THE EFFECTS OF MENTORING ON CHEMISTRY TEACHERS' PROFESSIONAL DEVELOPMENT

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ABSTRACT: Studies so far have emphasized that mentoring has positive effects on teachers' academic success, personal and professional development, teaching philosophy, and motivation levels. It has also been reported that mentoring helps teachers perform their roles successfully in their classes and be satisfied with their job. Similarly, many studies indicated that teachers' self-assessment plays an important role in ensuring the continuity of their professional development. The present study, in turn, builds on the basis of an analysis to identify chemistry teachers' problems regarding the implementation of the curriculum, and proceeds with mentoring designed to help with these problems. The effects of mentoring on teachers' capabilities and their teaching behaviors were determined by means of their self-assessments. Four chemistry teachers, teaching in Anatolian high schools in the metropolitan area of a mid-size city located on the north-eastern part of Turkey participated in this study. A self-assessment form (SAF) compatible with the requirements of the chemistry curriculum was developed by the researchers; the final version of the form was revised with reference to the opinions of three science educators. SAF was filled out by the teachers, who participated in weekly mentoring activities, both before and after each mentoring session for eight weeks. The data obtained from SAF was analyzed for each participant as a particular case. It was found that although the teachers assessed themselves as "insufficient" in terms of some items in SAF (regarding existing knowledge and giving examples from daily life etc.) before the mentoring sessions, they rated themselves "sufficient" for the same items after they completed each mentoring session. This change could be regarded as an indicator that teachers have given up some of the negative teaching behaviors and improved their deficiencies through the mentoring sessions. In addition, while some of the participant teachers held overly favorable views of their professional competences, rating themselves "sufficient" or "excellent" with respect to certain items (using performance based assessment and evaluation, employing student-centric teaching perspectives) at the beginning, it was found that they reached to a more realistic assessment of their competence in these themes after the mentoring sessions. One can forcefully argue that mentoring contributes to the participant teachers' endeavors to get a better grasp of their capabilities. Based on these results, the incorporation of mentoring to teachers' pre-service and in-service trainings is expected to contribute to the enhancement of the teachers' competence levels. Considering that Ministry of National Education in Turkey has embarked on a new program in which a prospective teacher (mentee) is mentored by an experienced teacher (mentor) for six months before she/he starts teaching, training the experienced teachers in a such mentoring process wherein faculty members in science education supports them continuously, is expected to bring about a chain reaction to improve teacher competences at all levels.

Key words: Mentoring, chemistry education, teacher training, self-evaluation

INTRODUCTION

Mentoring is one of the primary approaches to development; given its reference on how to use knowledge in addition to knowledge transfer from one generation to another (Rhodes, 2002). Mentoring not only contributes to the development of all involved, but also facilitates and enhances interaction between the stakeholders (Inelmen, 2004). Jacobi (1991) stated that mentoring does not have a clear definition because it has some similarities with the concepts of coaching, tutoring and psychological counseling.

In the mentoring process, sharing knowledge and experience is crucial. The ultimate aim of the mentoring process is to achieve personal and professional advancement of the mentee. A candid relationship covering every aspect of life exists between the mentor and the mentee. Through the mentoring process, the mentor provides guidance

and directions to help mentee achieve her true potential by building on her/his experiences (Kahraman, 2012). Expertise and skills in only a chosen issue is not a must. Through the mentoring process, the mentor not only reinforces the feeling of personal satisfaction, but also gets the chance to review her own growth, through a sharing of experience and insights (Crisp and Cruz, 2009; Kuzu and Kahraman, 2010; Perchiazzi, 2009).

One could say, in the light of these remarks and definitions, that mentoring is a multi-faceted concept. There are certain responsibilities and attributes to be exhibited by the mentor and the mentee through the mentoring process (Kahraman, 2012). Aynsley (2009) listed a mentor's responsibilities as maintaining confidentiality; remaining easily accessible; listening to the mentee carefully and without prejudice; supporting the mentee in decision-making processes; motivating the mentee to enable her/him to achieve her/his objectives; establishing a professional relationship with the mentee; acting as a role model; and setting the time frame to conclude the process. Lee et al. (2006) on the other hand, defined the obligations of a mentor who wishes to form an effective relationship as being prepared for the mentoring relationship; setting targets; establishing open and sincere communications; acting in a planned manner; operating with an open heart; willingness to learn; maintaining an open mind towards new knowledge; and effective problem solving. The roles and obligations of the mentor and the mentee form the infrastructure of the prospect of professional development in a given field.

