Beliefs of Teachers Who Teach Intensive One-to-one Intervention about Links to Classroom Teaching

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This paper reports teachers' beliefs about the extent to which expertise in one-to-one teaching can be transferred to classroom teaching. The study involved 21 mathematics intervention specialists. Data collection involved a structured questionnaire with six open-ended questions. Participants were found to be very positive towards transferring strategies developed in one-to-one teaching to their classroom teaching. The strategies included using material settings, using particular questioning techniques, incorporating assessment into teaching, focusing on dimensions of mathematisation, valuing students' responses, teaching at the 'cutting edge', and using mathematical language.

There is minuscule research on comparisons between classroom instruction and one-to-one instruction. Empirical studies examining the benefits of what teachers bring from their roles as one-to-one tutors to their classroom teaching are rare, particularly in the case of teachers who are expert tutors. Even in the absence of empirical evidence, certain links between classroom and one-to-one teaching are obvious (Brophy & Good, 1986; Graesser, Bowers, Hacker, & Person, 1997). Anecdotal evidence from the Mathematics Intervention Specialist Program (MISP) (Wright, Ellemor-Collins, & Lewis, 2011), for example, shows that many teachers who have undertaken a professional development program to be specialist teachers in one-to-one teaching, have been active in supporting classroom teachers. Some MISP teachers have become instructional leaders of Professional Learning Communities (PLCs) and Professional Learning Teams (PLTs) in their schools. This study aims to document beliefs of teachers who are expert tutors and teach intensive one-to-one intervention, about links to classroom teaching.

Literature Review and Theoretical Framework

The effectiveness of one-to-one teaching on student achievement has been well-documented in English speaking countries (e.g., Bloom, 1984; Chi, Roy, & Hausmann, 2008; P. A. Cohen, Kulik, & Kulik, 1982). Cohen et al.'s meta-analysis (1982) also found that undertaking one-to-one teaching positively affected teacher achievement, self-concept, and attitudes towards the subject matter that they taught. However, the benefits that tutors gain from their one-to-one teaching are often overlooked (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001).

The role of teacher-student interactions in developing students' conceptual understanding and knowledge construction has been emphasised recently (Grandi & Rowland, 2013), and there is a corresponding emphasis on student-centred instruction, also called inquiry-based instruction. Since the 1960s, the teacher's role in teacher-student interactions has gradually changed. An alternative to the view that teachers are a source of information and students are receivers is the view that teachers engage their students by asking probing questions and thereby enable students to express their solutions to tasks. In a shift towards these new approaches to instruction, however, teachers can encounter difficulties in implementing teaching strategies in their classroom such as scaffolding,

asking probing questions, and querying a student response (Kyriacou & Issitt, 2008). Teaching strategies such as these are emphasised in training teachers to be specialists in individualised intervention programs such as MISP (Wright et al., 2011).

Additionally, in part due to individual differences in knowledge, motivation and socialization (Dowker, 2005; Graesser et al., 1997), teachers encounter difficulties in making optimal teaching plans that cater for all students in their classes. This has inspired researchers to explore individualised student instruction via intelligent tutoring systems or one-to-one human tutoring (e.g., Graesser et al., 1997). By analysing tutorial dialogues between non-expert tutors and seventh graders in mathematics, Graesser et al. (1997) identified six teaching strategies that can be transferred from one-to-one contexts to classroom contexts. Three of these: taking student questions seriously, using conversation moves to encourage student contributions, and giving discriminating, but polite, feedback to students' error-ridden contributions; are identified as what tutors do in attempting to assist students. Another three: never trusting students' answers to comprehension-gauging questions, asking deep-reasoning questions, and planning complex material and special teaching strategies in advance; are reflected in what tutors normally do not do. Graesser et al. (1997) believed that, in both cases, there must be a focus on how teachers can improve the conversation patterns in their classrooms.

