MTCP: A Model for Transforming Classroom Practice

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Contents:

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Introduction

This model for transforming classroom practice was developed by the authors through their collaboration in conducting the Visible Maths Pedagogy (VMP) research project.

This document provides advice and guidance on how to adopt a model of research and professional development that aims to:

- Facilitate teachers' critical reflection on existing practice;
- Acknowledge constraints experienced by teachers in the classroom;
- Take account of socio-cultural aspects of learning;
- Address issues of equity and social justice;
- Bring about changes in classroom practice in contexts where conventional approaches to research and professional development have had limited impact.

The distinctive features of the model include:

- A participatory action research methodology based on 'plan-teach-evaluate' cycles;
- Establishing a genuine collaboration between teacher researchers and a research facilitator;
- Teacher researchers engaging in the design, development and dissemination of a project;
- Teacher researchers collecting evidence, to evaluate their own practice, by conducting surveys, interviews, peer observations and videoing lessons with their own students;
- Promoting critical reflection through maintaining research journals, engaging with research literature, reviewing existing practice and video-stimulated reflection.

The guidance is accompanied by a brief justification of various aspects of the model. Providing such a rationale enables readers to adapt the model to their own situation whilst retaining its key features.

The model is exemplified with references to the Visible Maths Pedagogy (VMP) research project (shown throughout this document in italics).

Further information about, and findings of the VMP research project, which provide evidence to support the efficacy of the model, can be found at: https://visiblemathspedagogy.wordpress.com/

Initiating a research project

This model for transforming classroom practice is best suited to situations in which an existing issue or problem has persisted over a long period of time and has proved difficult to address though the application of conventional approaches to research and professional development. The model advocates critical reflection on existing practice and is therefore most appropriate for addressing issues of social justice where the current situation is considered problematic.

In the case of the VMP research project, the focus was on the strong and persistent association between students' socio-economic background and mathematical attainment, which has proved reluctant to change despite numerous research studies and government initiatives seeking to close the gap in attainment between students from privileged and disadvantaged backgrounds.

Formulating a research question

The choice of research question(s) is essential to the success of the project and can regulate the extent to which the research study generates meaningful and significant findings:

- The research question(s) should address one or more specific aspects of the issue or problem which will provide valuable insight into the bigger picture.
- It should be possible to explore the research question(s) within the setting in which the research study is to be carried out.
- The research question(s) should enable researchers to easily identify an action they can take, or a strategy they can try out, at the beginning of the study.
- The research question(s) should enable the researchers to remain open minded about the findings that might be generated and should avoid hinting at anticipated outcomes.
- Researchers should be prepared to adapt or amend the research question(s) in light of the initial findings of the study.

Research evidence, on the one hand, suggests that more open-ended and dialogic approaches to teaching mathematics can lead to more equitable outcomes for students, whilst, on the other hand, highlights how disadvantaged students might find it more difficult to read the intentions of the teacher when adopting less-structured pedagogy. The VMP research project aimed to develop strategies teachers can use to make their pedagogy more visible, and help all students recognise their intentions as teachers, when adopting open-ended and dialogic teaching approaches. The two research questions for the VMP research project were therefore:

- *Which teaching strategies are successful in helping students develop their ability to decipher the recognition and realisation rules of the mathematics classroom? [i.e. being able to correctly interpret the intentions of the teacher and to respond appropriately]*
- *What impact do these strategies have on students' mathematical achievement and engagement, particularly for those from disadvantaged backgrounds?*

Establishing a research team

The research team, sometimes referred to in this document as the 'researchers', should include a number of 'teacher researchers' (or 'practitioner researchers' if non-teaching school staff are involved) and a 'research facilitator'. All researchers should share an interest in the issue or problem under investigation and should be willing to commit the time necessary to conduct the research, from the design phase through to the dissemination:

- The teacher researchers should be open to engaging with research literature and to trying out new ideas in their classroom. They should be willing to reflect critically on their own teaching and not take existing practice as a given.
- The research facilitator should be from outside the school context so that s/he can provide an external stimulus and not be subject to institutional constraints (in relation to thinking or practice). S/he should have knowledge of research literature in a field that is relevant to the issue or problem under investigation and some expertise in conducting research projects.

- *For the VMP research project, the research facilitator was a teacher educator from a local university who had previously been involved in collaborative action research projects.*
- The research team must be based on collaborative relationships of mutual respect between colleagues, with recognition of the equal status and complementary expertise of all members of the team. Wherever possible, decisions should be taken jointly by the research team. However, there may be some aspects of the research where it is more appropriate for the teacher researchers to take the lead, e.g. planning and teaching research lessons, or for the research facilitator to take the lead, e.g. seeking ethical approval and analysing data.