The curricula, and hence, the roles and responsibilities of the teachers, change continuously in the light of the changes in technology, science, and the field of education. In this context, in-service teachers had better involve in constant professional development process. The changes and developments worldwide are reflected on education and teaching through the curricula. For this reason, curricula for different coruse subjects are revised continuously, in an endeavor to render them compatible with the requirements of the age. In a trend, comparable to those prevailing in other developed countries, Turkey has innitiated comprehensive changes in its curricula since 2003, with a focus on contemporary learning approaches such as constructivism, active leranring, student-centered learning environment, and inquiry based learning in both primary and secondary education (Gömleksiz and Kan, 2007; Kurt and Yıldırım, 2010). Obviously, there are numerous factors shaping the process of raising individuals equipped with the requirements of the age, as well as the achievement of the objectives of curricula. The leading one among such factors is the teachers; the implementors of the curricula. That is why teachers in charge are expected to have some knowledge and skills regarding the contemporary learning approaches as well as the teaching methods and the techniques. The competence in these fields can be achieved only through continuous professional development of teachers. In Turkey, the impact of the professional development programs provided to support teachers remains quite limited andthese programs do not often go beyond the training context (Günel and Tanrıverdi, 2014; Harris, 2002). Moreover, the group meetings of the same discipline teachers, which play a major role at schools, are also considered a means too limited to achieve the development of classes and schools (Küçük, Ayvacı and Altıntaş, 2004; Şahin, Maden and Gedik, 2011). At this junction, it is crucial that school administrators and teachers are influenced by their colleagues, have educational cooperation with each other, and play a part in the system through professional and personal mentoring.

Mentoring would be applied in numerous fields, from health to industry. Yet, the recent efforts in the US and Europe in particular have focused on the field of teacher training (Özdemir, 2012). Today the method of "presenting information to individuals" has been gradually abandoned. This method has been replaced by an emphasis on allowing individuals to construct their meaning through concrete and personal experiences. In this context, the system of mentoring presents an important domain of sharing knowledge and experience. Mentoring is also crucial in terms of enabling the teachers to assess their competence in teaching, and to improve their awareness of classroom practice. Celep (2002) listed the prerequisites of an effective learning/teaching process as follows: provision of a suitable physical environment; optimal planning; robust time management and effective use of time; regulation of social relationships; and learning experiences in the classroom in line with the objectives of curricula. In this context, it is evident that teachers assume major responsibilities for their profession. Effective class management depends mostly on the exhibition of effective teaching behaviors in the class. According to Doveston (1985), the effective teacher was the one who is capable of establishing good relations with the students; developing a teaching strategy regarding the topic presented; and making use of new techniques and resources for teaching (quoted by Dilekmen, 2008). Mentoring practices are deemed to be crucial in terms of developing and supporting all these responsibilities and capabilities. Numerous international studies have reported contributions of mentoring practices to the professional development of teachers (Holloway, 2001; Ingersoll and Strong, 2011; Lindgren, 2007; Pinkston, 2008; Waters, 2009).

The present study aims to assess the effects of mentoring provided to chemistry teachers on their competence and teaching philosophy in terms of in-class practices (course introduction activities, the didactic analysis of the course, student-teacher communications, student-centered approaches, assessment-evaluation perspectives, and classroom management).

METHODOLOGY

In the present study, the "Holistic Multiple Case Study" was employed to address the research questions. A "case" may involve an individual or a program in such a study. In the holistic multicase study, there are more than one case which can be perceived on its own. Each case is initially reviewed completely yet in isolation, leading later on to comparisons between cases (Creswell, 2007; Karasar, 2005; Yıldırım and Şimşek, 2006). The present study mentees were reviewed and analyzed as individual cases.

Participants

Four volunteering chemistry teachers working at Anatolian high schools in the metropolitan area of a mid-size city located on the north-eastern part of Turkey took part in the study (as mentees). The demographics of the participants are presented in Table 1. As seen in Table 1, all of the participants had at least 14 years of teaching experience and taught 10th grade chemistry at the time of the study. Of four teachers one was female.

Table 1. Demographics of the teachers

Participants	Professional experience	Graduation	Age	Gender	Class reviewed in the project	Previous participation in a similar project
KÖ1*	25 years	Faculty of Education	50	M	10	None
KÖ2	27 years	Faculty of Arts and Sciences	53	F	10	None
KÖ3	25 years	Faculty of Education	53	M	10	Yes
KÖ4	14 years	Faculty of Education	38	M	10	Yes

*KÖ: Chemistry teacher

Data collection

The researchers developed a Self-Assessment Form (SAF), with reference to the behaviors expected from the teachers within the framework of the chemistry curriculum. The form developed by the researchers on the basis of literature review and then it was put in the final form after the recommendations of three faculty members who specialized in the field of science education. The final version of the SAF contains 48 propositions (behaviors) associated with six main themes. The themes presented in the form are as follows:

- Course introduction activities (Theme A)
- Didactic structure of the course (Theme B)
- Teacher-student relationship (Theme C)
- Student-centered approaches (Theme D)
- Assesment-evaluation approaches (Theme E)
- Class management (Theme F)

SAF was applied with the participating teachers before and after the mentoring, in an attempt to find out to what extent the mentoring has been transfered to the participants' teaching.

