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A Centre for Higher Education Research, Innovation and Learning Project.

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Abstract

'Across the Divide' is a cross-faculty initiative that questions how Manchester University's (UoM) Science, Technology, Engineering and Mathematics (STEM) practice and pedagogy are aligned with current primary and secondary school provision. It engages academics, teachers and students in knowledge exchange through discussion about STEM teaching and learning through focus groups and study visits, ultimately producing a documentary film and report. By identifying similarities and differences between Higher Education (HE) and school provision it considers implications for academic teaching and learning and student transition, critically reflecting on pedagogy across the divides of primary, secondary and HE.

Introduction

'*Across the Divide*' aims to promote dialogue about STEM practice and pedagogy between University academics and primary and secondary teachers. Since the launch of SEERIH in January 2014 there have been a wide range of curriculum development and teacher professional development projects which have brought HE academics, postgraduate students together with teachers in knowledge exchange activity. To date, the learning experience from SEERIH projects has focused mainly on the school teachers. University representatives have expressed interest and noted their heightened awareness of the school system which has led to enhanced recognition of the pace of change and development in the teaching of STEM subjects in schools. Colleagues in the Schools of Electronic and Electrical Engineering Mechanical, Aerospace and Civil Engineering and Computer Science expressed a keen interest to develop further awareness of school-based practice and pedagogy in order to inform debate around whether undergraduate courses require refinement and/or enhancement to better appreciate the experiences of students joining the University, and how the change in practices can be best supported (an approach undertaken by MIE in the www.transmaths.org project).

Over the past 12 months SEERIH has run a range of projects focused on teacher-scientist/engineer collaboration. In this SEERIH will actively promote the engagement and dialogue of UoM academics with teachers through activities such as (i) a 2/3 day Immersion Event in which participants cocreate lesson experiences for Key Stage 2, 3 and 4 pupils, (ii) academics visiting primary and secondary schools to coteach (see Murphy et al., 2014), and (iii) visits to the University by teachers. All of these provide ideal opportunities for UoM staff to see at first hand leading practice in schools across Greater Manchester and for teachers to gain a sense of University taught courses in this subject area. We have utilised this SEERIH project as rich source of data, from which critical evaluation of practice in schools can be compared to that taking place at HE level. The intended outcome was to identify the similarities and differences between Higher Education (HE) and school provision, allowing consideration about potential implications for academic teaching and learning and student transition, critically reflecting on pedagogy across the divides of primary, secondary and HE.

Research question: How can university-school partnerships influence university academics' pedagogic practice?

Aims

- To broker learning opportunities between leading secondary and primary schools and the University (drawing on SEERIH networks with Teaching School Alliances, UTCs and school clusters);
- to engage academics, teachers and stakeholders in opportunities for knowledge exchange and discussion about STEM practice, pedagogy and philosophy, through focus groups, study visits and film making;
- to identify the similarities and differences between HE and school STEM provision, exploring the implications to student transition and academic teaching and learning;
- to stimulate critical reflection within the University and school settings about the fitness for purpose of STEM;
- courses and delivery for 21st century learners.

Data collection and analysis

Sampling

The project has been planned over data collection and analysis phases. Phase 1 involved getting an account of the perceptions of the academics and teachers of teaching in their individual and each other's settings:

- 5 academics and 5 teachers were interviewed (ref. pre-interview schedule – Appendix 1). These interviews were audio recorded.

Phase 2 data collection process can be summarised as follows:

- A full day workshop (STEM study day) for the 5 academics and 5 teachers to attend a school/college that has a different style/focus of teaching. The participants were shadowed by the research associate. Critical moments were recorded on the observation schedule. The day was also video-recorded and a short edited video can be obtained from the following link: <https://www.youtube.com/watch?v=-lt8zRSQnqI>.
- Two teachers and one academic were observed during their visits to the partner setting by the research associate. The dialogue was audio-recorded and video-recorded for the purpose of making a film.
- All participants (including the 5 teachers, 5 academics, Dr Lynne Bianchi [Director of SEERIH] and Principal Investigator for the project [Peter Green] and Research Associate [Dr Sophina Choudry]) were asked to complete short evaluation questionnaires immediately after their partnership visits (ref. evaluation questionnaires - Appendix 2).

Similarly, phase 3 activities were as follows:

- Focus group evaluation meeting (2 hours max) for all participants to reflect on their experiences (ref. focus group schedule - Appendix 3).
- Post-placement interview (max. 30 mins.) with two 'interesting' cases (one teacher and one academic) to explore deeper understanding of the project (ref. post interview schedule - Appendix 4).

