the prevalent practice of chemistry teaching and their perception of recent educational reforms.

Theoretical framework and objectives

In 1992, Pajares argued that by this time teachers' beliefs were a long-neglected field of educational research. Also Tobin, Tippins, and Gallard (1994) described a lack of knowledge on teachers beliefs. They recommended further research about teachers' beliefs with respect to science education. Research should not only expose relevant beliefs, but also enrich understanding of belief change in the teacher preparation and of the relationship between beliefs and their impact on educational innovation (Tatto & Coupland, 2003). The argument is that successful reforms must take teachers` beliefs into account if they aim at sustainable change in classroom practices (Lumpe, Haney, & Czerniak, 2000).

Anyhow, the construct of beliefs is not sharply defined. The construct 'teachers' beliefs' can bee used to describe all the ideas that lead to teachers' decisions about which way they teach, how they act, and why they organise their teaching the way they do (Pajares, 1992; Beck & Lumpe, 1996). Taking this open definition into account, teachers' beliefs are more than what the teachers 'belief' in. In this open form beliefs comprise also aspects of teachers' knowledge and attitudes, or are at least highly interconnected to them. Until now, the term 'beliefs' seems not to be clearly defined, as can be seen from the discussion in Pajares (1992):

> *'They [the beliefs] travel in disguise and often under alias names – attitudes, values, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual system, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practice principles, perspectives, ...'* (Pajares, 1992, p. 309).

Taking this weakness consciously into account, Markic, Valanides and Eilks (2008) suggested understanding the term 'beliefs'

> *"to mean all mental representations that teachers or student teachers consciously and unconsciously hold in their minds which influence, to a certain extent, their (potential) behaviour as teachers within their subject. Within this perspective, teachers' beliefs can be interpreted as all personal constructs connected to the practice of teaching influenced by experience, knowledge, and social background."*

Despite of the still existing tentativeness in having a sharp definition of teachers' beliefs, today the necessity to know about them when starting educational reform is widely acknowledged (Trigwell et al., 1994; Van Driel et al., 2007), as it is for the knowledge base of

teachers (Shulman, 1986; Abell, 2007). It is also plead for making research on (student) teachers' beliefs and knowledge an active field both general educational research (Munby, Russel, & Martin, 2001) as well as in the science education (Abell, 2007; De Jong, 2007). Studies started focusing on both in-service teachers (Smith, 1993; Woolley, Benjamin, & Woolley, 2004), student teachers (Abed, 2009; Bryan, 2003; Foss & Kleinsasser, 1996; Haritos, 2004; Richardson, 2003) while others compare student teachers` and teachers` at different contexts (Al-Amoush, et al., 2011; Pigge & Marso, 1997; Tatto, 1996; Yildirim, 2000).

Domains of teachers' beliefs are broad. Calderhead (1996) differentiated five different, but interrelated areas of teachers' beliefs: beliefs about learners and learning, beliefs about teaching, beliefs about learning to teach, beliefs about one's self and one's role, but also beliefs about the subject matter. As the domain of beliefs is broad it is the domain of knowledge. Aside the content knowledge within the specific teaching domain and general education knowledge, we can find also domain specific parts of educational knowledge under the term Pedagogical Content Knowledge (PCK) (Shulman, 1986). Today, PCK is considered having at least five different sub-domains: orientations towards teaching within the specific subject domain, knowledge about the subject's curriculum, about students' understanding of specific topics within the subject area, about specific assessment, and instructional strategies for teaching within the subject (Magnusson, Krajcik & Borko, 1999).

Studies on teachers beliefs and their knowledge base provide promising approaches for better understanding teachers' learning and later behavior in class (Fenstermacher & Soltis, 1986; Nespor, 1987). Furthermore, evidence of student teachers' beliefs and prior knowledge is valuable for teacher trainers, who can map out currently-held ideas and knowledge background for teaching and learning, then see how they can be changed and improved (Nisbett & Ross, 1980). Such knowledge also shows potential for improving university teacher education programs in order to better facilitate candidates' personal learning and professional development (Bryan, 2003). One example was described by Haritos (2004). Haritos examined the relationship between teacher concerns and personal beliefs about their own role in teaching. The results revealed three areas of concern which a teacher must overcome: concern about pupils, issues dealing with the teaching situation itself, and survival concerns. Such research offers focal points for training measures by making teacher educators aware of these areas so that they can address them during the trainings. Finally, research on beliefs and knowledge is seen as useful for curriculum innovators and planners, who can more effectively implement curriculum changes by taking existing teachers` beliefs and prior

knowledge into consideration (De Jong, Veal, & Van Driel, 2002; Eilks et al., 2006; Justi & Van Driel, 2006).

Making the teachers aware of their own beliefs about teaching and learning and prior knowledge relevant for the teaching situation is an important step for teacher learning. Self-reflection on one's beliefs, knowledge and potential misconceptions can help reflection on intended or experienced classroom action, because personal beliefs and prior knowledge act as filters for interpreting new experiences, selecting new information, processing gained information, and choosing instructional approaches (Goodman, 1988; Nespor, 1987; Pajares, 1992; Putnam & Borko, 1997). Constructivism says that knowledge is one of the most influential factors in information gathering and processing (Bodner, 1986). Bandura (1997) defined beliefs as the best indicator of why people make specific decisions throughout their lifetimes and how they will act in a given situation. Both aspects are also the case for teachers when it comes to their decisions and actions in the classroom. It is also why paying increased attention to teachers` beliefs and knowledge and their effects may potentially enhance educational effectiveness (Brophy, 1988).