Data Analysis

The participants were asked to assess themselves to state their application levels of the propositions (behaviors) corresponding to the themes in SAF, before and after the mentoring practice. They were asked to employ the following criteria for self-assessment regarding the propositions (behaviors) provided in SAF:

(0)-Never: The propositon (behavior) not observed,
(1)-Low: The propositon (behavior) rarely observed,
(2)-Medium: The propositon (behavior) observed at acceptable leved,
(3)-Good: The propositon (behavior) observed at required leved,
(4)-Excessive: The propositon (behavior) observed more than necessary.

The sum and average self-assessment scores assigned by participating teachers for each theme were specified separately. Moreover, comparisons were applied over the average of the scores teachers received for each theme in SAF before and after mentoring, in order to identify how the mentoring process affects the teachers teaching.

FINDINGS

The findings are presented as a comparison of average scores each teacher (KÖ1, KÖ2, KÖ3, KÖ4) received with respect to each theme, before and after mentoring. The scores that the teacher coded KÖ1 received from each theme on the SAF, before and after mentoring, are presented in Table 2.

Table 2. Comparison of Pre-Test and Post-Test SAF Scores of the Teacher Coded KÖ1

Themes	KÖ1's Pre-Test Average	KÖ1's Post-Test Average	Change (-/+)
Theme A	2.4	2.2	0.2
Theme B	1.8	2.27	0.47
Theme C	2.71	2.43	0.28
Theme D	2	2.1	0.1
Theme E	2.33	2.17	0.16
Theme F	2	1.67	0.33

Table 2 reveals differences between mean scores of pre-test and post-test assessments of KÖ1 with reference to major themes and the subtitles. In particular, Theme B (Didactic structure of the course) was observed to present the largest margin. The lowest margin, on the other hand, was observed with Theme D (Student-centered approaches).

The scores that teacher coded KÖ2 received from each theme on the SAF, before and after mentoring, are presented in Table 3.

Table 3. Comparison of Pre-Test and Post-Test SAF Scores of the Teacher Coded KÖ2

Themes	KÖ2's Pre-Test Average	KÖ2's Post-Test Average	Change (+/-)
Theme A	2.8	3	0.2
Theme B	2.47	2.40	0.07
Theme C	2.57	2.71	0.14
Theme D	2	2.6	0.6
Theme E	2.17	2.67	0.5
Theme F	2.67	1.33	1.34

Table 3 reveals differences between mean scores of pre-test and post-test assessments of KÖ2 with reference to major themes and the subtitles. The margin was particularly evident with Theme F, standing for class management. The lowest margin, on the other hand, was observed with Theme B (Didactic structure of the course).

The scores that teacher coded KÖ3 received from each theme on the SAF, before and after mentoring, are presented in Table 4.

Table 4. Comparison of Pre-Test and Post-Test Self-Assessment Form Scores of the Teacher Coded KÖ3

Themes	KÖ3's Pre-Test Average	KÖ3's Post-Test Average	Change (+/-)
Theme A	2.4	1.8	0.6
Theme B	2	2.2	0.2
Theme C	2.71	2.57	0.14
Theme D	2.4	2.4	-
Theme E	2.33	2.33	-
Theme F	2.67	2	0.67

Table 4 reveals differences between mean scores of pre-test and post-test assessments of KÖ3 with reference to major themes and the subtitles. In particular, Theme F (Class management) was observed to present the largest margin. The lowest margin, on the other hand, was observed with Theme C (Teacher-student communications). A comparison of the results of the self-assessment by KÖ3 before and after the mentoring led to the conclusion that he had not perceived any changes regarding his behavior under the themes D (Student-centered approaches) and E (Assessment-evaluation approaches).

The scores that teacher coded KÖ4 received from each theme on the SAF, before and after mentoring, are presented in Table 5.

