TEACHERS AS PARTNERS FOR DESIGNING PROFESSIONAL DEVELOPMENT PROGRAMS

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The recent reforms in mathematics education generate the necessity for teachers to attend professional development programs. In order to increase the teachers' motivation to attend such programs it is essential to adjust their contents to the teachers' needs. These needs are culturally and socially dependent; hence a certain program which is successful in one country might not be appropriate in another. While designing professional development programs it is important to consider the needs of the population to whom it is intended. The current study was designed in order to explore the needs of Israeli mathematics teachers for professional development, assuming that considering their urgent needs would help us in designing relevant programs.

INTRODUCTION

Mathematics education has undergone significant changes in recent years. The NCTM's Standards (2000) had motivated educators to develop frameworks and approaches aimed at supporting the professional development (PD) of teachers, assuming that such a development will result in improving pupils' learning and understanding of mathematics. Consequently, various extensive professional development programs (PDPs) were initiated, bearing the shared vision of the 'new teacher'. Unfortunately, many of these programs did not yield the expected results.

Various factors are associated with the accomplishment of the goals of the reform. Most of them depend on the teachers' ability to change (Borko, 2004). Teacher change necessitates extensive support and guidance, and opportunities for PD. As PDPs' designers we often face difficulties, not to mention frustration, in bringing teachers to recognize the need for attending PDPs and changing their practice. This implies to the need to rethink the aims and the methods of such programs.

CONTEXTUAL FRAMEWORK

The study was performed within the framework of Israel National Center for Mathematics Education ("Kesher Cham"). The Center provides in-service mathematics teachers with various opportunities for PD (short/long term programs, on-line courses, conferences and seminars). During the last few years we noticed a constant reduction in the attendance of teachers to most of our programs. Talking with teachers about the phenomenon, we realized that teachers feel distressed and frustrated. Many of them express the need to modify some of the contents and the teaching methods, however they are not convinced that the suggested PDPs provide satisfactory answers to their needs. PDPs usually rely on what the designers believe

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might help teachers expand their mathematical and didactical knowledge and what sort of knowledge teachers need. These decisions are made on the basis of field experience and the research literature. The problem with designing PDPs based on research literature is the fact that the roles and needs of teachers are culturally and socially embedded, and teachers' perspectives regarding their profession are affected by the way teaching is perceived by their societies (Calderhead & Shorrock, 1997). Namely, the accumulated shared knowledge regarding PDPs is actually based on experiences gained through working with specific communities of teachers. This knowledge should be synthesized considering local, social and cultural aspects, in order to adjust it to local needs. Following that perspective, and based on Little's (1993) claim that PDPs should explicitly consider the experiences of teachers, we initiated a study that enabled us to learn about the Israeli mathematics teachers' actual needs, with the intention of implementing the results to new PDPs. This paper describes our findings regarding what the study participants find as essential for their PD.

THEORETICAL BACKGROUND

Teacher educators and school reformers are paying considerable attention to the influence of effective PDPs on the improvements of teaching. In this section we present a brief literature survey concerning PD of teachers. We distinguish between PD, as an internal process teachers experience through their entire professional lives, and PDP as an external framework aimed at supporting their PD.

Professional development. PD is viewed as an essential mechanism for teachers to improve their knowledge and expertise, in order to enhance pupils' learning and achievement (Guskey & Huberman, 1995). PD means changes over time in behavior, knowledge, images and perceptions (Kagan, 1992). The process of PD enables teachers to review, renew and extend their commitment as change agents to the purpose of teaching, and by which they acquire and develop critically the knowledge, skill and emotional intelligence that is required for good teaching (Day, 1999). This process is a long-term learning by its nature, and is based on self reflection on experiences (Brown & McIntyre, 1993). The self examination enables teachers to strengthen their knowledge about the subject matter, about different pedagogies and about the ways pupils learn, as well as supporting them in applying these kinds of knowledge in practice (ACME, 2006), in order to generate better learning opportunities for their pupils.

Professional development programs. PDPs play an essential role in successful education reform. The enhancement of students' achievement is dependent upon responsive teachers, who are active participants in on-going, high quality PD activities (Guskey & Huberman, 1995). According to the NCLB forum for teachers preparation institutions (2003), PDPs should include, among others, activities that (i) improve and increase teachers' knowledge of the academic subjects the teachers teach, and enable teachers to become highly qualified; (ii) give teachers the

knowledge and skills to provide pupils with the opportunity to achieve highly academic standards; (iii) improve classroom management skills; (iv) advance teacher understanding of effective instructional strategies. The types of teacher knowledge mentioned above are consistent with Shulman's (1987) suggested framework for discussing teachers' knowledge: content knowledge, pedagogical knowledge, curriculum knowledge, knowledge of learners, knowledge of educational contexts, and knowledge of educational ends.

