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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 teachers' 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 teachers` 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 purely 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

Introduction
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 (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 (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 where the learning of facts is the central focus while the facts are detached from their scientific origin and not connected to potential applications in relevant contexts.

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) what is the background of this study.

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 purely content-structured beliefs to more open, student-orientated contexts and methods (Luft, 2009; Markic & Eilks, 2011a).

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.

In the case of Germany, Markic and Eilks (2011a) compared student teachers' beliefs at different stages of their pre-service teacher training. 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

Where in some countries teacher studies are a self-standing program on its own right with integrating content learning, pedagogical seminars and school placements during a the whole university studies, e.g. in Germany, Jordan's teacher education system uses a layered model. The teacher training begins with students completing a Bachelor's degree in the subject to be taught. Students can decide to whether continue science studies after the Bachelor's degree or to move into science teaching. In the later case, the university studies are extended pedagogical workshops during the first active year of teaching after the Bachelor's for getting a full secondary science teacher qualification. Trainers for the pedagogical seminars must possess a Master's degree. Also some teachers also obtained a Master's level of education before entering science education practice and the accompanying one-year pedagogical seminars (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. Inter-rater reliability was calculated by the agreement rate. Following Marques & McCall (2005) there is no commonly accepted threshold for the agreement rate. Anyhow, most papers on qualitative and phenomenological studies suggest rates above 66,7% or 80% for considering the agreement rate as being acceptable. This part of our study uses qualitative data which evaluated by a non-linear scale of potential interpretation. Therefore the discussion of Marques and McCall (2005) might provide a framework for reflecting our agreement rate which we remained continuously remaining above 80%. Thus we consider the agreement as being acceptable. Anyhow, in those cases of disagreement, joint rating was carried out by searching for inter-subjective agreement to get a mostly complete evaluation of the data (Swanborn, 1996).

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 tested by Cohen's Kappa. With Landis and Koch (1977) inter-rater reliability was moderately high with $\kappa = 0.74$ for teachers and $\kappa = 0.76$ for student teachers.

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	Teaching focuses more-or-less exclusively on content learning. Facts are learned detached from their origin and potential contexts of application.	↔ -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.

However, this kind of knowledge is not the same as a list of disconnected facts but organised around core concepts or "big ideas" that guide their thinking about their domains

Beliefs about good education

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 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 (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

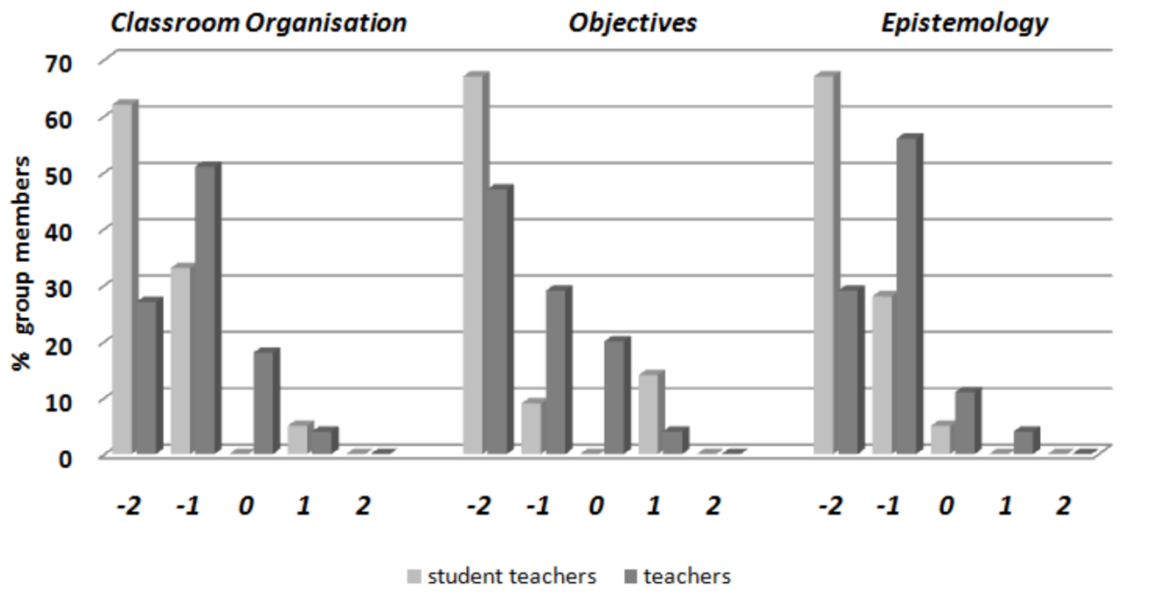

Figure 1: Distribution of traditional vs. modern beliefs about chemistry education

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 where in the pedagogy the content is detached from its scientific origin and potential student-relevant contexts of application. 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.