Table 5. Comparison of Pre-Test and Post-Test Self-Assessment Form Scores of the Teacher Coded KÖ4

Themes	KÖ4's Pre-Test Average	KÖ4's Post-Test Average	Change (+/-)
Theme A	2.6	2.6	-
Theme B	2.47	2.47	-
Theme C	2.14	2.43	0.29
Theme D	2.2	2.6	0.4
Theme E	2.17	2.83	0.66
Theme F	2	2.33	0.33

As seen in Table 5, differences between mean scores of pre-test and post-test assessments of KÖ4 with reference to major themes and the subtitles. In particular, Theme E (Assessment-evauation approaches) was observed to present the largest margin. The lowest margin, on the other hand, was observed with Theme C (Teacher-student communications). A comparison of the results of the self-assessment by KÖ4 before and after the mentoring led to the conclusion that he had not perceived any changes regarding his behavior under the themes A (Course introduction activities) and B (Didactic structure of the course).

DISCUSSION

The present study aims to assess the effects of mentoring provided to chemistry teachers on their competence and teaching philosophy. A brief glance at the findings may lead to a misperception that there is not any distinct pattern, because no changes were observed with four themes while score decreases were evident in the self-assessment results for 9 themes, and increases with 11 themes. Analysis closer look based on individual themes, on the other hand, reveals that three out of four teachers experienced improvements with their skills regarding assessment and evaluation, coded under "Theme D". The fourth teacher, in turn, reported no change. A similar yet contrasting pattern appears with the class management theme. Under the class management theme, three teachers' self-assessments worsened after the mentoring practice when compared to pre–mentoring data.

The reason of decrease on the scores of certain themes would be a real decrease in these skills. However, more realistic self-assessment for the themes as a result of mentoring process would be a better explanation. Combination of two different data sets actually supports this claim. The first one stems from in-class observations made by the researchers before mentoring showed that the teachers had actually performed lower than their self-assessment scores that we discussed somewehere else (Sağlam Arslan, Ünal, Karataş and Aslan, 2016). The second data sets came from demographics of the teachers. KÖ4 graduated from a faculty of education after the year 2000 as noted in Table 1. KÖ4's pre-service training included more pedagogical credit hours than the other participants with a five-year-program rather than four years. His training also focused on pedagocical content knowledge (PCK) in addition to general pedagogical knowledge as pre-service chemistry teacher education was changed in 1998 (Ayas, 2009. In other words, he is considered to have more extensive and in-depth knowledge regarding the six themes discussed here. Hence, his pre-mentoring self-assessment scores are more accurate than the other mentees. Dunning-Kruger effect may help explain this issue (Kruger & Dunning, 1999). One can put the case as follows: since other teachers lacked the foundations regarding the themes discussed in the mentoring practice, they had initially assessed themselves to be better in terms of such themes, followed by a more insightful and accurate assessment after the mentoring. In this context, the findings of the study revealed that mentoring had an impact on the teachers' self-assessment of their professional performance.

CONCLUSIONS AND RECOMMENDATIONS

The developments in science and technology lead to continuous changes in curricula which cause changes in the roles and responsibilities of teachers who would continuously need help and support in order to keep up with the changes in professional development form. Numerous studies in the field of education present the need for and recommend inclusion of mentoring to support the personal and professional development of teachers, lead their careers, and ensure their coping with contemporary learning environments (Allen, et al., 2004; Kahraman, 2012). The findings of the present study revealed that, mentoring practices contribute not only to the professional development of teachers, but also in terms of enabling them become aware of their shortcomings/behaviors regarding in-class practices. One of the conclusions of the study was that chemistry teachers involved in the study had been able to achieve a more objective assessment of their capabilities after the mentoring process. Each teacher gained an awareness of his or her true potential and came to know which of his/her teaching practices require further improvement or which of them is at an acceptable level.

On the basis of these findings, the following recommendations were developed with respect to the teaching/learning environments, as well as any future studies:

- The present study attempted to establish a bridge between the faculty members working in teacher training, and teachers who are the practitioners –the designated beneficiaries of developments regarding the profession. Establishing the permanence of such practices, contributing to life-long learning on part of the teachers and helping them get more comfortable with constantly changing curricula, and hence improving their classroom practices are expected to produce innumerable benefits.
- The implementation of large-scale projects with funds to cover associated costs, with a view to motivating the mentors and mentees involved, is considered to be beneficial in terms of encouraging and supporting them.
- The factors and parameters involved in enhancing interaction through and ensuring efficiency of the mentoring process should be examined.
- The mentoring model utilized in this study can be integrated into pre-service teacher training programs. The crucial point in this context is to provide the mentoring not only pre-service teachers, but also the experienced teachers who supervise them at practicum. Unfortunately, the majority of experienced teachers do not keep up with current developments in the field of pedagogy.
- The study was based on group mentoring model. Further comparative investigations regarding the effectiveness of the mentoring models (one-on-one, gradual, peer mentoring etc.) are suggested to better suit the needs of in-service training.

ACKNOWLEDGEMENT

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