It is well known that different factors influence and shape existing teachers` beliefs and knowledge base. These include a teacher's own learning experiences and outcomes in school, his/her educational background, the quality of pre-service training, gained experiences in the classroom, opportunities for self-reflection (or the lack of) during pre-service training, the influence of discipline-related and domain-specific subject matter training, and communication with colleagues (Appleton & Kind, 1999; Bean & Zulich, 1992; Cherland, 1989; Goodman, 1988; Markic & Eilks, 2008; Markic et al., 2008). The larger context of national policies and the context of cultural norms and values also play an important role in affecting teachers` cognition. (Isikoglu, Basturk, & Karaca, 2009). Markic and Eilks (2008) also demonstrated influences of the educational domain and the level of education on the formation of educational beliefs. The latter two aspects might more influence attitudes and beliefs than the subject matter knowledge

Observing the present situation, it is clear that research on science teachers' beliefs is an expanding field (De Jong, 2007). The growing body of research has shed light on many aspects of science teachers' beliefs. Nevertheless, beliefs are context-bound and thus related to the educational and cultural circumstances in which teachers live, the institutions in which they were educated, and the places where they currently work (Alexander, 2001; Woolfolk-Hoy, Davis, & Pape, 2006). In the case of Jordan, evidence concerning secondary chemistry teachers' beliefs about teaching and learning is relatively scarce in the literature (Al-Amoush

et al., 2011). Despite this fact, educational innovations are being planned and implemented in Jordan. It seems teachers' beliefs are not included in the focus of these innovations, whose implementation remains unsatisfactory as recently described in the case of primary school teachers (Abuhmaid, 2011; Qablan, Juradat & Al-Momani, 2010). Therefore, in our previous study (Al-Amoush et al., 2011) we tried to investigate different aspects of beliefs chemistry student teachers' and experienced teachers hold about teaching and learning in chemistry, the aims and objectives of chemistry lessons, and classroom culture and activities. The study showed a dominance of traditional, subject-matter guided and teacher-centred beliefs among the chemistry student teachers and experienced teachers concerning chemistry education. The beliefs were even more traditional among the student teachers compared to experienced teachers having completed a first in-service training program. Nevertheless, the study also revealed more open and student-centered beliefs when it came to beliefs about the general nature of a potential good education.

The study described in this paper is now to elaborate experienced teachers views on the prevalent and wished practice of teaching and learning in chemistry in Jordan. Accompanied the study evaluates the Jordanian chemistry teachers' views about ongoing educational reform. The study was thus objected on two areas of research questions:

1. *What is the perception of experienced chemistry teachers in Jordan about the actual teaching situation in chemistry classes? How do they consider and explain the balance of student- and teacher-centredness? What are the reasons for the prevalent strong teacher-centered beliefs among most student teachers and experienced teachers as described in Al-Amoush et al. (2011)?*
2. *What do experienced Jordanian chemistry teachers think about recent educational reform in Jordan? Do they agree to the reform? What are fostering and hindering factors for reform? Which direction should reform take from the view of experienced chemistry teachers?*

Method and Sample

The study is based on semi-structured interviews. The interview guide was developed according to the research questions taking into account the directions of educational reform in Jordan and previous findings on Jordanian student teachers' and teachers' beliefs as described in Al-Amoush et al. (2011). The interview guide was cyclical refined by discussions within the research group. Finally, the interview guide was translated into Arabic language.

Five main areas of questions were elaborated (see Appendix). The first group of questions deals with current chemistry teaching practices in Jordan. It also focuses the teachers' experiences by asking for reflecting their own teaching concerning the roles of the teacher and the students in class, the teaching objectives, applied pedagogies, and the role of experiments in chemistry teaching. A second group of questions deals with the teachers' knowledge and views about recent educational reforms in Jordan. The third part of the interviews asked the teachers to reflect and explain the prevalent very traditional and teacher-centered beliefs of Jordanian chemistry student teachers and experienced teachers evaluated on the base of drawing of classroom situations by Al-Amoush et al. (2011). The fourth aspect focused potential reasons for the very traditional views of the chemistry student teachers on teaching and learning chemistry in the foreground of the Jordanian educational reforms and international trends in science education. The last focus of this exploratory interviews encompassed questions on the teachers' wishes and expectations for future development of chemistry education in Jordan.

The participants in this study were 12 secondary chemistry teachers from 10 different schools located in two different districts: Amman (the capital) and Mafraq (80 km north of Amman). All teachers are teaching chemistry at the secondary level. Secondary chemistry teachers in Jordan are trained by first completing a Bachelor's degree in the chemistry. Additionally, the teacher qualification is based on pedagogical workshops during the first active year of teaching after the Bachelor's (Qablan et al., 2010). The pedagogical workshops accompanying the initial stage of a teacher's career concentrate on teaching methodology, different types of assessment, performing experiments within the educational context, and other educational issues. These workshops are conducted once a week for five hours. Additionally, a computer workshop focuses on the use of information technology in education including *The International Computer Driver's License* (ICDL) (Alhawari, 2008; Jordan Ministry of Education, 2010). Some chemistry teachers also have the chance to continue postgraduate studies in the field of science education. However, this is not an obligatory component. Three out of 12 teachers from this sample did a MEd-program. In our case all the teachers were trained by this system and are experienced. All teachers had more than 3 years of experience, their average number of teaching years was 12.6 (for further details see table 1).

The interviews were conducted in Arabic language within the teachers' school environment. The interviews lasted between 30 and 60 minutes and were audio-taped. Data was inductively analyzed (Thomas, 2006) following the basic tenets of qualitative content analysis (Mayring, 2000). Validation of interpretations was done by a communicative

discourse on the base of translated interview excerpts in the means of a search for inter-subjective agreement (Swanborn, 1996).