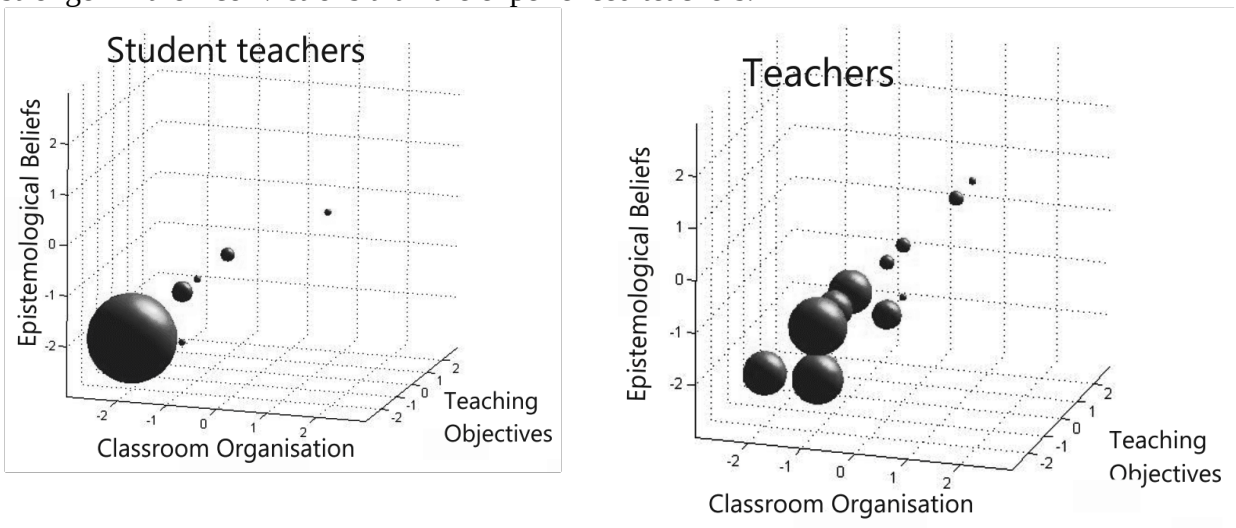

Figure 2. Results of Jordanian educators with respect to traditional vs. modern beliefs about chemistry education

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.

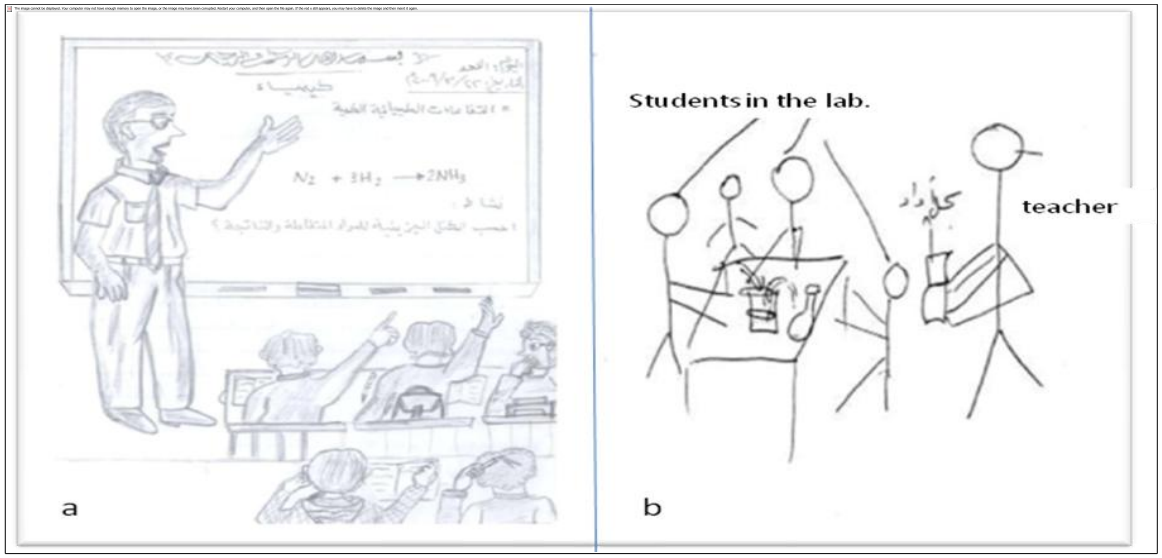

Figure 3. Drawings of two Jordanian teachers of a typical chemistry lesson, (a) traditional/teacher-centered and (b) modern/student-centered

Table 4 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.