Ethical considerations

It is important to consider ethical issues related to the research at the design stage of the project in order to minimise the risk involved for all those taking part in the project:

- Thought should be given at the beginning of the project to how the researchers will use any data collected and how they will disseminate the findings of the study.
- All research participants should be informed how their data will be used before they are invited to take part in the study and their consent is sought.
- Every effort should be made to ensure participants, other than the research team, cannot be identified from the published research findings, e.g. pseudonyms should be used for all students and only anonymised transcripts of interviews should be shared.
- Data cannot be used later if permission is not given in advance, so it is best to err on the side of caution and seek consent for every possible way in which the data might be used.
- All data collection should be carried out in accordance with the school's child protection and data protection policies and it is wise to secure the written approval of the school's headteacher, relevant line-managers and/or child protection officer.
- If the findings are to be made public, then an application for ethical approval should be made through an appropriate body, e.g. a university ethics committee.

Ethical approval for the VMP research project was obtained from the UCL Institute of Education Research Ethics Committee on the following basis:

- *The student survey was anonymous and included an initial paragraph explaining the aims of the project and how completion of the survey was entirely optional.*
- *An information leaflet was circulated that explained the aims of the project and the ways in which data would be collected, stored and reported.*
- *Informed consent was obtained from all students (and parents of students) before they took part in the interviews.*
- *All names of students and other information that might identify individuals was removed from the transcripts of interviews and meetings.*
- *The Headteacher gave her approval for the project and agreed that the name of the school could be included in any findings published.*
- *The teacher researchers were treated as co-researchers, rather than participants, and hence their names could be included as co-authors of published findings.*

Research team meetings

Given that teacher researchers are likely to have limited time available, the role of the research facilitator is pivotal in ensuring that the research team meetings are focused whilst, at the time, conducted in a collaborative and participatory spirit. For example, the research facilitator might

circulate notes summarising key decisions and action points from the meetings and compile an agenda that includes items that the teacher researchers are invited to submit. The research facilitator should act as a critical friend, willing to encourage teacher researchers to question assumptions and norms relating to existing practice, whilst recognising their expertise and detailed knowledge of the classroom situation. The research team should agree who chairs each meeting and decisions should be made jointly.

Research team meetings serve a variety of purposes, as outlined below, although it is likely that each meeting will incorporate several of these different functions.

Design meetings

These meetings can be used for strategic discussions, e.g. refining the research questions, clarifying the aims of the project, identifying constraints and resolving how these might be overcome. They can also consider logistical arrangements and decisions relating to the finer details of the research design, e.g. the timings of meetings and research lessons, which classes and students might participate, which data collection and analytical tools to use, and resources that might be required.

Review meetings

The purpose of these meetings is to review current practice within teacher researchers' own classrooms, their departments and schools, and practice in other settings. An important aspect of these meetings is to facilitate critical reflection on existing practice, e.g. by members of the research team presenting research articles to each other, then discussing how these relate to their own situation. These articles might be in a field relevant to the project's research questions or related to the research methods that have been adopted within the research design.

Planning meetings

During these meetings, the researchers negotiate and agree the actions to be tried out in the classroom as part of the action research cycles. They will also need to consider how to plan the research lessons to enable the actions to be undertaken. There are also likely to be discussions relating to finalising the data collection tools, e.g. deciding the questions to be asked in surveys and interviews. The researchers need to reflect carefully on how the actions to be tried out, and the data to be collected from students, will allow them to address the project's research questions. Later in the project, these meetings might be used to plan how to disseminate findings, e.g. through joint presentations at events, co-authoring publications or through a designated website.

Evaluation meetings

These meetings focus on evaluating the outcomes and impact of the actions tried out in the research lessons. The data collected during and after the research lessons, e.g. through videos, surveys, interviews and examples of students' work, is discussed and related to the teacher researchers' own reflections on the lesson. The evaluation of the actions should be related back to the research questions and used to inform subsequent review and planning meetings.

The programme of meetings from the VMP research project (along with the research lessons, surveys and interviews) is shown in the Appendix. Most of the meetings were approximately one hour in length and held in the teacher researchers' school. Some of the meetings (research team meetings 8, 11 and 15) were approximately three hours in length and these were made possible due to the school releasing the teacher researchers for half a day to travel to the university.