In summary, (a) while one-to-one tutoring has been shown to be beneficial for teachers, these benefits are often overlooked; (b) in the switch to student-centred instruction, teachers can encounter difficulties in implementing strategies such as scaffolding; and (c) teachers' difficulties in making optimal teaching plans have inspired research focusing on the analysis of teacher-student dialogues and has resulted in an emphasis on the improvement of conversational patterns in the classroom. Accordingly, this study aims to investigate beliefs of teachers who are expert tutors about the extent to which expertise in one-to-one teaching can transfer to their classroom teaching. The following research question is addressed. Which teaching strategies and skills developed through one-to-one teaching do MISP teachers regard as useful for classroom teaching?

Method

MISP is an ongoing project (2009-2014) with origins in Mathematics Recovery (Wright, 2008) and related programs (Wright, Ellemor-Collins, & Lewis, 2007) which focus on intervention in the number learning of low-attaining students. MISP instructional approach is intensive, highly interactive and targeted at the student's zone of proximal development (Vygotsky, 1978). Twenty-one teachers who had worked as MISP teachers for one to five years participated in the study. They were involved in both classroom and one-to-one teaching or at least formerly were classroom teachers. A qualitative research methodology was used to gain insight into teachers' beliefs about the extent to which expertise in one-to-one teaching can transfer to their classroom teaching. Data collection involved using a structured questionnaire and a modification of a focus-group approach (L. Cohen, Manion, Morrison, & Morrison, 2011). The structured questionnaire focusing on links between one-to-one teaching and classroom teaching was developed. The questionnaire consisted of six open-ended questions and was emailed to the teachers one week in advance of a professional development meeting. The teachers were asked to complete initial responses to the questionnaire and advised that time would be provided for completing the questionnaire at the professional development meeting. At the meeting teachers participated in a group discussion based on the questionnaire, led by MISP

leaders. The format of the session involved teachers working in groups of three or four. Each question was discussed in turn and a member of each group verbally reported a summary of the group's discussion which yielded a collective rather than an individual view (L. Cohen et al., 2011). At the completion of the session, teachers were asked to complete the questionnaire individually and return it to the researchers by email.

A standard method of analysing the data is to review very carefully the teachers' questionnaire responses and then to identify emergent themes related to teachers' beliefs about links between one-to-one and classroom teaching. In order to identify emergent themes, the data were coded using the NVivo 10 qualitative data processing software. Each teacher's responses were analysed through intensive scrutiny and across the corpus of the teachers' responses to develop and refine categories related to these themes.

Results and Discussion

The findings are now discussed with reference to five aspects: (i) issues faced when shifting from classroom to one-to-one teaching; (ii) teaching strategies and skills developed in MISP; (iii) teaching strategies and skills that can be transferred to classroom teaching; (iv) usefulness of the key elements (KEs) of one-to-one teaching for classroom teaching; and (v) actions by MISP teachers in supporting classroom teachers.

Issues Faced in Shifting from Classroom Teaching to One-to-One Teaching

The participating teachers reported a range of issues in four categories: assessment, planning, teaching and teaching strategies. Each category involves some subcategories. In Table 1, the categories of responses appear in the first row and below this more specific responses related to a particular category are listed.

Table 1

Issues Faced when Shifting from Classroom to One-to-One Teaching

Assessment	Planning	Teaching	Teaching strategies
Schedules of tasks	Interpreting the assessment data	Changing teaching environments	Questioning
Conducting	Tailoring a teaching plan	Shaping a teaching environment	Using material settings in teaching
Coding and analysing		Teaching approaches	Using new mathematical terms
			Time management

Most teachers reported that MISP is challenging initially. They have to become familiar with assessment schedules, learn to conduct an assessment interview, and also learn to interpret assessment data in order to plot students appropriately on a learning framework (e.g. Wright, Martland, Stafford, & Stanger, 2006). The teachers reported that mastering all these practices is a time consuming task.