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 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	

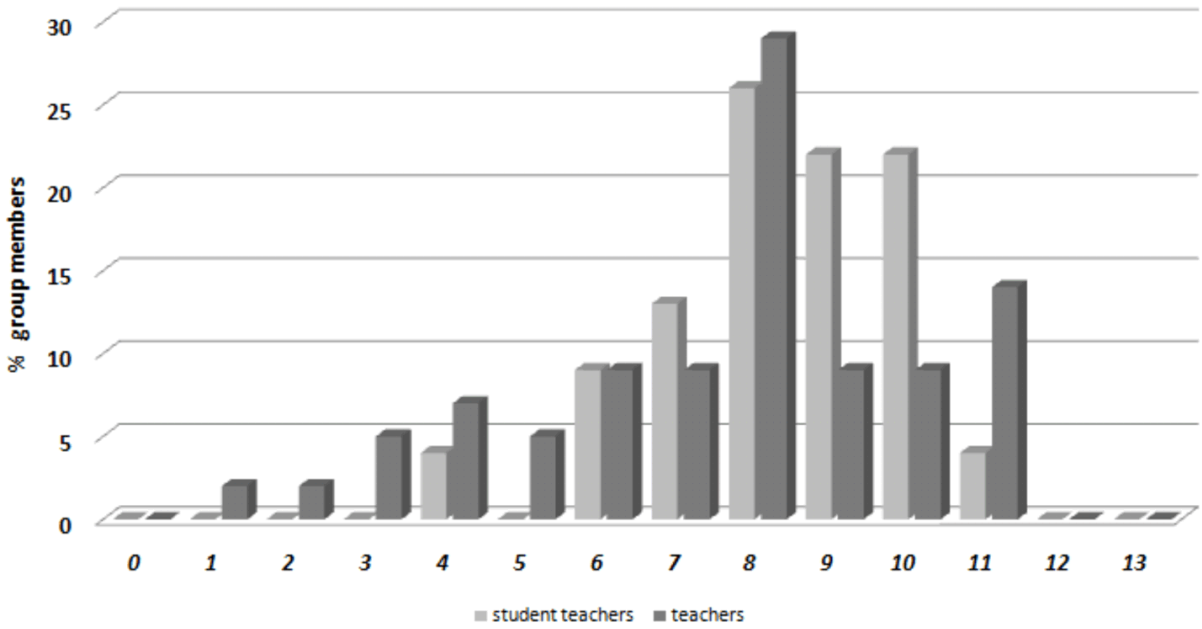

Figure 4. Distribution of student and in-service teachers according to DASTT-C

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	.50	.74
Teachers	M	4,92	4,53
	SD	0,242	0,15
	α	.56	.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 the imagination of 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, have already shown that substantial and sustainable changes are possible in the long run by combining educational courses with domain-specific education (Markic & Eilks, 2011a). 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. The special focus on learning about education and the pedagogy of chemistry teaching is limited to only some seminars accompanying the initial year of being a

teacher in practice. Changes in such fundamental areas as beliefs about teaching styles and ideas about learning theories is difficult and will not occur overnight (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 and expanding the initial teacher training over a longer period of time in the beginning phase of working as a teacher might be of greater potential for provoking the process of long-term, far-ranging changes in prospective teachers' beliefs. But, one can also think of another solution. Maybe a better approach would be to start earlier. From recent studies in Germany (Markic & Eilks, 2011a) we know that educational seminars and school placements during the university training program do have great potential for substantial change in the student teachers' beliefs. Change took place from very traditional towards modern, student-centered and theory driven beliefs. Also the structure of the introductory educational seminars should be reflected. This is not only a question of duration. Evidence from research says that effective in-service teacher training asks for long-term cooperation, external support and structured connectedness towards own experiences and reflection. Using these principles Continuous Professional Development (CPD) of teachers can substantially change their beliefs and knowledge (e.g. Eilks, Markic & Witteck, 2009; Markic & Eilks, 2011b). Obviously, the most potential strategy is to refer all three points of potential action (I) allowing prospective teachers learn about their later profession of being a chemistry teacher from the beginning of their university studies, (II) re-organize the introductory seminars in the initial phase of teaching towards more connectedness with experience and reflection, and (III) establish long-term CPD programmes based e.g. on teacher collaboration, interactive workshops, or action research based innovations (e.g. Mamlok-Naaman & Eilks, 2011).

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. Furthermore, Luehmann (2007) found out in her study that there is also 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. 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 (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. 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 focussing 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.

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