Data collection and evaluation tools

Using a variety of different data collection tools provides a range of complementary forms of evidence that can be used to evaluate the impact of the actions and generate insight in relation to the research questions. Involving the teacher researchers in designing and administering the data collection tools, particularly the surveys and interviews, can enhance the trustworthiness of the research findings. By drawing on their in-depth knowledge of their students, the teacher researchers are best placed to choose the most appropriate questions, and forms of language, that will enable their students to articulate clearly their thoughts and experiences. Relationships of mutual trust and rapport that have already been established between teachers and students helps students to feel more comfortable, and less anxious, about answering questions openly. The increased likelihood of students sharing their thoughts and experiences with their teachers outweighs the possibility that they will say what they think their teachers want to hear (although the researchers should consider carefully how to mitigate against the latter, e.g. by triangulating data).

Research journals

Keeping a research journal is a potentially powerful strategy for researchers to capture their thoughts and experiences relating to the research project. The research journals can be used to record immediate responses to, and reflections on, the research lessons, as well as details of any other thoughts, events or conversations considered to be significant and relevant to the research project. The research journals are valuable in helping researchers recall their thoughts and experiences, which can be used to stimulate discussion during research team meetings, evaluate the actions tried out and disseminate the findings from the project.

Student surveys

Student surveys are particularly useful for evaluating the impact of the project on all students participating in the research. They might be administered immediately after a research lesson, to evaluate students' immediate responses to the actions tried out, or before and after one or more action research cycles, to evaluate developments in students' thinking over an extended period.

The following questions were included in the student survey, which was administered twice during the VMP research project, i.e. at the beginning of cycle 3 and at the end of cycle 4:

- *'How successful do you think you are in maths in general?' [on a scale of 1 to 5].*
- *'How do you know?'*
- *'What do you think you can do to be more successful in maths?'*
- *'What does your teacher do to help you to be successful in maths?'*

These questions relate to the first research question (see page 2): the first three questions are designed to assess students' appreciation of the 'realisation rules', whilst the fourth question aims to explore their awareness of the strategies used by the teacher to help them develop this appreciation.

Student interviews

Interviews are particularly useful for evaluating the impact of the project on individual students and should be carried out as soon as possible after the research lessons. Since they are more time-consuming than surveys, a limited number of target students should be selected for interviews, giving careful consideration to the research questions. Semi-structured interviews are usually most appropriate, in which a series of questions are decided in advance to prompt discussion and then

follow-up questions, e.g. "That's interesting, can you tell me more?", are used to encourage interviewees to expand on their responses.

The same three students from each class were interviewed during cycles 3 and 4 of the VMP research project. Since the researchers were particularly interested in the impact of the strategies on students from disadvantaged backgrounds (see the second research question on page 2), it was decided to select these students from those designated as 'pupil premium' [a category dependent on qualifying for free school meals due to parents' low income]. The following questions were used as initial questions to prompt discussion in the interviews carried out shortly after the third research lesson:

- *'Did you enjoy today's/yesterday's lesson? Why?'*
- *'Did you notice anything different about today's/yesterday's lesson?'*
- *'Why do you think I got the class to come up with a model solution to the first problem?'*
- *'Why do you think I asked you to copy down the model solution and use it to solve the other problems?'*

The first question above relates to 'engagement' referred to in the second research question, whilst the other questions are designed to assess students' appreciation of the 'recognition rules' referred to in the first research question. The use of a 'model solution' was one of the strategies tried out.

Peer observation

Peer observation enables researchers to develop a feel for each other's classroom context, so that they can make more sense of the responses of students to the research lessons. Peer observers should focus on noticing elements of the lesson that relate directly to the research questions and avoid making judgements about other aspects of teaching. The role of the peer observer can be instrumental in facilitating video-stimulated reflection (see below).

In the VMP research project, the first research lesson was peer-observed by the research facilitator, whilst the remaining three research lessons were peer-observed by the two teacher researchers.

Audio recording meetings

It is useful to audio record the research team meetings to allow the research facilitator to engage fully in discussions, whilst enabling her/him to summarise the key decisions, agreed outcomes and action points after the meeting. It can also be useful to audio record selected parts of meetings to generate and capture data that is valuable in evaluating the actions tried out during the project.

All research team meetings held during the VMP research project were audio recorded and used to produce summary notes from meetings. Transcripts of selected parts of the meetings were also used to evaluate the research design and processes, in the development and refinement of this model.