Table 1: Background data of the sample

Characteristic		***Teachers number***
Gender	*Female*	8
	Male	4
Age	*25-30 years*	3
	30-40 years	7
	> 40 years	2
Experience	3-10 years	5
	10-20 years	5
	20-30 years	2
Study	BSc	9
	BSc + MEd	3

Findings and discussion

Teachers views on and explanation of the practice of chemistry teaching in Jordan

Within the interviews the teachers described their view of most chemistry classes in Jordan as using a frontal mode and being very teacher-centered. The prevalent teaching practices were characterized by (i) the teacher being the source of knowledge, (ii) a very passive role of the students, (iii) and the absence of student experiments and longer phases of student active pedagogies. One teacher assumed that teachers prefer lecturing and frontal teaching because it seems to be easier and can be mastered well. The teachers also described their own style of teaching this way but with more experiments. They describe their own chemistry classes as a frontal teaching style using blackboard with either demonstration-discussion activities or small phases of interactivity using tasks and worksheets. Only four out of the twelve teachers described doing student experiments, eight do not. Anyhow, the styles described by all the teachers but one are dominated totally by a dominant teachers' role whereas the role of the students can be described passive as they are either listening to the teacher or answering short questions. Only one teacher – coming from a model school with specific facilities - described her chemistry teaching completely different, being student-centered, with student-active phase, and her presence as a facilitator for the education process:

> "*In the previous lesson I give them a hint of what we are going to perform next time, for example by showing them a small shot on the you-tube for five minutes, the following lesson they come to be prepared to perform an experiment by themselves in*

a group, but this is as we have as a model school special support for our laboratories and facilities."

Like in Al-Amoush et al. (2011) there are already few chemistry teachers in Jordan having a student-centred view of their teaching, but as in this study they seem to form a very small minority. The description of the teaching styles supports the findings about the beliefs of chemistry teachers in Jordan described in Al-Amoush et al. (2011). When being confronted with results from this study ten out of the twelve teachers' considered the findings being very sound, mirroring the situation in Jordanian chemistry education on secondary level, and also within their classes. The interpretation in Al-Amoush et al. (2011) that the Jordanian system of teacher education is one of the main reasons for the dominance of teacher-centeredness was supported by ten out of the twelve teachers. Only two teachers saw the reason exclusively by other factors, especially the demands of curriculum and assessment, infrastructure and class sizes, and the abilities and interests of the students.

Al-Amoush et al. (2011) describe also that most teachers' beliefs concern the basic aim of chemistry teaching is rote learning of chemistry facts and theories with low orientation on general educational skills and the application of chemistry in student-relevant contexts. The teachers are aware of problems caused by this kind of teaching. The teachers described the students complaining that chemistry is a kind of knowledge that doesn't have to them any application or benefits in their life. Two teachers explicitly described negative attitudes of the students to both chemistry and also lab-work as they see chemistry as a subject of theoretical facts without any application in practice and life. In the interviews most teachers described that they would like to have a better link between chemistry and everyday life. But they didn't describe or know how to do so, like context-based orsocietal driven chemistry curricula as discussed e.g. by Gilbert (2006). The teachers mentioned the approach of providing an application theme after each unit to make the connection visible, as suggested by textbook material, but also considered being less successful taking this road. The reason for low success in getting the relevance or chemistry clear to the students is addicted by the teachers to the official curriculum and textbooks:

"*at the end of each unit, there is a page talking about science and application in everyday life. On one hand it is not enough and presented in such a weak way and not-interesting way. It is even boring for me. I am trying to discuss it with my students, but many teachers don't. And my students prefer not to have additional knowledge to the intense curriculum and crowded books."*

Thus, from the teachers' perception the curriculum makes the teachers mainly focusing on rote learning of chemistry facts and theories. In addition the chemistry books are described to lack making connections among the different topics and between different levels of understanding.

From the perspective of some of the teachers, this is the style of teaching the students want to have. Ten out of twelve teachers mentioned the students as being one of the reasons for teacher-centered teaching style in Jordanian schools. Seven teachers said explicitly that the students prefer to be passive in the lessons and like to be dependent on the teacher in explaining each single point. From the teachers' experience, considerable numbers of students don't ask questions or are acquainted to discussion and reflection:

> "*At the start of my teaching practice, I asked a question for my students. And I got the same answer from all of them. So, I learned a fact, not to ask a direct questions again…The students are used to take the knowledge from the teacher as it is. They don't ask questions that are beyond the subject matter part."*

But this observation might be a problem in general, beyond the chemistry classroom. The students are not acquainted to learning by inquiry or self-directed questions. Anyhow, if applied, the situation can change:

> *"At the start of the semester when I give my students a question to think about, they find it strange and an unexpected request. Some of them think that I don't know the answer. Afterwards they are used to have such questions to answer and give their opinions."*

Because of not being allowed, or not being able to make everyday-life or societal connections and to apply problem- or question-driven pedagogies the teachers see the role for more meaningful chemistry education by the experiments. All the teachers believed that lab-work is an essential component in chemistry teaching. They described it to be the main entrance to a meaningful chemistry. Concerning their own classes and their own teaching, however, they applied their beliefs differently. For example, half of teachers explained performing experiments solely as lecture demonstrations, although they are aware about the different role of lecture demonstrations and students' lab-work. This pedagogy is justified by safety issues and lack of adequate materials:

> "*The ideal chemistry lesson should be in the laboratory where students perform experiment and teacher presence is a facilitator for their learning. But in my classes, I am demonstrating the experiment for them in the laboratory, so I can't call it experiment, but a show."*

Four teachers described shifting between lecture demonstrations and students performing experiments, once there are enough materials. They consider their students learning better through performing experiments by themselves. Thus, they are supporting students to perform of experiments:

> "*As we are model school, we have well equipped labs, so experiment performance always is done by the students. And we support enquiry labs which are always open for students' projects and work. But if once we don't have enough or dangerous materials to use, I am doing a demonstration for them."*

One of the teachers appreciates the role of the computer experiments as a solution for the shortage in materials and time. Another teacher didn't perform any experiment throughout fifteen teaching years, because of time shortage.