Phases of professional development. PD is a gradual process that occurs in teachers' professional lives. At any stage in their careers, teachers move forwards and backwards between phases for reasons associated with personal history, psychological and social factors (Day, 1999). Therefore, the meaningful variable – teachers evolve over cycles during their careers – should be taken into consideration while planning PDPs. Huberman (1989) developed a schematic model of cycles of teaching career. The implication of these cycles is that teachers have different aims and dilemmas at various moments in their professional lives. Consequently, their desire to acquire more information, knowledge, expertise, and technical competence will vary accordingly. The phases teachers go through while developing professionally generate the necessity for adjusting PDPs to their needs, according to their current phase of development.

Teachers as partners for designing professional development programs. Knowles (1990) uses the term "Andragogy" to describe the process of engaging adult learners in learning experiences. According to Knowles, adults want to know why they need to learn a certain subject and they are most interested in learning subjects that have direct and immediate relevance to their job or personal life. Since adults are self-directed and expect to take responsibility for their decisions, they need to be involved in the planning and evaluation of their instruction. According to Wilson & Berne (1999), in order for PDPs to affect teaching, they have to consider teachers' experiences and use them as a basis for designing the learning activities. Moreover, PD may be viewed differently in diverse settings (Scribner, 1999). There is no single model or form of PDP which is better than the others. Therefore teachers must evaluate which PDP model would best serve their needs, beliefs and practices.

The current study aimed at listening to the Israeli teachers' voice, viewing them as partners for designing PDPs, and hoping that it might increase their motivation to take an active part in such programs and consequently internalize their contents (Knowles et al. 1998). Following that, we examined the responses of a group of Israeli mathematics teachers to the question: what do they find as essential for their PD.

THE STUDY

The present study has an explorative nature and it uses quantitative as well as qualitative methods. No preliminary hypotheses were assumed. In what follows we

describe the phases of the study, the main research tools and the methods of the data analysis.

Phases of the study. The study was performed within the frame of the Israel National Center for Mathematics Education, and was implemented in three main phases:

At the *first phase* 17 experienced teachers (with experience ranging from 2 to 22 years) were asked to write as many statements as possible for describing their perceptions regarding the meaning of: i. Professional development; ii. Good mathematics teaching and iii. Meaningful learning. In order to identify what teachers perceive as the most meaningful characteristics of teaching, learning and PD, we followed the process of analytic induction (Goetz & LeCompte, 1984). Within this process we reviewed the entire corpus of data gained from the teachers' statements in order to identify themes and patterns and generate initial assertions regarding their perceptions of PD, teaching and learning. The statements were then categorized according to Shulman's (1987) categories of knowledge. In addition, we found that part of the teachers' statements related to communication and self development. The categories and the attribution of the statements to them were validated by these 17 teachers. Due to space limitations, the obtained results of the first phase are not included in this paper.

At the *second phase*, the statements were used for generating two-part Likert-type questionnaire. The statements that were included in the questionnaire were the most frequent in each category (more than two thirds of the participants referred to them). The first part included statements regarding teaching and learning, and the second part included statements regarding PD. The questionnaire was given to another 43 teachers, with various number years of teaching experience (see Table 1 below). Referring to the second part of the questionnaire, these teachers were asked to rank each statement according to its essentiality for their PD needs and explain the ranking.

At the *third phase*, ten representative teachers (out of the 43 teachers) were interviewed (two from each group, according to number of years of experience). The purpose of the interviews was to gain deeper understandings regarding the teachers' PD needs.

Research tools. In this paper we describe two of the research tools – the questionnaire and the interviews.