Data Analysis

The project has been designed to allow participants to critically reflect upon their experiences throughout the various planned activities, partly by identifying and keeping a log of critical moments or observations (see Brookfield, 1995). We have understood and applied critical moments as an observation (or a series of observations) that provoke reflective thinking in the participants.

The most distinctive of these very good teachers is that their practice is the result of careful reflection . . . They themselves learn lessons each time they teach, evaluating what they do and using these self-critical evaluations to adjust what they do next time. (Ofsted, 2004, p. 10)

As such the findings from the observations, interviews and focus group analysis can be classified as an emergent phenomenon, which develops further as the participants continue to probe their own reflections.

The pre-placement interviews have been analysed using thematic analysis (see Aronson, 1995) through the software NVivo. The emergent themes have been used as an object of critical reflection during the focus group meeting (post-placement) in order to stimulate further discussion. Furthermore, one partnership visit to a University and a school and the immersion day event were also observed by the research associate (first author). Finally, two participants (one academic and one teacher) were interviewed post observations to unpack the reasons of why certain recommendations/reflections were made by them during this process.

Findings

Emerging Themes from pre-project interviews

The pre-placement interview was semi-structured around 8 questions (see appendix 1 for a full list of interview questions). As such the analysis focused on identifying themes within each of the these topics:

- Strengths and Expertise
- Develop or change
- Barriers and challenges
- Philosophy of teaching
- Support
- Perception of STEM teaching – primary school
- Perception of STEM teaching – university
- Project expectations

The full summary of results is displayed in table 1.

Table 1 - Across the Divide – Emerging themes (Pre-placement interviews)

	Strengths or Expertise	Develop or Change	Support	Barriers or Challenges	Teaching Philosophy	Teaching Perception of STEM - PS	Teaching Perception of STEM – Uni.	Project Expectations
University Academics	Industry links (2)	Curricular links with schools (2) Develop teaching philosophy (2) Manage student expectations (2)	Community links/network (3) Resources (2)	Facility - physical space (7) Like-minded staff (2) Module Feedback (4) Student expectations (2)	Flipped classroom (4) Fun environment (3)	Dynamic spaces (2) Teaching to exam (2)	Lecture based (2)	Develop network (2) Pedagogy/Knowledge exchange/Ideas (4)
Teachers	Group Work (2)	Transition practices- from primary to secondary (3)	Community links/network (2)	Teach to exam (4) Time (5)	Skill focussed (2)		No experience (2)	Develop network (2) Pedagogy/Knowledge exchange/Ideas (5)

Table 1 shows that physical space limitations perceived to be a significant barrier for University staff in terms teaching in the way that they wished to do so. There were a total of 7 responses that mentioned this barrier. On the other hand for secondary school science teachers, time and teaching to exams was thought to be a dominant constraint in the pre-interviews (with 5 and 4 responses respectively). Both teachers and academics expected to exchange pedagogic knowledge and ideas by visiting each other's teaching practices.

Immersion Day

The JCB Academy visit further challenged the academics' and teachers' understanding of their own pedagogical practices.