> *"Laboratory work should present 100%, but in our classes it presents approximately 30% of the time. On one hand, we have just three chemistry lectures per week to complete the intense curriculum, so there is no time to perform an experiment. And on the other hand our laboratories lack tools and materials or even special budgets for laboratories needs."*

Asking the teachers in this study about their satisfaction with the current situation in their schools they have a lot of things to criticize. Main critics concern the infrastructure and teaching conditions. The teachers in the vast majority complain about the crowded classes and a lack of lab facilities. The teachers talk about the high workload as being a teacher that prevents them from having time for promoting students' activity and creativity and from investing in their own professional development. In this respect the teachers felt missing support for their work concerning innovation and student-oriented methods. Four teachers even complained that the school context, parents, and students are against applying student-oriented pedagogies in chemistry classes. Three teachers referred this explicitly to the whole context starting from the head of the school:

> *"The school context is struggling student-oriented classes: When I ask students to work or discuss with each other, the director of the school criticizes the class. As she said that just my voice should be present in class, and students should be silent. This is our very traditional school system."*

But, also the workload in class is too demanding for teachers and students. As already mentioned in one of the quotes above, the teachers described the textbooks being overloaded with subject matter. The teachers complain that with the number of chemistry classes per week, they hardly can finish the textbooks in time. This is one of the main concerns of the

teachers finishing the whole book page by page in time. The teachers considered it to be tricky to apply problem-oriented methods because from their estimation these methods will require more time than in their traditional classes, and this affects success in finishing the books part that should be covered within the given time frame.

Another explanation for many deficits was given by some teachers too. The teachers criticized the teacher education of Jordanian chemistry teachers. From their point of view the pre-service teacher education does not qualify the student teachers to become teachers since the students only study the subject matter knowledge. Five teachers describe a lack of proper training to operate problem-posing methods in their classes. In addition to that, the teachers described not earning enough money by being a teacher and thus doing a second job after school what affects their performance in the school negatively.

Teachers' views on and explanation of the practice of chemistry teaching in Jordan

Concerning recent educational reforms in Jordan, most of the teachers mentioned having only a vague knowledge. Their view supports Qablan et al. (2010) who showed that Jordanian teachers mostly were not affected by the orientation and philosophy of the national educational reform movement or international trends of reform towards more constructivist learning environments. All the teachers heard about the ongoing reform process, but seven out of the twelve teachers mentioned not having a clear view about the reform objectives, the framework, applications, and the state of implementation. Only five of the twelve teachers mentioned to have some basic knowledge about the reforms. They said their knowledge was coming from different sources, e.g. official documents or letters coming from the Ministry of Education to the schools to be applied and discussed as part of teachers- director meetings. A second source of information were the newspapers and internet sites.

Despite the lack of knowledge the teachers had different attitudes towards the top-down reform process. Five teachers agreed with these reforms, two were against, and the rest mentioned not having a clear opinion about it. Asking for the reasons about a slow implementation success of the reforms among the teachers different answers were given. Answers comprised several reasons prohibiting the reform process. The teachers felt themselves not to be prepared to innovate their teaching within a reform framework. They don't see themselves prepared for the reform neither form their pre-service teacher education at the university, nor from the workshops during their initial phase of working as a teacher. So teachers feel lacking the required knowledge for these reforms and the way to apply them. The teachers felt the reforms not sufficiently being translated and communicated to the

teachers. Again many aspects in the infrastructure and working conditions were mentioned as obstacles for reform, e.g. shortage of time or missing support. The teachers mentioned also that their financial situation could be improved to motivate and convince them to change. Teachers suggested that the reform framework, from their perspective doesn't include all the stakeholders in the educational arena needed to work in concert to make the reforms successful that are normally only directed to teachers. Reforms should work step by step and need the cooperation of the whole system. This necessarily has to include change in assessment practices. As long as the relevant exams are only paper and pencil tests and exclusively focusing factual knowledge, even the students wouldn't like change devoting learning time to other aspects or activities.

Starting from the teachers' perception of the prevalent practice and their view on recent reforms the last part of the interviews focused the teachers' wishes for future change concerning chemistry education. The teachers' suggestions can be categorized in three main areas of needed reform: teacher education, environment and pedagogies.

The teachers formulated need of change in chemistry teacher training. The teachers insisted that improvement in the educational arena has to start with changes and developments in teacher education. While having a purely science oriented university degree, the teachers see great potential having university programs combining subject matter learning, pedagogical courses, and field experience in applying the learned content and pedagogies. As Ashton (1992) claimed, teachers in training need extensive opportunities to examine educational theories, research and practices if they are to help students develop conceptual understanding of subject matter and a critical view of education. This should be followed by continuous workshops relevant for their profession and being about applicable curricula and pedagogies.