Other data collection tools

There are other data that it might be useful to collect in evaluating the actions tried out during the research lessons, e.g. examples of students' work and video recording lessons (see next section).

During cycles 3 and 4 of the VMP research project, a card sort activity was used as a strategy to prompt discussion of the reasons why students thought their teacher adopted specific teaching approaches. Groups of students were asked to agree how to arrange a series of statements in order of importance. Photos were taken of each group's arrangement of the statements to facilitate discussion amongst the research team during the evaluation of the strategy.

Video-stimulated reflection (VSR)

A video recording can present an alternative view of the research lesson from the perspective of a student. It therefore stimulates reflection that goes beyond merely what the teacher can recall. For this reason, it is more appropriate to refer to the process described below as video-stimulated 'reflection', rather than video-stimulated 'recall' (as it is commonly referred to in the literature).

Videoing lessons

Video recording a lesson provides a powerful tool for evaluating the actions to be tried out:

- Placing a single video camera at the back of the classroom provides an alternative view of the research lesson from the perspective of the students.
- Setting the video camera up in lessons prior to the research lesson helps students become comfortable with its presence. They will then be less likely to behave differently as a result.
- Having a colleague (peer observer) to start and stop the video camera ensures that nothing is missed and is less likely to draw the attention of students to the camera.
- Recording the whole research lesson allows a choice to be made later about which extract(s) from the lesson to focus on during reflective discussions.
- It helps to facilitate post-lesson discussions if the colleague uses a timer, synchronised with the timer on the video recording, to generate a timeline by writing down key events (i.e. those relevant to the research question) and the times they occurred during the lesson.
- It is important that the teacher researchers retain ownership and control of the video recordings. This helps to make the distinction clear between research lessons, in which they need to feel confident to try out new strategies, and observations related to performance management, in which they may feel under pressure to avoid taking risks.
- The video recording needs to be carried out in accordance with the school's child protection and data protection policies. However, since the videos are not treated as research data, there is usually no need to obtain informed consent. Students should be given prior warning that the lesson will be video recorded and the reason for doing so should be explained.

Protocols for VSR

The protocols for using the videos to stimulate critical reflection are intended to provide focus, whilst maintaining flexibility, during the post-lesson discussions. The following protocols *(developed and used by the VMP research project)* are suggested to prompt VSR involving the research facilitator and two teacher researchers who have peer-observed each other's research lesson:

- The VSR discussion should take place relatively soon after the research lessons, e.g. within approximately one week, whilst it is fresh in the minds of both teacher researchers so that the video stimulates recall of the lesson.
- Each teacher researcher views both research lessons independently before the VSR discussion and chooses one short clip (2 to 3 minutes in length) from each research lesson that is considered relevant to the research question (i.e. altogether four clips are selected).
- During the VSR discussion, each teacher researcher explains the reason why they chose the clip from the first research lesson. All three researchers then watch each clip in turn and discuss the extent to which it provides insight in addressing the research question.
- The timeline is useful for providing a context for the video clips and for locating other parts of the lesson which the researchers feel might be useful to view to inform discussions.

- The research facilitator chairs the discussion, which begins with a 'descriptive phase', in which researchers stick to a factual discussion of what happened during the lesson, before moving on to an 'evaluative phase', in which researchers discuss what can be inferred from this evidence in relation to the research questions.
- Researchers may choose to draw on other evidence available to them, e.g. from surveys and interviews, in informing their discussion.
- The research facilitator should ensure the discussion remains focused on addressing the research questions and aim to prompt critical reflection by questioning the extent to which inferences are backed up by the evidence (from the video clips, research literature, etc.).
- The discussions prompted by the video clips during VSR may be audio recorded and used as data to be analysed. However, any voices from the video clips captured on the audio recordings should not be treated as data.

Data analysis

Transcribing survey responses and dialogue from interviews is time-consuming but worthwhile in terms of facilitating an analysis of the data. The relatively large number of responses from surveys can be analysed by reading them through several times and identifying different categories into which they might fall. Grouping the responses according to these categories, and then considering the number of responses falling into each group, can help to draw out themes and meaning from the data. It is more appropriate to analyse the transcripts of interviews by associating categories or codes (identified by an initial reading) with extracts of text. This can be done by using software designed specifically for this purpose (e.g. NVivo) or, more simply, by colour coding (using highlighters) or using spreadsheets (which makes it easier to sort the text according to the codes). Themes and meaning can be drawn out from the data by reviewing extracts of text sharing the same code, comparing these with other codes and by looking for similarities and differences.