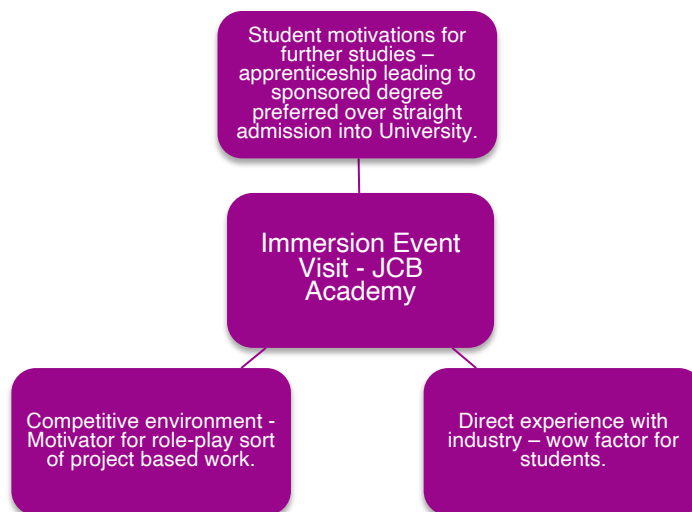


Figure 1 – Immersion Day Event

The project film (ref, <https://www.youtube.com/watch?v=-lt8zRSQnqI>), identifies the issues raised by University academics which included a sense that the pace of change related to pedagogical practices within the University wasn't in line with the 'changing technology' advances, e.g. in use of digital devices, software etc., that there seemed to be limited 'know-how' of the current primary/secondary school pedagogic practices and students' 'learning styles'. Specifically during the Immersion event, the participants learned about the JCB Academy's partnership with industry and the impact this has on students' engineering learning experiences and aspirations at secondary school level. The participants also reflected on the importance of making explicit within teaching and learning opportunities the range of mindsets or 'habits of mind' related to thinking skills and engineering in secondary schools (i.e. beyond primary schools). In summary, the visit itself served as an object for reflection on various levels depending on the participants own background and motive of participations.

Focus Group Reflections

The impacts of the partnership visits on the academics and teachers were diverse depending how the visit was planned and conducted. One of the major constraints was that teaching at University ended very soon after the placements commenced, which meant that not all teachers had the opportunity to observe and take part in teaching activities. However visits and observations of teaching spaces bridged the issue. At the end of the placements, participants were asked to attend a focus group to evaluate and reflect upon their experiences. The group was posed the following open-ended questions:

1. **Identify:** what were the notable differences in pedagogic practice between the two settings?

2. **Clarify:** what was the impact on pupil/student learning that resulted from the approaches you identified?
3. **Extend:** how can your own practice be enhanced as a result of seeing this practice in another setting?

Table 2 represents the comparisons with suggested implications for teaching practice, which were drawn by each of the participating groups (i.e. academics and school teachers) together in the focus group.

Table 2 – Focus Group Reflections

Identify: notable differences in pedagogic practice	Clarify: impact on pupil/student learning from the approaches	Extend: resulting impact on one's own practice
Students in schools are able to raise their own questions, asking and raising their own questions. However in university they don't often want to answer, yet alone an explanation.	The experience allows everyone to take part and not only the top or bottom 5%.	Encourage students as teams to share ideas and encourage them to do so with their peers.
At school there is more reliance on standards and curriculum but at university the course leader develops their own curriculum. The academics make up their own unit objectives and there are no learning objectives in the structure of university teaching.	Moderation is purely based on student feedback. How do you know that the students have learned what you intended them to learn?	Structured teaching support for academics to input some kind of framework in their teaching schemes.
Knowing children and pupils by their first names. The notion that teachers at primary and secondary schools had a firm understanding of knowing their pupils. At university felt that everyone anonymous	Not knowing names possibly has implication on students' motivation to learning, as they do not feel as pressured or accountable to achieve.	Academics felt that keeping tutorials in smaller groups over a sustained amount of time would be of benefit (even in labs and lectures. Keeping the same group and smaller group tutorial over a period of time. Building questions into the teaching opportunities were questions are embraced.

One particular partnership has been reviewed in more detail in order to provide an example for a typical visit structure that took place with most of the partnerships. This example has also been chosen as the academic makes key contributions that are also echoed by other participants.

Other participants also noted that they would have liked to provide teachers with the opportunities 'to observe the different teaching and learning activities in action (lectures, workshops and small group tutorials) as well as teaching labs, and speak to a few more people who are involved with these (the Director of Teaching and Learning, other academics involved in teaching, and most importantly more of our student cohort)'.

Table 3 - Example Partnership Visits – Academic reflections

Visit to University		Visit to a Secondary School	
<p>What happened? A secondary school Head of Science Department visited a Senior Lecturer in the School of Electrical and Electronic Engineering) to observe a series of activities including: (i) a tour of School of Engineering and Physical Sciences, (ii) observe a tutorial group, (iii) observe a mathematics lecture; and (iv) show the High Voltage laboratory.</p>		<p>What happened? A Senior Lecturer in the School of Electrical and Electronic Engineering) visited a secondary school took part in the following activities: (i) a conversation with the school career advisor, (ii) observation of a Chemistry lesson, and (iii) observation of two Mathematics lessons.</p>	
Planned Outcomes	Critical Reflections	What's different?	Recommendations
<p>Show and tell - 'Show and talk to the visitor about what we do'.</p>	<p>More focus on learning was needed: 'show less and create more opportunities to observe teaching and learning'.</p>	<p>Learning objectives for each of the lessons with clear indication for students' progress were evident in all lessons.</p>	<p>There was interest for the University to try and get some standardization of learning outcomes.</p>
	<p>For the visit to make the best sense to the teacher it was useful to show fewer and more specific learning activities.</p>	<p>There were active moderation procedures for exams. Summative and formative assessments.</p>	<p>Peer lecturers set exams based on units.</p>
	<p>The lecturer was found to be more critical than usual towards University teaching and learning practices, because '[the teacher] asked questions like how much of the lab activities are prescribed?'</p>	<p>In schools there was a greater personalised learning experience for students as teachers were knowledgeable of their names and were able to plan and negotiate learning for each of the students as much as possible.</p>	<p>Interest to keep personal tutorials over sustained periods of times.</p>
		<p>Authority in secondary schools – this relates to the students achievement being notably accountable to teachers.</p>	