Concerning the school environment, the teachers asked for better conditions in the schools, smaller classes, and the development of new teaching materials which will replace the old exclusively content-focused books. The teachers suggested improvement in the lab facilities in schools to allow for chemistry lessons concentrating on problem solving method and inquiry skills. They again insisted on the importance of changing assessment towards assessing a broader range of skills in a variety of assessment techniques.

Concerning pedagogies, the teachers asked for reform on pedagogies making the students the active part in classes, especially to make teaching possible allowing the students performing the experiments in class.

But do the teachers expect change to be happen? The teachers were finally asked about their vision for chemistry education in future and where they do see Jordan chemistry teaching in

ten years. Most of the teachers expected or hoped to have better equipped chemistry laboratories for student active lessons. Developing chemistry teaching by improving lab instruction is seen as of potential for showing the student how chemistry can become an applied branch in their lives. Half of the teachers expect to have a different style of assessment which is authentic, and do not depend solely on the factual text book knowledge. This kind of assessment should show how students can use the knowledge for problem solving in life or within experiments. But, the other half of the teachers didn't expect this to come. One third of the teachers expressed hope that teaching in future will be more taking into account students' attitudes and abilities concerning science in secondary science education. This would lead to higher achievement, better attitudes towards chemistry and increasing career chances for the students. Also one third hoped for a changed chemistry teacher training more oriented on the later field of profession. Three teachers wished to have in ten years time reconsidered curricula and textbooks. Anyhow, overall only two of the teachers were very optimistic this change to come. Half of them had expectations for improvement on a medium level while one third was skeptical for respective reforms to become successfully implemented.

Conclusions and implications

The purpose of this study was to get insights into experienced Jordanian chemistry teachers` views about prevalent practices of teaching and learning in chemistry and about educational reform in Jordan. The findings from the interviews support a dominance of a traditional and teacher-centered style of chemistry teaching in Jordan as it was mirrored in the beliefs of chemistry student teachers and teachers described in Al-Amoush et al. (2011). Many reasons were named from problems in infrastructure and too big class sizes, via traditional curricula, textbooks and assessment systems, towards teacher education programs too less oriented at the later profession of being teachers. The study revealed also that despite many reform initiatives in Jordan took place in recent years, most of the teachers in Jordan are not very acquainted to the reforms and implementation is slow (see also Qablan et al., 2010). The study revealed that the majority of teachers from this case sample is not even very optimistic that neither the reform process is taking the teachers' needs sufficiently into account, nor that it will lead successfully to sustainable change. The teachers mention that the reform process should more thoroughly target the whole educational system and also involve the teachers with a more active role.

With the described findings, need for more effort in educational reform becomes clear. There are many suggestions that can be possibly recommended. Anyhow changing the whole system is a sophisticated and not easy step to start with. Because it might economically also not be easy to equip all schools with better facilities and lab or to give teachers better salaries and more money for the teaching, recommendations might concentrate first on the educational fields that are easier and cheaper to innovate. From the findings we see especially two fields where investment with considerable costs might result the most promising effects: implementing change in pre-service chemistry teacher education and connecting reform initiatives more thoroughly with teachers' needs, beliefs and practices.

Chemistry teacher training in Jordan seems not to achieve its full potential for getting the prospective teachers educated in the best way. This is in line with Al-Doulat and Abu Hola (2009), who recommend that science teacher education programs should be developed and improved in Jordan. One reason of the low success of the teacher training might be that the university teacher training is not objecting the training of teachers. Jordanian teachers are prepared to become a scientist first and a chemistry teacher only secondarily. It is not clear whether all of those becoming later a teacher are doing so because of an intrinsic motivation, or because they don't get a job as being a chemist. Anyhow, in both ways there is a lack of training in the field of their later profession. Knowledge growth and beliefs change in such fundamental issues as teaching styles and understanding of modern learning theories will not take place within a short period of workshops over one year (Oliamat, 2009; Al-Amoush et al., 2011). Such a change seems to be necessary because one can assume that most teachers and student teachers have probably experienced exactly such teaching styles themselves in school and at university. For the profession of being a chemistry teacher a good understanding of chemistry is an unavoidable pre-requisit. Unfortunately, this is not enough. Knowledge in pedagogy within the domain-specific educational domain is similar important too. This is what today is conceptualized as PCK (Magnusson et al., 1999) and what Shulman (1986) considered to be the most essential domain of a teachers' professional knowledge. From our point of view, there is need for offering additional training courses in Jordan chemistry education that can help begin the process of long-term knowledge growth concerning modern educational theory, pedagogies, and to improve the teachers' and prospective teachers' PCK. Also, teacher education should encompass scaffolding for beginning science teachers to develop their identities as reform-minded science teachers (Luehmann, 2007). Providing educational and domain-specific educational courses or placing individuals in schools already accompanying the Bachelor's programs might give the student teachers time for re-thinking

and revising own assumptions and beliefs connected to own experience (Hubermann, 1993). Maybe the best way would be to think about a separate, self-standing, and profession-oriented bachelor and/or master track for future chemistry teachers. Such a track should contain educational and pedagogical courses, seminars, and school placements. Additionally, long-term Continuous Professional Development (CPD) programs also showed great potential for sustainable innovation. Long term interactive CPD proved to be effective in changing and developing science teachers' beliefs and PCK (Markic & Eilks, 2011; Mamlok-Naaman & Eilks, 2012) and could be applied more.

