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Science & Engineering Education Research and Innovation Hub

Across the Divide – Research Report

Dr Lynne Bianchi, Peter Green and Dr Sophina Choudry (Science & Engineering Education Research and Innovation Hub, Faculty of Science & Engineering)

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Project Coordinators: Dr Lynne Bianchi (SEERIH) and Peter Green (School of Electrical, Electronic Engineering), The University of Manchester

Executive Summary

'Across the Divide' was a cross-faculty project designed to question how University - primary/secondary school partnerships can influence academics' pedagogic practice in Science, Technology, Engineering and Mathematics (STEM). It is offered at time of when schools and academic institutions are being encouraged to review and reflect on the quality of teaching and professional development, in line with the Teaching Excellence Framework consultation (2016) and the Standards for Professional Development (Department for Education, 2016). This paper reports on the engagement of a group of academics, primary and secondary teachers who through a collaborative activity over the course of 9 months, focused on critical reflection and discussion about STEM teaching and learning in their respective settings. Participatory research activity scaffolded reflection-in and -on action (Schon, 1983), and a documentary film of project experiences and dialogue was produced. By identifying similarities and differences between Higher Education (HE) and school provision the project stimulates improvements around the use of learning outcomes, small group/tutorial work, examination design and collaborative professional development which have implications on the enhancement of student experience, feedback and transition.

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

A. Rationale

Transitioning students from the pedagogic practices of school to HE is a long-standing challenge for Universities. Knowledge of mainstream primary and secondary school pedagogic practice presents HE with opportunity to understand current teaching and learning practices in schools and to harness this knowledge to stimulate innovation within HE pedagogic practice to support the process of transition for the student.

B. Introduction

'***Across the Divide'*** prompted collaboration between academics and primary and secondary teachers. The joint exploration focused on teaching and learning experiences and approaches towards STEM in their respective settings. Emphasis was placed on how academics and teachers can have agency and control in their professional development, driving towards pedagogical reform and refinement.

'Across the Divide' aimed to empower educators to reflect on and discuss practice and pedagogy in a bid to prompt and scaffold reflection-on-practice (Schon, 1983). The project's aims were to:

- broker learning opportunities between leading secondary and primary schools and the University
- 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;
- identify the similarities and differences between HE and school STEM provision, exploring the implications to student transition and academic teaching and learning.

C. Methodology

Participant group: 5 academics from the Faculty of Science & Engineering and 5 teachers (3 primary and 2 secondary)

There were three phases to the project with data analysis running concurrently, as outlined in Figure 1.