(i) The *questionnaire*. The questionnaire was anonymous and was comprised of two sections and some informative details relating to the teachers' teaching experience. The first section included 15 statements referring to aspects that concern teaching and learning, and the second section included 15 statements referring to PD. The statements in each section were randomly assigned. In the scope of this paper we relate only to results obtained for the second section of the questionnaire. The questionnaire was a Likert-type scale with the choices: 1. most relevant; 2. relevant;

3. fairly relevant; 4. less relevant; 5. not relevant. The 15 statements that referred to PD were:

S1. Strengthening my confidence in viewing myself as a proficient mathematics teacher; S2. Developing my ability to cope with my limitations; S3. Developing my ability to deal with conflicts that concern my relations with pupils; S4. Developing openness for changing my ways of instruction; S5. Developing my reflective skills; S6. Changing my perceptions regarding teaching and learning; S7. Enriching my knowledge regarding theories that relate to teaching and learning; S8. Changing my teaching methods; S9. Developing my ability to write papers which describe my teaching experiences; S10. Expanding my knowledge regarding the way pupils perceive various concepts; S11. Expanding my knowledge regarding the way pupils construct their mathematical knowledge; S12.Developing my ability to cooperate with my colleagues; S13. Enriching my mathematical knowledge; S14. Developing my ability to implement mathematical inquiry activities; S15. Developing my ability to implement an educational research.

The categories of the statements were: self development (S1, S2, S4, S5, S9, S14, S15); pedagogical knowledge (S6, S7, S8); knowledge about pupils (S10, S11); inter-personal communication (S3, S12); and content knowledge (S13).

(ii) The *interviews*. In order to gain deeper insights regarding the teachers' PD needs we interviewed 10 of the 43 teachers. As was mentioned, within the questionnaire the teachers were asked to explain the ranking they attached to each statement. From each group of teachers (see Table 1) we interviewed two of the teachers who provided the most extensive explanations. The interviews were open, and we asked the interviewers to relate to any issue that appears to them relevant to PD.

The subjects. At the second phase, the questionnaires were filled by 43 mathematics teachers, teaching middle and high-school pupils. Table 1 presents the distribution of the study subjects according to number years of teaching experience.

Years of experience	1-5	6-10	11-15	16-20	21+	Total
Number of teachers	7	6	9	10	11	43

Table 1. Informative data regarding number of years of teaching experience

Data analysis. The study is both qualitative and quantitative; therefore we used data analysis methods from both research paradigms. Analytic induction (Goetz & LeCompte, 1984) was applied for the first and the third phases, and the non-parametric Mann-Whitney Test for the second phase, in order to compare between groups. The comparison was made according to various factors associated with teaching experience and former participation in in-service PDPs. In this paper we focus only on the comparison according to number of years of teaching experience, since it turned out to be the most significant discerned factor among groups.

RESULTS AND DISCUSSION

In this section we present and discuss the issues which we found to be relevant for mathematics teachers regarding PD and PDP. In particular, we focus on the relation between the ranking of a statement as most relevant (MR) and number of years of teaching experience (YTE). It should be noted that we do not assume that statements which were not rated as MR is regarded by the teachers as unimportant.

Results and discussion of the second phase of the study

General Findings. Table 2 summarizes the results. The first row (1) refers to the number of the statement. At the second row (2), appears the percentage of teachers (out of 43) who find each statement as MR for PD (e.g. in row no. 2, 30.2% referred to S1 as MR). In rows 3-7 appears the distribution of percentage of teachers who find each statement as MR, according to their YTE (e.g. in row 6, 3 teachers from the group of 10 teachers with 16-20 YTE designated S1 as MR (30%)). In addition, in each of the rows (2-7), the numbers in bold designate the highest percentages obtained for each group.

1	Statement	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
2	MR(%)	30.2	23.3	34.9	48.8	41.9	18.6	46.5	23.3	4.7	**69.8**	**69.8**	30.2	**69.8**	30.2	14
	YTE															
3	1-5	0	14.3	28.6	**71.4**	**71.4**	28.6	57.1	28.6	0	**85.7**	**85.7**	28.6	57.1	42.9	28.6
	(N=7)															
4	6-10	16.7	50	33.3	50	16.7	16.7	50	16.7	0	50	**66.7**	33.3	**83.3**	16.7	0
	(N=6)															
5	11-15	44.4	0	22.2	33.3	33.3	11.1	55.6	33.3	11.1	**66.7**	55.6	11.1	**77.8**	33.3	0
	(N=9)															
6	16-20	30	0	20	60	60	10	50	30	10	**80**	**80**	25	60	10	40
	(N=10)															
7	21+	45.5	54.5	**63.6**	36.4	27.3	27.3	27.3	9.1	0	**63.6**	**63.6**	54.5	**72.7**	45.5	0
	(N=11)															