Changes in teachers training and investment in CPD programs are already components of reform. A lot of reform effort is taking place in Jordan. Beyond teacher training it is good that the country invests in development of infrastructure, ICT use and is offering the teachers newly developed teaching materials (ERfKE, 2008). Anyhow, the teachers' role in the recent reform initiatives seems to be too passive. The teachers' themselves feel their beliefs and needs neglected in the process of reform. For many of them their role is considered just as to make students memorize more facts for the final exams and not to be part of changes in the learning style and objectives. The teachers described their role as teaching the content and the curricula school authorities ask for without being trained on the reasons and pedagogical justifications for them. The teachers feel themselves to be the dead end of the road because in the implemented reform they are not a part in planning, developing, or even play a role in the reform development. This is always the case with top-down models of educational innovation (Fullan, 1994) and contributes significantly that most often these strategies are not very successful (Smith & Neale, 1989). A required improvement of the present situation should consider the teachers getting an active role in the reform process. As Hubermann (1993) stated, any sustainable change of substantial character in educational reform asks for long-term strategies including the connection towards practical experiences and multiple exchanges between practitioners and researchers in the specific educational domain. Educational reform should more thoroughly take into account the teacher as a learner, but in the means of being a contructivistic, active learner (Loughran, 2007). The idea of teachers being active learners is also modeled in the *The Interconnected Model of Teacher Professional Growth* (IMTPG) by Clarke and Hollingsworth (2002). Within this model for teacher learning we have to consider the basic theories of learning and the role of influencing factors on a successful and sustainable learning process (Eilks et al., 2006). That means, within educational reform teacher training should consist of a process based on self-reflection and action, which is taking into account four domains in an interconnected way: 1) the personal domain (beliefs,

attitudes, and pre-experience), 2) the practical domain (authentic teaching practices of the teacher), 3) the external domain (topic requirements, media and curriculum), and 4) the domain of consequences (goals and effects) (Clarke & Hollingsworth (2002). All these domains should be taken into account more thoroughly within the Jordanian educational reform process, expecially the personal and practical domain which seem to be neglected so far. E.g., the described problems of an overcrowded curriculum and textbooks lacking on contentions with inquiry-learning or the applications of chemistry should be acknowledged seriously for the reform process and should have their impact on the newly developed teaching materials and the system of assessment. Teachers should become an active part of the planning of changed curricula, pedagogies and assessments, and how they are to be implemented (Huberman, 1993). Such a way will allow them to develop respective competencies for applying changed curricula and will give them ownership (Eilks & Markic, 2011). Projects taking the teachers as partners of the reform process showed success in many countries. Success was documented for sustainable change in practice as well as in reforms contributing to teachers' professional development when forming interactive models of curriculum innovation and implementation (Staub, West & Bickel, 2003; Putnam & Borko, 2000; McIntyre, 2005; Eilks & Markic, 2011). Such strategies should be applied more often in the field of reform in Jordanian chemistry education.

References:

Abed O., (2009). Class teacher students' efficacy beliefs regarding science teaching and its relation to their understanding level of scientific concepts. *Jordan J. Educ. Sci., 5(3)*, 187-199

Abell S. K., (2007), Research on science teacher knowledge, In S. K. Abell & N. G. Lederman (Eds.), *Handbook of* r*esearch in science education* (pp. 1105-1150), Mahwah: Lawrence Erlbaum.

Abuhmaid A., (2011), ICT training courses for teacher professional development in Jordan, *Turkish Online J. Educ. Tech.*,10(4).

Al-Amoush S. A., Markic S., Abu-Hola I. and Eilks I., (2011), Jordanian prospective and experienced chemistry teachers' beliefs about teaching and learning and their potential role for educational reform, *Sci. Educ. Int.*, 22(3), 185-201.

Al-Doulat A. and Abu-Hola I. R. (2009), Science teachers' perceptions about Learning. theories and its relation with their teaching practices, *J. Ass. Arab Univ.*, 52, 159-211.

Alexander R. J., (2001), *Culture and pedagogy: International comparisons in primary education,* Oxford: Wiley-Blackwell.

Appleton K. and Kindt T., (1999), How do beginning elementary teachers cope with science. Development of Pedagogical Content Knowledge in Science, Paper presented at the NARST conference, Boston, US.

Ashton P. T., (1992), Editorial, *J. Teach. Educ.*, 43(5), 322.

Bandura A., (1997), *Self-efficacy: The exercise of control*, New York: Freeman.

Bean T. W. and Zulich J., (1992), A case study of three preservice teachers' beliefs about content area reading through the window of students-professor dialogue journals, In C. K. Kinzer & D. J. Leu (eds.), *Literacy research. theory, and practice: Views from many perspectives* (pp. 463-474), Chicago: The National Reading Conference.

Bodner G. M., (1986), Constructivism – A theory of knowledge, *J. Chem. Educ.*, *63*, 873.

Brophy J., (1988), Research linking teacher behavior to student achievement: Potential implications for instruction of Chapter 1 students, *Educ. Psych., 23(3)*, 235-286.

Brown S. and McIntyre, D., (1993), *Making sense of teaching,* Milton Keynes: Open University.

Bryan L., (2003), Nestedness of beliefs: Examining a prospective elementary teacher's belief system about science teaching and learning, *J. Res. Sci. Teach., 40(9)*, 835-868.

Cherland M. R., (1989), The teacher educator and the teacher: When theory and practice conflict, *J. Read., 32(5)*, 409-413.

Clarke D. and Hollingsworth H., (2002), Elaborating a model of teacher professional growth, *Teach. Teach. Educ.,* 18, 947-967.

De Jong O., (2007), Trends in western science curricula and science education research: A bird's eye view, *J. Baltic Sci. Educ., 6(1)*, 15-22.

De Jong O., Veal W. R. and Van Driel, J., H., (2002), Exploring chemistry teachers' knowledge base, In J. K. Gilbert, O. de Jong, R. Justi, D. F. Treagust & J. H. van Driel (Eds.), *Chemical education: Towards research-based practice* (pp. 369-390), Dordrecht: Kluwer.