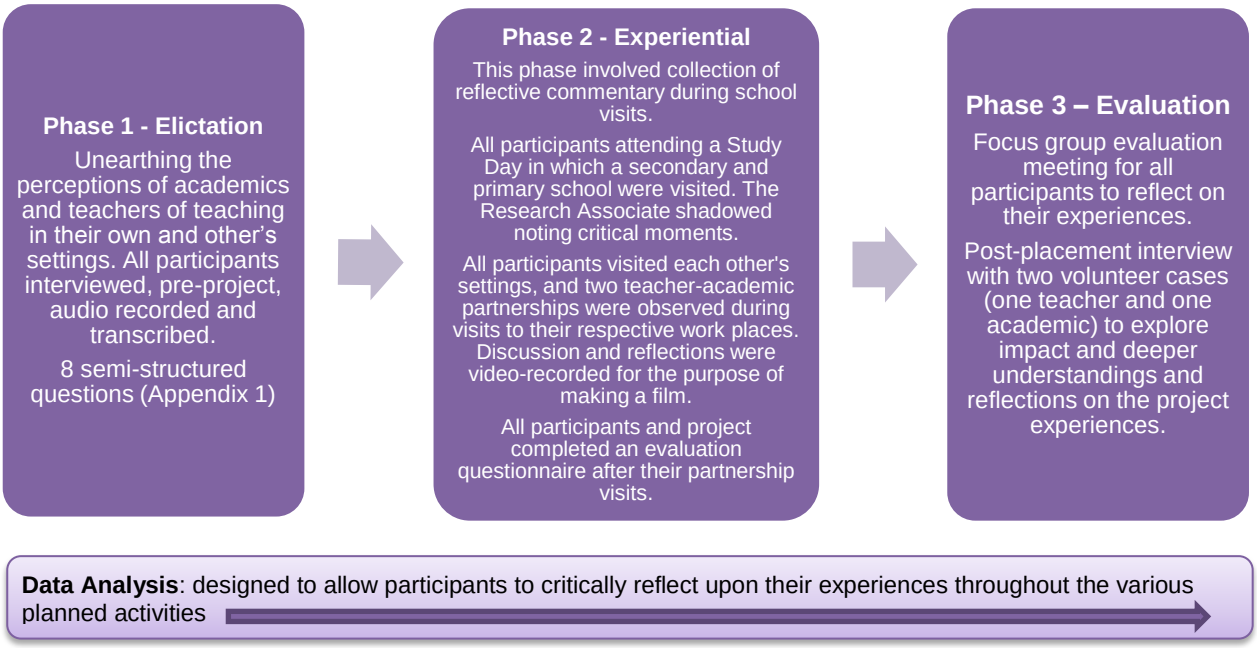

Figure 1: Project Phases

Project facilitators and the Research Associate encouraged critical reflection on experiences throughout the project activities. Thematic analysis (Aronson, 1995) was undertaken to identify emergent themes and used as objects of critical reflection during focus groups in order to further interrogate and understanding the project findings.

D. Activity & Emergent Findings

This section focuses on the three phases of project activity (ref. Figure 1) with commentary around the findings from each phase.

Phase 1: The Elicitation Phase

The questions asked at the pre-intervention stage are listed in Appendix 1. Findings are shown in Table 1, where the numerical score alongside each outcome provides an indication of number of responses per theme.

	University Academics	Teachers
Strengths or Expertise	Industry links (2)	Group Work (2)
Develop or Change	Develop - curricular links with schools (2) Develop - teaching philosophy (2) Change - manage student expectations (2)	Develop - Transition practices from primary to secondary (3)
Teaching Philosophy	Flipped classroom (4) Fun environment (3)	Skill focussed (2)
What supports your teaching approach	Community links/networks (3) Resources (2)	Community links/networks (2)
Barriers or Challenges	Facility - physical space (7) Identifying like-minded staff (2) Module feedback (4) Student expectations (2)	Teach to exam (4) Time (5)
Teaching Perception of STEM teaching in schools	Dynamic spaces (2) Teaching to exam (2)	
Teaching Perception of STEM teaching in University	Lecture based (2)	No experience (2)
Personal project expectations	To develop existing networks (2) To engage in pedagogical reflection/ Knowledge exchange/Ideas (4)	To develop existing networks (2) To engage in pedagogical reflection/Knowledge exchange/Ideas (5)

Table 1: Phase 1 Interview Findings

Notable from this data is that physical space was perceived as a limitation for University staff in terms teaching in the way that they wished to do so. In contrast, for secondary school science teachers, time and teaching to exams was thought to be a dominant constraint.

Phase 2: The Experiential Phase

<u>Part 1: The Study Day</u>

Visit to a University Technology College (Engineering and Business), and a primary school were illustrative of schools whose curriculum was STEM focused. Visits were designed to provide a collaborative experience that was new to all participants.

A project film (https://www.youtube.com/watch?v=-lt8zRSQnqI) illustrates the key issues drawn out within the day, in particular the pace of change in technology, resources and pedagogy. Participants suggested that University practices could be influenced with the greater use of the digital technologies evidenced in both the primary and secondary phases. The use of explicit learning outcomes was identified as an area well defined for all learners in both school settings.

