RESEARCH AND TEACHING – CAN ONE PERSON DO BOTH?
A CASE STUDY

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In the last two decades, it seems that the border between teaching and research has become blurred. Teachers are doing research in their classrooms, while researchers are turning to teaching the population they are investigating. This article is an introspective one, in which I exemplify this issue through my own experience of teaching and doing research in parallel. A short analysis is presented of the various roles of teachers and researchers. I then present a case study in which I held both roles simultaneously---researcher and teacher. I describe the strategies I used to distinguish between the two roles, as well as examples of synergy and clashes between them. The case study is used as an example to illuminate possible gains and losses in holding such a dual role.

In mathematics education, being teacher and researcher are two related roles. For one or two decades now, we have been observing a phenomenon in which people are deciding, or feeling the need to "serve" in both roles---teaching and research. In this presentation, I take an introspective stand, as I trace my own professional development from a teacher, to a teacher involved in research, to a researcher-teacher. While examining my path, I will refer to the similarities and differences between the two practices, and examine two types of mixed practices: teacher-researcher and researcher-teacher. I will present the case of my Ph.D. study, as an example illustrating the synergy and clashes that might occur while fulfilling the two roles in parallel.

I started my path in the mathematics education community as a teacher. During my second year as such, I became an experimenting teacher in the CompuMath project (Hershkowitz et al., 2002). I was given new curriculum materials, and I tried them in my class with my students. I was asked to reflect on the given activities, and was encouraged to make my own suggestions regarding ways of improving teaching/learning processes. In addition, during one lesson per week, an experienced researcher came to my classroom to observe and analyze learning. I very quickly became a member of the research team and found myself involved in reflective talks regarding the materials and classroom events.

DIVERSITY OF TEACHER AND RESEARCHER PRACTICES

The differences between the practices of teaching and research can be examined in terms of several aspects, among them the training processes, the goals, and roles in the classroom. I examine each of these aspects here.
The training process

The educational backgrounds of a teacher and researcher differ: the teacher specializes in domains and aspects related to the contents s/he teaches (content knowledge), general pedagogical aspects (pedagogical knowledge), and aspects relating to the pedagogical knowledge of the contents s/he teaches (pedagogical content knowledge) (Shulman, 1986). The researcher's academic background and training include content knowledge, knowledge regarding research literature in the field of study. A researcher should be familiar with a variety of research tools, with ways of matching research questions, methodologies, tools, and data analyses.

Common issues in teachers' and researchers' education are areas of the topic of specialization (i.e. mathematics), basic cognitive psychology and possibly, learning theories. But even when learning the same topics, the emphases are different.

The initial goals

A teacher and a researcher in the same class have different goals. The teacher's goals vary from general educational goals, relating to values and norms, through general goals which are related to mathematics itself (such as gaining skills and language), to goals relating to specific content knowledge. The teacher's aims include students' understanding, students' success in examinations, students' interest, involvement and even enjoyment of mathematics. The researcher's goal is to answer a research question (or questions) s/he posed, by collecting relevant data for the research.

Role in the classroom

The aforementioned differences in goals express themselves in the roles of the teacher and researcher in the classroom. The teacher is responsible for classroom organization---both physical and mental (i.e. the physical organization of the classroom and the students, creating learning sequences according to teaching goals, curriculum, and so on). The teacher must instantly respond to students' needs, distribute his/her attention among the students, follow individual students (who need help), and solve problems which do not relate to learning (e.g., discipline problems). The intensity of the interactions among the teacher and students in the classroom dictates the teacher's instant reactions during lesson time. Such reactions are based on a combination of the teacher's knowledge, experience and intuition. However, a reflective teacher may examine the outcomes of her/his reactions and their influence on the course of events, and may modify her/his reactions to classroom happenings, to put learning back on the "right course" (Novotna et al., 2003). Teacher reactions and initiatives are guided by students' interests (from both affective and cognitive aspects), and the singularity of the situation (Labaree, 2003).