Other key critical reflections included:

- **Pedagogical development through reflection** - 'Greater reflective practice is required – how can I utilise 'active reflection' in classes that teach and how can we teach students to use active reflection?' (Academic)
- **Flexible approaches in Higher Education teaching** - 'How can we enable students to be more flexible in the learning approaches they use to solve problems? Can active reflection be one of these learning tools?' (Academic)
- **Common HE teaching framework** – 'The Director of Teaching and Learning need to look at teaching staff within and across schools. Diversity is good, but as academics they do not know what their colleagues are doing.' (Academic)

- **Transitional support** - 'We owe them transition. They are climbing up a mountain and we should support that.' (Academic)
- **Small tutorial groups** - 'As a result of this project, I would keep them [students] in small tutorial groups. Trying to perpetuate those groups beyond the tutorials into the lecture groups. I hope we will be able to encourage them as teams and groups to develop so that they will be more confident to answer and ask questions. Opportunity for them to interrupt'. (Academic)

Post-placement interviews

The post placement interviews do not only reinforce the above mentioned emergent themes, but both made clear recommendations as to how each of the critical observation moments could lead to their pedagogical development with implication to students' learning.

Table 4 – Post Placement Interviews

	(Academic)	(Primary School Teacher)
Critical moments	Small group studies – school is a personal environment and much more personal than HE: → Further re-emphasizes to keep small tutorial groups going in HE.	Immersion event - Real life context and how to make it more relevant to young children: → To motivate students with real world context.
	National curriculum standards and learning objectives: → No summative assessments of learning competencies in HE. → Balance between standardisation and freedom required in HE.	
	Moderation and setting off exams in HE: → Lecturer writes the exams based on the unit he or she teaches. → Peer moderation suggested as a solution, i.e. for peer lecturers to write the exam and lecturer to moderate it.	
	Transitional issues and linkage with schools: → Differences in pedagogical practices that focus on answers more than methods. → Provide teachers with active examples to → To allow schools to attend University Open Days to open up the Pandora Box of what the different courses are and what they entail.	Informative practices for teachers as well as academics: → Academics can also benefit by visiting schools more frequently to inform their own teaching practice.
	Learning outcomes: → Evaluating unit learning outcomes and consideration of standards.	To create links with the industry: → To create links with small businesses. → To create links with and involve young children with the University to motivate them in their learning.
	Contacting Director of Teaching and Learning in every school: → To feedback the findings of this study back to the Director of Teaching and Learning in each school. → To insist on standardization of learning outcomes.	For SLT to provide space and opportunities for professional development: → For schools to recognise the value in such practices.

	→ To insist on keeping small group tutorials.	
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Conclusion

In summary, we can draw key conclusions from the findings above in relation to the project question: How can university-school partnerships influence university academics' pedagogic practice?

To begin with the academics and school teachers expected to exchange pedagogic knowledge and ideas that could enhance each other's teaching and learning practices in their respective settings (see emergent themes from pre-placement interviews). Whereas the teachers highlighted the time constraints and pressure such as accountability measures to develop their practice in the way that they would wish to, academics referred predominantly to physical barriers such as facilities, etc.

However as the partnership visits were undertaken, the various research activities prompted them to reflect upon their own practice. Further differences between the pedagogical structures of schooling at primary/secondary level and University teaching emerged with recommendations on how exchange of pedagogical knowledge, ideas or some linkages between the settings could be made to enhance students' learning experiences.

What did we learn from the project?

How can university-school partnerships influence university academics' pedagogic practice?

1) In order for any partnership visits between teachers and academics to transgress beyond 'show and tell', we need a series of carefully thought out activities that demonstrate teaching and learning with careful reflection on how the participants will collaborate with each other.