Part 2: Academic-teacher reciprocal visits

These experiences provided opportunity for insight and reflection on different teaching settings. Each academic-teacher partnership was posed three fields of question to structure their reflections whilst on site, summarised in Table 2.

Identify: What are the notable differences in pedagogic practice between your setting and your partner's?	Clarify: What is the impact on pupil/student learning from the identified approach?	Extend: What could be the resulting impact on one's own practice having seen this approach in your partner's setting?
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.

Table 2: Phase 2 (Part 2) Teacher-Academic Reflections

Phase 3: The Evaluation Phase

During the evaluation meeting the focus of discussion was how this experience might enable teachers to design learning experiences that further enhance their student's learning experiences. Appendix 2 summarises these response which included using small, personalised study groups; seeking increased rigour over learning intentions for lectures; and increasingly visible and standardised expectations for learning within lectures.

E. Implications

'***Across the Divide'*** offered opportunity for joint exploration of teaching and learning experiences and approaches towards STEM in HE and school settings. Although it is acknowleged that the small sample size leads to findings that are particular to the participant group, it is possible to use this project as indicative and to draw out key areas of interest for further study.

Academics and teachers had expected to exchange pedagogic knowledge and ideas that could enhance their teaching and learning practices. They aspired to develop and change as a means of driving forward their own professional practice, through reflection on practice with colleagues outside their own sector. This collaborative endeavour was new and novel for all participants and the voluntary participation in this form of professional development did not 'fit' standard models of practice for either group, which for teachers mainly related to courses or independent professional study within research groups. For academics the opportunities for development are largely limited to the exchange of experiences and best practice through seminars and internal networks.

As a model of practice, the project provides HE with a novel approach, yet one that required mediation and facilitation which in this case was offered by SEERIH in line with the TOPD framework (Figure 2). Participants were not identified or selected to the 'best' or 'expert' but to have genuine interest in self-development, and often had supportive senior management to encourage and allow them chance to engage in this way. Moving forward it will be of interest to explore in more depth the nature of academic-teacher collaboration, and how the relationships developed and were supported that enabled open, professional and critical dialogue on and about practice.

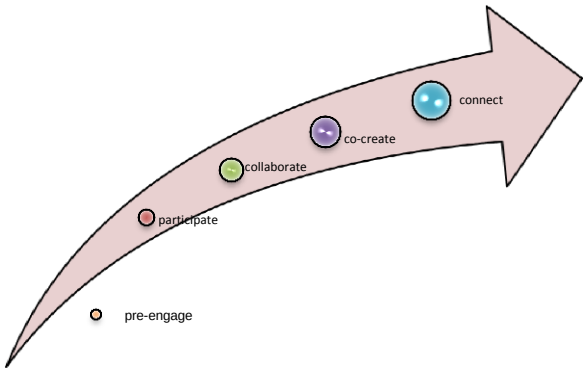

Figure 2: *The Trajectory of Professional Development (TOPD): A model for teacher leadership (Bianchi 2016)*

The project revealed key differences between the pedagogical practices of schooling at primary/secondary level and University teaching.

- Teachers highlighted the time constraints and pressure such as accountability measures as challenging to the development of their practice in the classroom, whereas academics referred predominantly to physical barriers such as facilities, etc.

- Academics questioned whether academic calibre within one's field and research did or didn't always reflect in the quality of teaching and learning practices in lectures.
- Teachers and academics shared ambition to ensure that their teaching was targeting high standards of learning, reflected by student outcomes
- Academics were distinctive in the way that the examinations were designed by themselves. Accountability was high for both groups, yet academics had more autonomy to set their own criteria for assessment and benchmarks, whilst guided by professional accrediting bodies.

The visibility of student learning outcomes was high in all school settings. The development of Assessment-for-Learning (AFL) practices in schools is shown in systematic and common approaches, such as marking, feedback and making explicit learning outcomes within lessons.