Table 2. The frequencies of ranking a statement as most relevant (MR) according to number of years of teaching experience (YTE)

From Row 1 of Table 2 one can realize that most of the study participants perceive knowledge about pupils (S10, S11) and content knowledge (S13) to be the MR for their PD. The least relevant are engagement in research and writing papers (S15, S9). It appears that the study participants are more concerned with psychological aspects (the way in which pupils comprehend and process information, and consequently

build their knowledge), than with pedagogical ones. In order to be able to explain the findings we examined the syllabi of several pre-service teachers training programs intended for qualifying middle and high-school mathematics teachers. We found that students are required to attend at least two one-semester courses dealing with educational/social/cognitive psychology. However, these courses are general in their essence, and are not specific to mathematics. Most of the suggested pedagogical courses deal with the development of teaching skills and didactical methods. Not likewise methods courses, which are subject matter oriented, the courses aimed at developing teaching skills are not always specific to the teaching of mathematics. We also examined some PDPs intended for in-service mathematics teachers. Most programs focus on assimilating new contents of the subject matter, other focus on the integration of innovative teaching methods and tools (including computer software), and the minority concern with general mathematical education issues. We realized then that mathematics teachers are not provided with sufficient opportunities to acquire suitable knowledge regarding the various aspects concerning pupils' thinking and apprehending.

Relations between MR and YTE. Using the non-parametric Mann-Whitney Test we compared between the five groups of teachers (see Table 1), trying to identify differences between the groups regarding their perception of PD. In the scope of this paper we focus on findings relating to the most prominent differences between beginners and highly experienced teachers. As to the beginners, we found that most of them (71.4%) express a need for self development (S4, S5) while most of the highly experienced (63.3%) expressed a need for developing inter-personal communication (S3).

The fact that the beginners are more interested in self development than the others is consistent with Huberman's (1989) model of career cycle. In their initial steps as teachers they are mainly engaged in 'internal observations' of themselves as proficient teachers, struggling to consolidate their world view regarding teaching methods. For that matter, they need to develop their reflective skills and to be open minded. Highly experienced teachers, according to Huberman, are more 'mechanical', self-accepting and exhibit resistance to innovations. Consequently, as can be seen from Table 2, they neither express a significant need for developing their reflective skills nor a need for developing openness to changes. As to S3, Huberman's model does not provide a framework for explaining the gap between the two groups. We refer to this gap within the analysis of the third phase.

Results and discussion of the third phase of the study

We present excerpts from the interviews that concern the issues discussed above. We mainly focus on teachers' responses relating to cognitive aspects of knowledge about pupils, aspects of self-development, and aspects of communication.

Excerpts concerning knowledge about pupils (S10 and S11). Sara, a teacher with 3 YTE said: "… *Frequently I have to teach the same subject* [to low and high

achievers] *but in different levels…While I was a student, my method course instructor talked about the necessity to adjust the materials to the level of the pupils. But what does it really mean? …What actually discern between pupils – I don't deeply understand. What is going 'in the head' of one pupil that is not in the other? Do they think differently? How? Do they have different images? Why?...When I talk, for example, about a parallelogram, in what way every pupil perceive it?*".

Rebecca, a teacher with 23 YTE said: *"… I can tell which teaching method is going to work in what level, and what problem should be posed in every class. But I gained these insights from my experience. I developed some theories about the way in which pupils think and process knowledge, and also about the source of their difficulties. I am curious whether my theories resemble those which are based on research, but we never discussed it formally in PDPs "*.

Both Sara and Rebecca wish to acquire knowledge about pupils. However, it stems from two different perspectives. While Sara believes such knowledge can assist her in becoming a better teacher, Rebecca does not sense that it would be beneficial for her in terms of improving her teaching. Rebecca is curious about whether her own theories, which are based on her experience, suit the research literature. This is in line with Hubermans' (1989) model, according to which beginning teachers are trying to define their professional goals, while experienced teachers tend to stick to what they know.

Excerpts concerning self reflection and openness (S4 and S5). Gail, in her second year of teaching said: "*When I was a pre-service teacher…they* [her instructors] *observed me while teaching and together we analyzed my lessons…Now that I am on my own, I find myself doing what I was preached not to do– lecturing…Why do I do that? How can I change it? What should I do differently? I know I have to do things differently, but I need someone…to direct me in seeing my successes and failures, to help me help myself in realizing what is going on"*.