> Filming, coding and analysis are time issues. It took quite a long time to complete the assessments, then review and code them! This practice has become more honed as experience has been gained.

Also challenging is tailoring an individual teaching plan based on the assessment. A key aim is to find the cutting-edge of the student's knowledge. This involves finding out what the student both can and cannot do. However, after mastering the assessment approach, the teachers found that it is a powerful tool that enables understanding students'

mathematical knowledge and strategies. The teachers reported that the development of assessment skills in MISP is very helpful in their professional development.

> To become less self- conscious of having lessons videoed as this wasn't a form of observation that I had used previously for recording student progress. However it is a very powerful and informative tool for tracking teacher pedagogy, student progress and for sharing findings or imparting Numeracy knowledge and teaching strategies with colleagues.

Teachers reported that when changing the teaching environment from a classroom to a one-to-one context, they have to prepare for the new content, teaching materials and the mode of operating that involves working intensively with one student. Teachers reported that they are often aware of a need to slow down when giving instructions, whereas classroom teaching sometimes does not lend itself to proceeding more slowly.

The Teaching Strategies and Skills Developed in the MISP

Table 2 describes the teaching strategies and skills that the participating teachers reported they have developed in MISP.

Table 2
Teaching Strategies and Skills Developed in the MISP

Categories of Teacher Responses	Sources	References
Using particular questioning techniques	18	28
Wait-time	17	28
Using material settings in teaching	16	23
Interpreting assessment data and planning	13	22
Developing mathematical and pedagogical knowledge	11	20
Developing new approaches to teaching	10	15
Instructional management	10	15
Using mathematical language and terms	9	11
Focusing on dimensions of mathematisation	8	12
Time management	7	8
Tailoring an individual teaching plan	6	8
Teaching at 'cutting edge'	6	10

Sources refers to the number of respondents who mention the response.
References refer to the number of occurrences of the response.

Teachers' Beliefs about Transferring Strategies to the Classroom

Most teachers reported that the teaching strategies and skills developed through one-to-one teaching are very useful for their classroom teaching. The way they teach mathematics in the classroom has changed to incorporate more MISP strategies. Following are seven teaching strategies reported as useful in classroom teaching: using material settings, using particular questioning techniques, incorporating assessment into teaching, focusing on dimensions of mathematisation, being responsive to students and valuing students' responses, teaching at the 'cutting edge', and using mathematical language and terms.

Using material settings in teaching. A setting refers to materials used as a standard context for posing arithmetical tasks, for example, collections of counters, numeral track, arithmetic rack, ten frames, etc. Most teachers reported that using settings in teaching is

crucial in developing students' conceptual understanding. The teachers believe that using appropriate settings supports students' visualizing and reasoning. This supports their development of understanding and the ability to make connections in their mathematical knowledge. Some teachers reported that they are able to adapt the settings they have used in one-to-one teaching to classroom teaching. Further, they reported that some of these materials have been provided for teachers and students to use in classroom teaching (e.g., numeral rolls, digit cards, arithmetic racks, bundling sticks, arrow cards). The teachers reported that using the settings provides a hands-on approach to teaching. The teachers also reported that incorporating techniques such as displaying, flashing and screening of settings is very useful in classroom teaching. They highlighted the importance of using settings when introducing a new concept.

> With the use of the interactive board some settings can be shared with the whole class e.g. arithmetic rack tens frames, fingering patterns. These are all helpful in moving students from their perceptual to figurative and then initial stages of understanding.

Using particular questioning techniques. The ability to ask and answer questions is central to instruction (Lewis, 2007). Compared with classroom teaching, tutors ask students about 1.5 times as many questions and thus one-to-one teaching provides a context for improving questioning skills (Person & Graesser, 2003). Many teachers reported that improvement of their questioning skills through one-to-one teaching has been very useful for promoting discussions in their classroom teaching. They report that they are able to use questions to clarify students' responses, encourage students to verbalise their strategies, gauge students' knowledge and strategies, and expose student's misconceptions.