2) The university serves a multitude of purposes in an 'across the divide' placement scheme: (i) it allows brokerage of transitional practices, and (ii) it is also a hub of many research practices, projects, activities, and role model scientists that if these are linked to the school curriculum or, generally, school's teaching and learning practices can potentially enrich students' learning experiences. Especially with science being such a vast and sometimes abstract environment, such linkages could develop meaningfulness and engagement with the wider community for students.

3) In terms of pedagogical development, there are 'take aways' for both academics and teachers (for those who took part in the project). In a crude sense, academics are envisaged to be specialist in their research areas but not necessarily in teaching and learning practices. At the same time they have to derive overall course outcomes, set exams, moderate them, etc. and think of ways to enrich students' learning experiences in meaningful ways. Teachers at the same time face the same dilemma in a reversed order. Their focus is on developing innovative teaching and learning practices to enrich (for example) the students' science learning. However, the difficulty for the teachers interviewed in this project lies in dealing with conflicting pressures such as accountability measures that sometimes lead to 'teaching to the exam' practices, time constraints and the willingness of a leadership team to allow space for such activities which do not necessarily immediately feed back into exam success. Hence, collaborative practices in a true sense (see Murphy et al., 2014 - for a model of collaborative practices in terms of participating, co-teaching and co-creating) could not only lead to the pedagogical development of academics (see Harrison et al., 2011) but also teachers through a continued partnership and brokerage between the two settings.

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Toby Tyler, Great Moor Infant School/Primary Teacher Fellow

Andrew Weightman, School of MACE

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Appendix 1 - Pre Interview Schedule

Core open-ended questions

1. Can you briefly describe your role and experience in the teaching STEM or Science?
2. What are the strengths or expertise you have in teaching STEM or Science?
3. What are the areas of your teaching that you wish to develop/change?
4. Would you say you align with a particular framework, philosophy or theory when you teach – e.g. problem-based, constructivist, behaviourist, content focused, skills focused etc.
5. What would you say are the things that support you to teach in the way you wish to?
6. What would you say are the things that create challenges or barriers to teaching in the way you wish to?
7. What is your perception of how STEM is being taught at university/school primary setting?
Any previous experience?
8. What do you expect to take back from being involved in this project?

Appendix 2 - Evaluation Questionnaires

Host Reflection

You are advised to complete this as soon as possible after the visit

Name: _____ School/Department: _____

Please

I am a primary teacher secondary teacher academic

Brief outline agenda for the visit

What did you want the visitor to gain from the experience?

What are your overall reflections on the visit?

How could you make the experience even better if you were to host another visit?

What were the critical moments during the visit or during your dialogue with your partner. Consider the critical moments with regard to your shared observations or learning about teaching methods in a different setting. *(please continue overleaf)*

Visitor Reflection

You are advised to complete this as soon as possible after the visit

Name: _____ School/Department: _____

Please

I am a primary teacher secondary teacher academic

1. Brief outline of what you did on your visit

2. How would you best describe your role when you visited your partner setting?

A. Participator (i.e. you took part)

B. Collaborator (i.e. you suggested/requested what the visit might include)

C. Co-creator (i.e. you actively designed the visit to suit your interests and that of your host)

3.	Consider the teaching and learning approaches, settings or opportunities you observed. (e.g. facilities and resources, number of students being taught, teaching methods, teacher or student led learning, assessment practices, feedback, marking etc.)
A. What was similar?	
B. What was different?	
C. What was surprising or interesting?	

4. What **two** things can you identify in the practice of your partner that you feel you can **most** learn from?

5. From your experience, what could have made this learning experience even better for the students/pupils?

6. In summary, outline the critical moments that reside with you after the visit. What have you gained from this experience?

Appendix 3 - Post Evaluation Focus Group Schedule

1. What happened?
2. What's similar?
3. What's different?
4. What are the opportunities that they could transfer in their own practice?

Appendix 4 - Post Interview Schedule

Focus: Reflect on their experience with key focus on critical moments

Step 1. Ask to identify and reflect on critical moments (highlights):

Why do you think this is critical?

Step 2. Point towards critical moments observed by researcher.

In your questionnaire/during observations you mentioned...could you elaborate?

Step 3. Focus on professional development.

How *could* this experience impact your pedagogical practices in your own teaching in your own setting?

Step 4. Consider the implications

What are the 'things' that will support or hinder you in developing your own professional practice in this way?

What role do you think the University or your school leadership team have in influencing this change?