It is likely that the research facilitator, because of her/his previous experience in conducting research projects, will take the lead in analysing the data that has been collected. Wherever possible, and time permitting, s/he should involve the teacher researchers in this data analysis, at the very least by sharing and discussing the analytical methods used and presenting back initial findings from the analysis for further comment and consideration of their reliability.

Much of the data analysis for the VMP research project was carried out by the research facilitator, with the initial findings presented back to the teacher researchers during research team meetings.

Dissemination of findings

In presenting the research findings, it is important to provide detailed descriptions of the project's background, aims, context, design and methods employed. These need to be comprehensive enough to allow the readers to judge for themselves the extent to which the findings are transferable to their own situations and to build on the ideas in developing their own practice. Wherever possible the findings should be disseminated jointly by the teacher researchers and research facilitator.

The findings of the VMP research project were disseminated jointly by all three researchers:

- *Articles were co-authored and published in several professional and academic journals;*
- *Joint presentations were made at various conferences, seminars and events;*
- *Regular blogs and detailed reports at the end of the first and second years were published on the research project's designated website:* https://visiblemathspedagogy.wordpress.com/

Appendix: Timetable and structure for the VMP research project

Dates	Structure of action research cycles
1st/29th November 2017	**Two initial research team meetings** focused on: clarifying aims of the project, generating research questions, agreeing research design and overall structure; presenting and discussing relevant research literature; reviewing existing practice.
January 2018	**Beginning of action research cycle 1**
16th January	**Research team meeting 1** focused on: planning the first research lessons; negotiating strategies (actions) to try out; agreeing survey questions.
31st January	First research lessons (both peer-observed and video-recorded).
31st January	Student surveys (administered immediately after the research lessons)
7th February	**Research team meetings 2 and 3** focused on: evaluating strategies (actions); reviewing survey responses; video-stimulated reflection.
20th March	**Research team meeting 4** focused on: overall evaluation of cycle 1; relating evaluation back to the research questions; reviewing classroom practice.
May 2018	**Beginning of action research cycle 2**
9th May	**Research team meeting 5** focused on: planning the second research lessons; negotiating strategies (actions) to try out; agreeing survey questions; identifying target students to interview and agreeing interview questions.
16th May	Second research lessons (both peer-observed and video-recorded).
17th/18th May	Interviews conducted with 3 target students in each class (after research lessons).
13th June	**Research team meeting 6** focused on: evaluating strategies (actions); reviewing interview responses; video-stimulated reflection.
2nd July	**Research team meeting 7** focused on: overall evaluation of cycle 2; relating evaluation back to the research questions; reviewing classroom practice.
November 2018	**Beginning of action research cycle 3**
8th November	**Research team meeting 8** focused on: presenting and discussing research literature relating to VSR; developing VSR protocols; refining the research design; reviewing data analysis and initial findings from cycles 1 and 2.
5th December	**Research team meeting 9** focused on: planning the third research lessons; negotiating strategies (actions) to try out; agreeing timings of surveys and interviews, and questions to be asked.
9th December	Student surveys (administered before the third research lessons)
11th/12th December	Third research lessons (both peer-observed and video-recorded).
12th–14th December	Interviews conducted with 3 target students in each class (after research lessons).
16th January 2019	**Research team meeting 10** focused on: evaluating strategies (actions); reviewing survey and interview responses; video-stimulated reflection.
11th March	**Research team meeting 11** focused on: relating evaluation back to research questions; presenting and discussing research literature relating to critical reflection; reviewing and refining research design; reviewing classroom practice.
March 2019	**Beginning of action research cycle 4**
20th March	**Research team meeting 12** focused on: planning the fourth research lessons; negotiating strategies (actions) to try out; agreeing timings of interviews and surveys, and questions to be asked.
26th/27th March	Fourth research lessons (both peer-observed and video-recorded).
27th – 29th March	Interviews conducted with 3 target students in each class (after research lessons).
3rd April	**Research team meeting 13** focused on: evaluating strategies (actions); reviewing survey and interview responses; video-stimulated reflection.
4th April	Student surveys (administered after the fourth research lessons)
1st May	**Research team meeting 14** focused on: relating evaluation back to the research questions; reviewing classroom practice; reflecting on the data collection tools and research methods employed.
8th July	**Research team meeting 15** focused on: reflecting on the project as a whole; planning how to disseminate findings through publications and presentations at events.