> When teaching back in the classroom my questioning techniques have improved. I am able to know exactly where the student's needs or misconceptions may be by some simple but effective questions.

Incorporating assessment into teaching. Assessment and teaching are not separate entities (Rudman, 1989). In MISP, teachers learn a comprehensive approach to assessment and use of pedagogical tools for one-to-one teaching. The teachers reported that, in a one-to-one context, the instruction is much more focussed and tailored to the individual student. This provides them with a great opportunity to use the assessment data to pinpoint areas of need and then to work through the student's strengths to improve their weaknesses. The teachers reported that an effective coordinated approach to assessment and teaching can result in instruction that is targeted just beyond the limit of a student's current knowledge. The teachers reported that using the individual assessment interview results to determine the Stages of Early Arithmetical Learning (SEAL) (e.g. Wright et al., 2006) of all students in Prep -Year 2 in their schools has allowed them to tailor a teaching plan to better cater to student learning needs. They also reported that they 'used the results of individual assessment to prioritise whole class or year level strengths and weaknesses in the various learning topics in order to outline a Term planner'.

Focusing on dimensions of mathematisation. A framework of ten dimensions of mathematisation (Ellemor-Collins & Wright, 2011) including complexifying arithmetic, distancing the setting, extending the range of numbers, formalising arithmetic, organising and generalising, and notating is an important pedagogical tool in MISP. The teachers reported that instruction involving a close interweaving of progressions along several dimensions of mathematisation is very useful in both one-to-one and classroom instruction, in order to target and build on students' understanding.

Using the settings and then distancing the settings until students are working with the bare numbers gives the students' confidence and me assurance that they have gained sufficient understanding to move onto the next concept.

Being responsive to students and valuing students' responses. In both classroom and one-to-one contexts, students frequently ask questions and respond to the questions being asked. Thus teachers need to promote comment and discussion in response to students' explanations of their solutions (to the whole class). On the other hand, when teachers show genuine interest in students' explanations, they indicate to the class that their contributions are valued. Within such a supportive environment, students are encouraged to think and to attempt to verbalize their thinking and the strategies they use. The teachers reported that some strategies developed in MISP such as questioning techniques, wait-time and using mathematical language have helped them to be responsive to students and value student's responses in their classroom.

Being a better questioner and giving students opportunities to justify their answers by using mathematical language to help students making connections between what they already knew and what are new

Teaching at the 'cutting edge'. It is necessary for teachers to be clearly aware of students' current knowledge and strategies, what the students currently know and what is new to them. As stated previously, valuing of incorporating assessment into teaching can help the teachers to pinpoint where students are at and what they would need. The teaching plan for each lesson should include posing tasks or activities which are, on the one hand, challenging to high-attainers and, on the other hand, not frustratingly difficult for lower-attainers. The teachers reported that teaching at the cutting edge is challenging in classroom teaching due to individual differences. However, they reported that with knowledge of how to incorporate assessment into teaching developed in MISP, they can cater better to each student's needs.

Using the pre-post and ongoing assessment schedules to pin point the Zone of Proximal Development to keep my teaching at the cutting edge has been a strategy that I have employed more readily when teaching small groups and classroom.

Using mathematical language and terms. The capability to use language in mathematics communication is important for all teachers and students. Mathematical language facilitates the construction of mathematical knowledge and can enhance teacher-student interactions. The teachers reported that the highly interactive one-to-one teaching in MISP has provided an environment for them to improve their use of mathematical language. Also, the mathematical terms that they have learned in MISP such as decuple, complement, bridging, and partitioning, help them to improve their mathematical language in their classroom teaching.