Table 4 classifies assessment types and all of the assessment strategies support AFL where their ultimate use is to help the student progress in terms of their learning. Informal formative assessment was a particular area of interest from the academics in this project, and how the physical learning spaces, questioning techniques and feedback used in schools can be further developed support a visible and explicit learning culture within HE.

	Formative Assessment	**Summative Assessment**
Informal	Questioning Feedback Peer assessment Self-assessment	Essays in uncontrolled conditions Portfolios Coursework Teacher assessment
Formal	Further analysis or tests, exams, essays Target setting	Tests Exams Essays in controlled conditions

Table 4: Types of Assessment linked to AfL based on the UK's National Foundation for Education Research reports (NFER 2007),

Academics suggested that a better knowledge and understanding of students, through smaller group tutorials, would benefit their own practice within lectures as learning outcomes could be better tailored to need and feedback more precise in nature. They were keen to consider recommendations on how exchange of pedagogical knowledge, ideas or some linkages between the settings could be made to enhance students' learning experiences. They offered suggestions as to how Directors of Teaching and Learning in every academic School should be informed of the findings of this project with particular focus on the need to consider standardisation of learning outcomes across academic teaching provision and to further discuss the need to maintain small group tutorials as a means of enhancing learning due to more responsive, personalised learning gains. Both academic and teacher groups felt similar pressures of time and professional support/encouragement alongside those of space and accountability.

It is suggested that the teacher's reflections present less fundamental challenges to current practice. They identified industry and University links and networks, noting the positive benefits to their own and student learning in forging stronger partnerships in this way. They valued the opportunity to 'see from the inside' the working practice of the University and to have a direct link to an academic School which they could relate to and capitalise on. They suggested fewer of actual changes they would make to classroom based teaching and suggested that they were encouraged to develop innovative teaching and learning practices to enrich the students' science learning. This however which met with difficulty when dealing with conflicting pressures such as accountability measures. The forced pressures of 'teaching to the exam' at secondary school and the lack of parity of esteem of science against other core subjects in the primary curriculum, lead to limitations in opportunity or endorsement within the school day and policy.

F. Conclusions

In response to how University-school partnerships influence university academics' pedagogic practice, the project stimulated knowledge transfer and engagement. There was heightened opportunity and stimulus for discussion about learning, its purpose, approach and underpinning educational theory. For both academics and teachers it was evident that both groups were limited in their opportunity to discuss their professional practice, and the nuances of pedagogical processes, in any depth with colleagues within the course of normal work practices. This project provided the time and space for dialogue, reflection and critique, something that all participants valued and suggested needed further development within their settings.

Collaborative practice denoted by sharing, observing and reflecting on pedagogy across the primary, secondary and HE sector led to empathy and shared desires for learning practices. The opportunity to work in close alliance with each other, even for a short period not only led to the pedagogical development of academics (see Harrison et al., 2011) but also provided teachers with opportunities for continued partnership with colleagues between educational settings. Where such collaborations, or partnerships, are to take place it is recommended that teachers and academics go beyond the initial 'show and tell' activity that defines many of the initial cross-site visits. Further opportunity to co-create a series of planned activities that demonstrate teaching and learning within the different settings, exemplifying the range of learning styles, spaces and methods of reporting and assessing learning would be of advanced interest. This would move the group into the next stage of the TOPD framework, through the creation of new experiences drawn from genuine bringing together of academic and teacher pedagogical and subject based expertise.

Project coordinators noted that the making teaching and learning processes more 'visible' in busy, demanding educational environments, through the process of critical reflection-in- and on-action, was of value, heightened by the fact that this was done with participants from primary, secondary and HE staff. The 'stepping outside' one's own environment, opening up ones practice to an educator from a different age phase presented a newness and novelty that inspired, challenged and spurred on one's thinking. At a time when the Department for Education are setting out standards for teacher professional development that include the requirement for collaboration and expert challenge (DFE, 2016) and the

University begins to realise the impact of the Teaching Excellence Framework, Across the Divide presents a model of practice and evidence, albeit with a small cohort of teaching professionals, to the willingness and benefits of learning together, comparing practice and most crucially develop a language and discourse around teaching and learning.