Eilks I. and Markic, S., (2011), Effects of a long-term Participatory Action Research project on science teachers' professional development, *Eurasia J. Math. Sci. Tech. Educ.*, 7(3), 149-160.

Eilks I. and Ralle B., Markic S., Pilot A., Valanides N., (2006), Ways towards research-based science teacher education, In I. Eilks and B. Ralle (Eds.), *Towards research-based science teacher education* (pp. 179-184), Aachen: Shaker.

Erickson P. W., (2009), Jordan reforms public education to compete in a global economy, *Educ. Facility Planner*, 43, 13-18.

Fenstermacher G. D. and Soltis J. F., (1986), *Approaches to teaching,* New York: Teachers College Press.

Foss D and Kleinsasser R., (1996), Preservice elementary teachers' views of pedagogical and mathematical content knowledge, *Teach. Teach. Educ., 12(4)*, 429-442.

Fullan M., G., (1994) Coordinating top-down and bottom-up strategies for educational reforms. Retrieved, November 19, 2011, from http://www2.ed.gov/pubs/EdReform studies/SysReforms/fullan1.html.

Gilbert J. K., (2006), On the nature of context in chemical education, *Int. J. Sci. Educ.*, 28 (9), 957-976.

Goodman J., (1988), Constructing a practical philosophy of teaching: A study of pre-service teachers' professional perspectives, *Teach. Teach. Educ.,* 4(2), 121-137.

Haritos C., (2004), Understanding teaching through the minds of teacher candidates: a curious blend of realism and idealism, *Teach. Teach. Educ., 20(6)*, 637-654.

Huberman M., (1993), Linking the practitioner and researcher communities for school improvement, *Sch. Effect. Sch. Improv., 4*, 1-16.

Isikoglu N., Basturk R. and Karaca F., (2009), Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective, *Teach. Teach. Educ., 25(2)*, 350-356.

JEI (2009), Toward A New School Attitudees: Continuity of Adoption. Retrieved October 25.2011, from http://www.jei.org.jo/#/4). Amman: Jordan Education Initiative.

JEI (2011), JEI Annual report 2010. from Jordan Education Initiative. Retrieved October 25.2011, from http://www.jei.org.jo/#/0), Amman: Jordan Education Initiative.

Justi R. and Van Driel J., H., (2006), The use of the Interconnected Model of Teacher Professional Growth for understanding the development of science teachers' knowledge on models and modeling, *Teach. Teach. Educ.*, 22, 437–450.

Loughran J. J., (2007), Science teacher as learner, S. K. Abell & N. G. Lederman (Eds.), *Handbook of Research on Science Education* (pp. 1043-1066), Mahwah: Lawrence Erlbaum.

Lumpe A., T., Haney J., J. and Czerniak C., M., (2000), Assessing teachers' beliefs about their science teaching context, *J. Res. Sci. Teach., 37(3)*, 275-292.

Magnusson, S., Krajcik, J. and Borko, H., (1999), Nature, source, and development of pedagogical content knowledge. In J. Gess-Newsome & N. G. Lederman (eds.), *Examining pedagogical content knowledge* (pp. 95-132), Dordrecht: Kluwer.

Mamlok-Naaman R. and Eilks I., (2012), Action research to promote chemistry teachers' professional development – Cases and experiences from Israel and Germany, *Int. J. Math. Sci. Educ.*, published online first

Markic S. and Eilks I., (2008), A case study on German first year chemistry student teachers beliefs about chemistry teaching, and their comparison with student teachers from other science teaching domains, *Chem. Educ. Res. Pract., 9(1)*, 25-34.

Markic S., Valanides N. and Eilks I., (2008), Developing a tool to evaluate differences in beliefs about science teaching and learning among freshman science student teachers from different science teaching domains: a case study, *Eurasia J. Math. Sci. Tech. Educ., 4(2)*, 109-120.

Mayring P., (2000), Qualitative content analysis, *Forum Qual. Soc. Res.*, 1, www.qualitative-research.net/fqs (accessed 01/02/2007),

McIntyre D., (2005), Bridging the gap between research and practice, *Cambridge J. Educ.,* 35, 357-382.

McKinsey & Company (2005), Building effective public partnerships: Lessons learnt from the Jordan Education Initiative. Retrieved October 23, 2011 from http://www.jei.org.jo/#/23.

Ministry of Education (2010), Ministry of education. Retrieved November 20, 2010, from http://www.moe.gov.jo/Projects/ProjectMenuDetails.aspx?MenuID=1&ProjectID=2>.

Munby H., Russel T. and Martin A. K., (2001), Teachers' knowledge and how it develops, In V. Richardson (Ed.), *Handbook of research on teaching* (pp. 877-904), Washington: AERA.

Nespor J., (1987), The role of beliefs in the practice of teaching, *J. Curr. Stud., 19(4)*, 317-328.

Nisbett R. and Ross L., (1980), *Human Interferences: Strategies and Shortcomings of Social Judgement,* Englewood Cliffs: Prentice-Hall.

Oliamat M., (2009), Science teachers' perceptions about their pedagogical knowledge and its relation with their teaching practices in the Basic Stage, *http://www.damascusuniversity.edu.sy/faculties/edu/images/stories/news/t/35.doc.*

Pajares M. F., (1992), Teachers` beliefs and educational research: cleaning up a messy construct, *Rev. Educ. Res.,* 62(3), 307-332.