Rebecca said: "*Examining my professional life, I believe that I was sensitive to pupils' needs, and gradually constructed my knowledge about teaching methods and how to adjust them to various learning styles. For years I examined how things are 'working' in my class, and gained many insights...I don't think I need to attend a PDP in which a young teacher educator would tell me …what should be done at class"*.

Gail is frustrated from her inability to be reflective, although she did not use the word "reflection" explicitly. She feels that she does things 'wrong' but she keeps doing that because she is not sure how to do them differently. Rebecca, on the other hand, believes she knows everything about teaching and learning, and that this knowledge was acquired through her 'trial and error' experience. In fact, teaching experience seems to her central in consolidating a world view regarding effective teaching that she refuses to accept young educator's advices. This perspective is compatible with

the description of highly experienced teachers in Huberman's (1989) model: they are self-accepting and resistant to innovations.

Excerpts concerning conflicts with pupils (S3). Sara said: *"The most enjoyable part of my work is my relations with the pupils. I think that because I am young, they feel like they can talk with me about things that are going in their lives. I am not just their mathematics teacher, but also kind of a friend".*

Eva, a teacher with 27 YTE said: "*When I started to teach 27 years ago, the pupils were different. They respected teachers. I didn't have to spend so much time and efforts dealing with discipline. This is a new generation of pupils. They are not disciplined and they show no respect to us not only as their teachers but also as human beings".*

The differences between Sara and Eva are prominent. While Sara, as a young woman, enjoys the company of the pupils, and loves the idea that they regard her as their friend, Eva is frustrated. She does not know how to communicate with her pupils. Similar to Huberman's (1989) model, Eva is nostalgic, and leans on her memories. However, her past memories of her relationship with the pupils do not refer to 'friendship' but to 'mutual respect'. This difference in perception reflects the social and the cultural changes that the Israeli society had undergone, regarding the status and position of teachers.

Implications for designing local teacher educational programs. From the above results the following recommendations are raised: 1. Knowledge about pupils is essential for all teachers regardless their YTE. Teachers do not have sufficient opportunities to acquire knowledge regarding the way pupils perceive various mathematical concepts and the way pupils construct their mathematical knowledge and understandings. 2. All teachers find the enrichment of their mathematical knowledge as very important component of any PDP. Though most PDPs include this component, it is important to consider the initial knowledge of the teachers, taking into account their previous experience. 3. While designing PDPs special attention should be given to the fact that YTE is a meaningful factor distinguishing between groups of teachers. For example, PDPs designed for beginners should focus on developing the teachers' ability to reflect on their various experiences in class, and help them to consolidate their beliefs and views regarding teaching and learning, since these beliefs and views will affect their practice (Richardson, 1996). Highly experienced teachers should be provided with opportunities for developing abilities to communicate with the 'new generation' of pupils, in order to assist them to overcome their fatigue and frustration.

CONCLUDING REMARKS

Teachers' needs are culturally and socially embedded and are affected by the way teaching is perceived by their societies (Calderhead & Shorrock, 1997). Therefore, PDPs which are based mainly on research literature might not fully address the needs

of a certain community of teachers. The needs of teachers, as members of the society, should be evaluated considering cultural and social aspects of the community in which they are functioning. It should be remembered that adults want to know why they need to learn specific subject and they are most interested in learning subjects that have direct and immediate relevance to their job or personal life (Knowles, 1990). Thus, the teachers' voice is important for evaluating their real needs and for understanding what they perceive as essential for their PD. Relating to teachers as partners for designing PD programs might increase their motivation to take an active part in such programs and internalize their contents (Knowles et al., 1998). Providing suitable answers to variety of teachers is a real challenge for PDPs' designers.

A further research is needed in order to be able to explain why teachers are not interested in sharing their knowledge, as can be concluded from the low rate of S9 and S12. Teachers also show a little interest in carrying out action research (S15) for building their own knowledge. Instead, they prefer to acquire knowledge by learning from PDPs' instructors.

Further research is also needed in order to be able to answer questions like: How to construct an approach to PD, one that takes comprehensive perspectives on the relations between PDPs and the improvement of teaching and learning (Ball & Cohen, 1999)? How do teachers implement their acquired knowledge and develop it along the years? What kind of support teachers need in order to become life-long learners?

Research aimed at providing answers to these questions should consider the nature of the local society and culture, in order to generate an optimal compatibility between the contents of the PDPs and the needs of the target population. It would be interesting to compare between teachers' needs all over the world, relating it to social and cultural differences.

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