G. References

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H: APPENDIX

APPENDIC 1: Phase 1 – pre-intervention interview 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, philospophy 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: *Table of Post Placement Reflections*

Academic	Teacher
Small group studies – school is a personal environment and much more personal than HE and teachers are more knowledgeable of their student's needs and background → Further emphasizes the need for University to keep small tutorial groups going in HE.	**Study Day** – the real life context and how to make it more relevant to young children: → To motivate students with real world context.
Teachers in school are highly responsive to National Curriculum goals, standards and learning objectives: → Highlights the fact that there are no summative assessments of learning competencies in HE. → Questions whether a better balance can be struck between standardisation of academic teaching practices and still allowing freedom/autonomy across the HE teaching community.	**Informative practices for teachers as well as academics:** → Shared visits, e.g. academic into schools, teachers into the University, on a more frequent basis can inform the development of own teaching practice.
Moderation and setting of exams in HE: in school teachers abide by external awarding body examinations. → Within University, the lecturer writes the exams based on the unit s/he teaches, with professional body guidance. → Questions the need to encourage more peer moderation, for instance for a peer-lecturer to write the exam based on identified learning goals, and for them to moderate it together.	**To create links with the industry:** → To create links with STEM industry/businesses. → To create links with and involve young children with the University to motivate them in their learning.
Transitional issues and linkage with schools: → A key difference in pedagogical practices is where University student outcomes focus on answers more than methods. → Questions the possibility to allow school teachers to attend University lectures and Open Days to reveal the nature and variety of courses, teaching styles and expectations.	**For SLT to provide space and opportunities for professional development with peers from other sectors/contexts:** → For schools to recognise the value in such practices. → For collaborative, shared professional practice to be used alongside standard courses
Learning outcomes in schools are visible and explicit to the learners in each lesson. → Within University, learning outcomes are set at a unit level, could this become more clear within lectures. How is feedback more effectively given to students during the unit, based on learning outcomes and consideration of standards?	

APPENDIX 3: CHERIL Reflections

How has the project contributed to the strategic goals of the University and of CHERIL?	Many aspects of Goal 2 of the University's 2020 Vision are underpinned and enhanced by an early transition of students to independent learning. Understanding and bridging the divide between school-university pedagogic practice is a means by which to realise enhanced success in this area. The project directly addresses CHERIL's aim of "… understanding changes to secondary education and implications for transition to higher education"
Outline the robustness of your evaluation approach and what can be learnt from your project	The data analysis methodology was designed to allow participants to critically reflect upon their experiences throughout the various planned activities. This involved pre-project interviews, the collection of reflective commentary during school visits and post-placement interviews. The project has stimulated consideration of improvements around the use of learning outcomes, small group/tutorial work, examination design and collaborative professional development.
Outline the innovative aspects of your research, and explain how it might trigger pedagogic change	The primary innovation was the creation of partnerships between academics and teachers to provide a framework for experiential sharing and critical reflection on their respective pedagogical practices. The outcomes of the project have provided further focussed research questions which will be addressed by the follow-on CHERIL Project: "Mind the Gap".
Outline your project dissemination plan to ensure its impact are capable of making the greatest possible impact	The outcomes of the project will be disseminated at the CHERIL Conference in January 2017, and an international conference presentation and journal publication are in preparation. Further dissemination will come through the follow-on CHERIL Project: "Mind the Gap".
How well were you able to keep to budget? What is the sustainability plan for the project?	Stayed within budget. Further developmental project for 2017. Integration within SEEIRH academic research activity, related to the TOPD model.
If you were to undertake the project again, what would you do differently?	Further involvement/integration with Heads of School and Directors of Teaching and Learning.

APPENDIX 4:

Acknowledgements are extended to the academics and teachers involved in this study and to CHERIL for their investment and interest in its focus.

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