In contrast, the researcher is not responsible for classroom occurrences. S/he is motivated by the need to know and understand what is going on and why (Labaree, 2003). The researcher wishes to understand the sources of a certain thinking process or strategy students followed, sometimes regardless of the learning that did or did not take place. To achieve this, the researcher may sit near a small group of learners and
observe their work from start to finish, as it is happening. Meanwhile, the teacher is moving among all the learners, watching parts of the learning processes of many students. The researcher will usually record observations, and hence can observe events and episodes, in an attempt to analyze and understand what happened from different perspectives, and to suggest interpretations and conclusions.

The functions of the researcher and teacher might align while interacting with students, and asking questions. The teacher's goal is to listen (even if the teacher is listening in order to plan his/her next step, and not necessarily to completely understand the learning processes), and in this respect, s/he might resemble the researcher.

Both teacher and researcher function as designers: the teacher chooses curriculum materials s/he may adopt and change to suit instructional goals. A researcher might design his/her research tools, or adapt existing tools. Yet, the design goals are different.

**Summary**

Given the differences in training, aims and functions, it appears that research and teaching are so far apart that the gap could never be bridged. This issue has been referred to in the literature (Labaree, 2003). However, one of the research goals in mathematics education is an understanding of learning processes in order to improve teaching. There are descriptions of professional developmental processes that include the alternating performance of teaching and research, which specifically claim that the two points of view complement and empower one another (Magidson, 2005).

**THE TEACHER-RESEARCHER VERSUS RESEARCHER-TEACHER**

A growing body of research performed in recent years describes teachers who conduct research concerning their own practice. In the US, such research is called *Practitioner Research*, in England, *Action Research*. Here, I refer to a teacher doing research as a teacher-researcher. The role of teacher-researcher has some typical characteristics: it is performed by in-service teachers, who are involved in some sort of teacher's group---school staff, professional development program, or academic courses. Sometimes it is driven by the teacher's own needs concerning her/his practice, but in other cases it is driven by some main theme which is the focus of the group's leader (usually an academic member). The research is conducted by the teacher in his/her own classroom. It is sometimes aimed at establishing a practical knowledge base, including an attempt to articulate an epistemology of practice that includes experiences with reflective teaching, action research, teacher study groups and teacher narratives (Anderson, 2002; Matz & Page, 2002). The phenomenon of teacher-researcher is widespread, and it is perceived as advancing one's teaching practice. On the other hand, the possible contribution of research conducted by teachers to the knowledge of mathematics education is questionable (Breen, 2003; Labaree, 2003), since such research is preliminarily defined and focused according to the teacher's specific needs, and is therefore bound by them.

On the other hand, there is a trend in cognitive research that involves researchers choosing to go into the practice of teaching in order to conduct their research in a
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class that they themselves are teaching. I call these people researcher-teachers. These researcher-teachers are driven by a research question that has evolved from the literature of mathematics education, or their own curiosity, or both. To answer the question, the researcher chooses to be an involved researcher. For example:

- When the purpose of the study is to investigate and expose the considerations and dilemmas involved in teaching in classrooms from the teacher's perspective, the researcher-teacher uses her/his own classroom to conduct the research. Ball (2000) reflects upon her own teaching, to expose the knowledge a mathematics teacher needs to teach in elementary school. She offers an insider's perspective of people who belong to the classroom community.

- Lampert (1990) examines the possibility of teaching mathematics in a manner resembling the way mathematical knowledge is constructed within a community of mathematicians.

- Rosen (in Novotna et al., 2003) uses teaching in his own class as a base for the knowledge he may present to other teachers when he offers alternative teaching methods. Rosen develops his teaching methods in a "real" classroom setting, with all of its inherent complications.

These are some examples of researchers who were motivated by the search for answers to their research questions and chose to be teachers. The focus of these researchers was the teacher and the teaching.