Pigge F. L. and Marso R. N., (1997), A seven year longitudinal multi-factor assessment of teaching concerns development through preparation and early years of teaching, *Teach. Teach. Educ.*, 13(2), 225-235.

Putnam R. T. and Borko H., (1997), Teacher learning: Implications of new views of cognition, In B. J. Biddle, T. L. Good & I. F. Goodson (eds.), *International handbook of teachers and teaching* (pp. 1223-1296), Dordrecht: Kluwer.

Putnam R. T. and Borko H., (2000), What do new views of knowledge and thinking have to say about research on teacher learning? *Educ. Res.,* 29, 4-15.

Qablan A., Juradat S. and Al-Momani I., (2010), Elementary science teachers' perceptions of educational reform in relation to science teaching in Jordan, *Jordanian J. Educ. Sci.*, 6(2), 161-173.

Resalat Al Mo'alem (2010), Second stage of education reform for a knowledge economy project, *Resalat Al Mo'alem*, 48, 10-18.

Richardson V., (2003), Preservice teachers' beliefs. In J. Raths (ed.), *Teacher beliefs and classroom performance: The impact of teacher education* (pp. 1-22), Greenwich: Information Age Publishing.

Shulman L. S., (1986),Those who understand – knowledge growth in teaching, Educational Researcher, 15, 4–14.

Smith K., (1993), Development of the primary teacher questionnaire, *J. Educ. Res.*, *87*, 23-29.

Smith D. C. and Neale D. C., (1989), The construction of subject matter knowledge in primary science teaching, *Teach. Teach. Educ.,* 5, 1-20.

Staub F. C., West L., Bickel D. D., (2003), What is Content-Focused Coaching? In L. West & F. C. Staub (eds.), *Content-Focused Coaching. Transforming mathematics lessons* (pp. 1-17), Portsmouth: Heinemann.

Swanborn P. G., (1996), A common base for quality control criteria in quantitative and qualitative research, *Qual. Quant.,* **30**, 19-35.

Tatto M. T., (1996), Examining values and beliefs about teaching diverse students: Understanding the challenges for teacher education, *Educ. Eval. Pol. Anal., 18(2)*, 155.

Tatto M., T. and Coupland D., B., (2003), Teacher education and teachers' beliefs: Theoretical and measurement concerns. In J. Raths (Ed.), *Teacher beliefs and classroom performance: the impact of teacher education* (pp. 123-181), Greenwich: Information Age Publishing.

The World Bank (2008), *The road not travelled: Education reform in the Middle East and North Africa.* The World Bank report.

Thomas D., R., (2006), A general inductive approach for qualitative data analysis, *Am. J. Eval.,* 27(2), 237-246.

Tobin K., Tippins D., J. and Gallard A., J., (1994), Research on instructional strategies for teaching science, In D. L. Gabel (ed.), *Handbook of research on science teaching and learning* (pp. 45-93), New York: Macmillan.

Trigwell K., Prosser M. and Taylor P., (1994), Qualitative differences in approaches to teaching first year university science, *Higher Educ., 27*, 75-84.

Van Driel J., Bulte A. and Verloop N., (2007), The relationships between teachers' general beliefs about teaching and learning and their domain specific curricular beliefs, *Learn. Instr., 17*, 156-171.

Woolfolk Hoy A., Davis H. and Pape S., J., (2006), Teacher knowledge and beliefs. In P. A. Alexander & P. H. Winne (eds.), *Handbook of educational psychology* (pp. 715-737), Mahwah: Lawrence Erlbaum.

Woolley S. L., Benjamin W. J. J. and Woolley A. W., (2004), Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning, *Educ. Psych. Meas., 64*(2), 319-331.

Yildirim S., (2000), Effects of an educational computing course on preservice and inservice teachers: A discussion and analysis of attitudes and use, *J. Res. Comp. Educ., 32(4)*, 479-496.

Appendix: Interview Guide (Short version, extended version included additional impulses if answers are considered by the interviewer to be too short and lacking information)

Topic	*Interview Questions*
Teachers' perception of the situation in Jordan chemistry education and reflection on own chemistry teaching practices	How would you describe the prevalent practice in the teaching of chemistry in Jordan general? How does your chemistry teaching look alike? What is your style of teaching chemistry? What are your main objectives while teaching chemistry? Are you happy with the situation or would you suggest any changes?
Teachers' knowledge on educational reform in Jordan	Currently there are several reform initiatives in education in Jordan. What do you know about them? Do you agree to them? Are they implemented in your school? Reports document that reform in Jordan goes on very slowly. What is your consideration about potential reasons?
Teachers` consideration on the findings from the study by Al-Amoush et al. (2011)	From an empirical survey we found that Jordanian teachers and student have a very traditional view in chemistry teaching, characterized by teacher-centered methods and a strong orientation on pure knowledge transfer. (Results in figures from Al-Amoush et al, 2011, are presented) What do you think about our results? Do you think that this description is representative? What are the reasons that this one style of teaching is so predominant? *Or:* Why is your consideration so different from our findings?
Teachers view on effects of educational reform in Jordan on chemistry teaching	On international level, reform asks for more student-active methods and a stronger focus on general educational skills. Why do you think is such an approach so rarely documented in reports and studies concerning Jordan chemistry classrooms? We also found, that the teachers have positive attitudes on more student-oriented learning, but are unable to create teaching situations where this is operated. What do you think about this finding? Do you have any explanation for this? Do you have any suggestions for more effective implementation of student-active and competency driven methods in the chemistry classroom?
Teachers look ahead	What is your vision about chemistry teaching in Jordan in general? How would you like chemistry education to be in Jordan in ten years?