Usefulness of the KEs of One-to-One Teaching for Classroom Teaching

KEs of one-to-one teaching (Wright et al., 2006) are micro instructional strategies that teachers use during highly interactive one-to-one teaching. With respect to the KEs of one-to-one teaching, most teachers reported that many of the KEs are useful for classroom teaching and disseminating that knowledge to classroom teachers is worthwhile. The KEs that the teachers found very useful for classroom teaching are: scaffolding, post-task wait-time, pre-formulating a task, reformulating a task, introducing a new material setting, micro-adjusting, querying a correct response, querying an incorrect response, within-task setting change, affirmation or feedback, re-posing the task, and stating a goal. Many

teachers stated that before participating in MISP they were not aware of KEs for one-one teaching. Although they used some of the KEs such as scaffolding, post-task wait-time, and micro-adjusting in classroom as well as one-to-one teaching, they did not have specific labels for these and they were not explicitly aware of using them. The teachers also reported that through reflection on the KEs, they have had a chance to improve their use of the KEs and have come to realise how vital they are in both one-to-one and classroom teaching.

> In one-to-one teaching, many of the KEs are applied naturally as a response to students; however, I now have a name for them. I will be more aware of when and how to apply the KEs and upon reflection will be able to identify the KEs I have used and make a deliberate attempt to use some of the ones I hadn't used.

MISP Teachers Support Classroom Teachers

MISP teachers reported that they support and share their expertise with classroom teachers through school professional development sessions such as school professional learning days, mathematics learning communities and classroom demonstrations. They show videos of their one-to-one teaching in professional meetings as a basis for discussion of teaching strategies and skills, and also to highlight common misconceptions. In some schools, MISP teachers schedule regular fortnightly meetings with classroom teachers. This provides opportunities to clarify teaching strategies such as using settings and developing questioning techniques, and to discuss issues considered to be useful for classroom teaching. As well, some MISP teachers reported that have become instructional leaders in their schools. Some teachers are currently developing documents that outline how to use the material settings in the classroom with individual, small groups and whole class. They have been able to adapt the settings for use in classroom teaching.

> I have shared a lot of teaching strategies and mathematical knowledge that I have gained through my experiences of one–to-one teaching at several PLTs, and met with classroom teachers and LSOs to share strategies or resources that they may use to support students in the mainstream classroom.

The study by Graesser et al. (1997) and the current study have a common focus–links between one-to-one and classroom teaching. But the approaches of the two studies differ. While Graesser et al. identified strategies that can be transferred from one-to-one to classroom teaching by analysing the tutorial dialogues, the current study documented the teachers' beliefs by using the structured questionnaire with open-ended questions. Nevertheless, both studies describe some similarities in tutors' strategies when attempting to assist students which can be transferred to classroom teaching. For instance, the reference of Grasser et al. to taking student questions seriously is similar to the reference in the current study to valuing students' responses. Both studies serve to underline the importance of linking one-to-one and classroom teaching.

Conclusion and Recommendations

This study indicates that MISP teachers routinely transfer what they learn in one-to-one teaching to their classrooms and those of their fellow classroom teachers. Positive effects of tutoring on classroom teaching highlight an important additional benefit of training specialist teachers in one-to-one intervention teaching. In other words, training in one-to-one intervention teaching has the potential to improve teacher expertise in both one-to-one and classroom teaching. This is particularly the case when the methods teachers learn and use are applicable across a wide range of student attainment, as is the case with MISP. One-to-one intervention teaching when supported by a strong and ongoing program of

professional development can have multiple benefits. Also, it has a potential to develop strong instructional leaders. Further investigation of the effects of tutoring on teaching expertise, in terms of both one-to-one teaching and classroom teaching is important. Further research could focus on: (i) how teachers progress in their one-to-one teaching during the course of an extended professional development program; (ii) changes in teachers' classroom teaching after participating in an extended program of professional development and practice related to one-to-one intervention teaching; and (iii) how particular teaching strategies and skills that expert tutors use in one-to-one teaching can be adapted to classroom contexts.

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