Both terms, teacher-researcher and researcher-teacher, describe one person involved in two domains: research and teaching. The main dilemma occurs in class---how does this one individual react to classroom events in a way that will take into account the researcher's and teacher's agendas?

FROM TEACHER TO RESEARCHER-TEACHER---A PERSONAL CASE STUDY

I am a PhD student in the Department of Science Teaching at the Weizmann Institute of Science, where I completed my Master's thesis while, in parallel, accumulating extensive experience as a mathematics teacher. As such, my professional training includes both teaching and research. In my PhD study I am conducting research in which I define myself as a researcher-teacher. The source of my research work is twofold: the literature, which reports research findings in mathematics education regarding the benefits of initiating the use of computers in the mathematics classroom, and my own curiosity as a teacher about the possibilities of unlimited computer use. My goal is to examine learning in an environment in which a computer is always available, and its use is optional---students can decide if, when and how to work with computers. This has led me (as a researcher with education and experience in teaching) to design an innovative learning environment, and to implement the teaching in this environment for a 2-year period.

I am aware of the dilemma involved in a single person doing both research and teaching. I have tried to separate the roles temporally: the learning environment and
materials were designed before I started teaching, from a researcher's point of view, while bearing in mind the practical aspects of classroom life (duration, difficulty level, applicability, content, etc.). During the school year, teaching in the classroom was done from the teacher's point of view, while keeping an "observer's eye" on things, as is typical for a researcher (keeping a diary of interesting phenomena, documenting classroom work). While I am in classroom, the leading perspective is teaching (although awareness of the research exists). This limits my ability to observe (for practical reasons), which I try to overcome by means of documentation. Reflection after teaching is done from a researcher's point of view: studying events which took place, while watching and listening to recorded data from the classroom. Students' work files are examined after class from a researcher's perspective, bearing in mind that students' needs will determine my course of action as a teacher in the next lesson.

The teacher's role is a demanding one. The teacher's first priorities are responding to students' needs, which are many. In some lessons, I found myself acting as a teacher only, while in others, students functioned in a way that allowed me to observe parts of the events as a researcher. One of the things that helped me keep my "research eye" open was the teaching diary. During about a third of the research period, I sent my diary to my supervisors, after each lesson. Each of them read the diary and sent back questions, remarks, and insights regarding my research and even teaching. Since both are experienced researchers, their attitude towards the episodes I described reflected mainly that perspective. Reading their reactions drew my attention to the research aspects during my work as a teacher. In point of fact, an interested colleague, who offers support and interpretation, is a key factor in the professional development of a teacher (Davis, 1997). The interest, support and interpretation of research experts played a role in shaping my research view of my class.

In the following, I give some examples from my researcher-teacher experience, which demonstrate cases in which a researcher would have investigated more, but my obligations as a teacher towards my students did not allow it, as well as cases in which being an insider (teacher) helped me identify events which called for research.

A clash scenario: M-teacher disturbs M-researcher

As already mentioned, in the initial stage of the research, M-researcher designed the learning environment, including modifications of activities. In one such task, the following question was posed:

In the Excel file p80.xls you will find the following table. Open the file and fill in the table. Write down formulas which you used.

1 I use the term M-teacher to describe my perspective as a teacher, and M-researcher when I am referring to my perspective as a researcher.
M-researcher, from a designer's perspective, prepared this question to encourage the use of formulas and demonstrate the numerical power of Excel. M-teacher saw that students answered this question using three different tools: some calculated using pencil and paper (or a calculator), some used formulas in Excel, and some answered this question in a Word file. M-teacher was surprised by this third way, and M-researcher was troubled by the thought that students might perceive the computer as one entity, and not distinguish among the different tools---when is it preferable to use Excel? (The lesson took place in the third week of the course.) M-researcher wanted to administer a questionnaire in the next lesson, to ask students how they worked and why they chose that method. M-teacher thought that such a questionnaire was not directly relevant to the learning sequence, but in the end, she administered the questionnaire. M-teacher was surprised to read the students' answers. Only one student reported using Word, while the rest reported manual work or the use of Excel, mentioning the advantage of formulae and the "drag" operation. M-teacher was embarrassed: she had counted 10 students using Word during that lesson. What happened? M-researcher wanted to get to the bottom of this issue, confronting students' files with their questionnaire, but this time M-teacher decided it was sufficient, at this stage, that students could declare the benefits of using Excel. What did M-researcher lose? We cannot say.

### A clash scenario: M-researcher "takes over" M-teacher in class

In the second year, before the opening lesson, M-researcher read the diary of the opening lesson from first year. M-teacher felt that she was well prepared for this lesson, since she "knew" what was going to happen. I quote from that lesson's diary: "Reading last year's diary was a mistake! It made me expect a certain flow of events, the one that had occurred last year. This expectation led to a 'bumpy' lesson flow, because I was looking for last year's remarks!" M-teacher felt that this situation was a result of the "presence" of M-researcher.

### Synergy: M-teacher affects M-researcher, by identifying a phenomenon for research

During class work on an activity in which students look for equivalent expressions for a given expression by applying distributive law, M-teacher saw that students produced some unexpected expressions. In the diary entry from that lesson, M-

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<td>1</td>
<td>The large number</td>
<td>The small number</td>
<td>The difference between A and B</td>
<td>How many times A is greater than B</td>
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teacher wrote a remark to M-researcher, to examine students' working files closely. M-teacher designed a short assessment activity on the same mathematical topic, and administered it to the students. M-teacher checked the students' work, and found a wide variety of expressions. As a result, M-researcher collected the work done by students from other classes for future research. In the following year, M-researcher invited another researcher to observe the activity. More details about this activity and the findings regarding learning algebraic manipulations in an Excel environment can be found in Tabach & Freidlander (submitted).

**Synergy: M-researcher affects M-teacher, by creating learning opportunities**

In the diary from Oct 1, 2003, before the lesson, M-teacher wrote: "The problem I see in the coming lesson is that the activity does not invite students to use Excel. It will be interesting to see if students will surprise me once again." The next day, when M-teacher arrived at school, she faced a dilemma: to enter the computer laboratory or to stay with her students in the regular classroom, as one of the teachers had asked her to. Here M-researcher interfered, and hence M-teacher entered the computer laboratory. In that lesson's diary it was written: "To my delight, M-researcher took over M-teacher, and I did not give up the computer laboratory." During the activity, students used the Excel in a variety of original strategies. In this entry I wrote: "I think that the various strategies emerged due to a combination of elements. The activity itself contained no instructions as to how to use Excel, yet students already knew what spreadsheets could offer, and the norm of using the computer for their own needs had been established." The learning that took place in that lesson is reported in Tabach, Hershkowitz and Arcavi (in preparation).

**CONCLUDING REMARKS**

In this report, I have tried to shed some light on issues relating to attempts at being a mathematics teacher and researcher at the same time. I used my own experience to demonstrate a possible way of moving between the two roles. Self-awareness of the role you have taken on at every moment is crucial, even while realizing that sometimes it will not help (see above examples). Note that even in a clash scenario, an awareness of both perspectives enhances and sharpens. The most problematic part of being a teacher and researcher simultaneously arose during the lessons: the teacher's first commitment is to students' needs. Hence, in the classroom, the teacher must act like a teacher, keeping the researcher's voice silent. In analysis, the main perspective should belong to the researcher. An awareness of the opportunities afforded by mixing roles may advance both---teaching and research. Activities such as planning learning sequences or analysing data can be temporally separated from the teaching itself. A teacher who is doing research may become more reflective as a teacher. A researcher who is teaching may change his/her interpretations as a result of the broadening in his/her perspective. More thought is required with respect to possible ways of overcoming the dilemmas involved in being a researcher and teacher simultaneously.
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References


