

**Note:** This is an Accepted Manuscript of an article published by Elsevier in the journal *Teaching and Teacher Education* in April 2020. It is available online here: <https://doi.org/10.1016/j.tate.2020.103033>.

## **The ‘tipping point’ for educational research: the role of pre-service science teachers’ epistemic beliefs in evaluating the professional utility of educational research.**

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### **Acknowledgements**

Funding: This work was supported by the Irish Research Council [GOIPG/2016/1071]

## **Abstract**

Teachers' engagement with and in educational research has become an aspiration in many countries. However, this has been counterbalanced with decades of research on the perennial theory-practice divide. This study provides new perspectives by considering the role of epistemic beliefs in pre-service science teachers' (PSSTs') acceptance or rejection of "Education Studies" from their Initial Teacher Education (ITE). Individual case profiles demonstrate how PSSTs compare knowledge in science with knowledge in education. Certain belief profiles can be seen to present barriers to evaluating education research as valuable. Thus, we argue for epistemic development and support with boundary crossing in ITE.

**Keywords:** Teacher Education; Epistemic Beliefs; Theory-Practice Divide; Teacher Beliefs; Teacher Perceptions; Education Research

## **Introduction**

### **Research-informed teacher education**

Approaches to Initial Teacher Education (ITE) are not globally uniform. What is included on ITE curriculum varies across jurisdictions (Conway, Murphy, Rath, & Hall, 2009). In some countries, ITE has turned to school-based rather than university-based approaches (Kitchen & Petrarca 2016), justified by a claim that theory and research offered by universities is of little value (Beauchamp, et al., 2016). In other countries, the place of universities and the importance of research in ITE are being increasingly emphasised (Munthe & Rogne, 2015; Niemi & Nevgi, 2014; Tatto, 2013), through Master level qualifications and engagement with and in research as part of the programme (Flores, 2016). In these ways ITE can be "research-informed" in 3 senses:

- 1) The practice of teacher educators can be informed by research

- 2) The pre-service teachers (PSTs) are informed by research reading and using research literature explicitly
- 3) The PSTs become research active by conducting research for their theses, informing their practice but also increasing their skills in engaging with and in research.

Though there are differences in policy directions, there appears to be significant agreement in the international teacher education community that teaching is a profession with its own distinct body of professional knowledge, some of which is vitally constituted by theory and research (Carr & Kemmis, 1986; Edwards, Gilroy, & Hartley, 2002). It is widely acknowledged that teachers' professional knowledgebase must also consist of, and draw upon, experience to develop what might be called "practical wisdom", "phronesis", or "craft knowledge" (Carr & Kemmis, 1986; Kessels & Korthagen, 1996). None of these elements, however, remove the need or benefit of theory and research to serve as one input in developing teachers' professional knowledgebases.

### **"Education Studies"**

The component of ITE that is concerned with educational research is generally referred to as "Education Studies" in the Irish and UK context (Furlong, 2013). International readers may recognise the term synonymously with "Education Research", "Educational Theory", "Foundation Disciplines", and others. It is closely related to terms used in other jurisdictions, such as "pedagogik", "didatik", and "educational sciences", though the boundaries for each of these terms are arguably quite different (Whitty & Furlong, 2017). What is common about them is that they relate to content that is often present in ITE programmes that primarily draws upon the disciplines of psychology, philosophy, history, sociology (Furlong, 2013) and sometimes economics and geography (Edwards, Gilroy, & Harley, 2002). The *sin qua non* of Education Studies is that it draws on these disciplines in terms of what is relevant for

education. Yet, Education Studies is itself often referred to as a *discipline* (see Furlong, 2013). It is acknowledged that, philosophically, it fails the first test of being considered a discipline; that it should be coherent, distinctive, and rigorous in terms of epistemology (Bridges, 2006). Arguably, it is more accurately termed a “field” of study, however Furlong (2013) argues that the use of the word discipline is warranted because ‘institutionally and politically, it functions very much as a discipline in its own right’ (p.4).

While the boundaries of what is included in Education Studies can be contested, in ITE programmes in the UK and Ireland it can often be provided as structurally separated from subject content or school practice experiences (McPhee & Humes, 1998). What is included in any ITE programme may be guided by government policy or the providers own discretion. The particular ITE curriculum in the context of this study will be explored in a later section. Furlong (2013) discussed how Education Studies in ITE adds value in at least three ways. First, to ‘expose teachers to something beyond their own experience’ (p. 184). Second, to help teachers to make sense of the complex practical activity of teaching and to theorise education through their experiences. Not simply theorising but articulating their theories so that they are open to scrutiny, critique, and examination in light of the evidence available and in terms of the underpinning values or assumptions. Finally, it is argued that without Education Studies, ‘professional education becomes a narrow form of apprenticeship where current practices are simply reproduced’ (p.185).

### **Perceptions of Education Studies**

Education Studies is repeatedly reported as poorly regarded by PSTs and practitioners. For example, McIntyre reported that it was almost a ‘dirty word’ (1993, p. 39) in the teaching profession. Pring (2000) writes that ‘theory is seen as a disease, which has to be eradicated and replaced by professional judgement’ (p. 77) and Gleeson has written that there has been

an ‘apathy towards Education Studies, associated research and reflective practice’ (2012, p. 1). It is reported that theoretical aspects are seen as the least relevant component of ITE programmes (Hobson, et al., 2008). Accordingly, engagement with theory can be at a surface level and used in the ‘reaffirmation of belief rather than a tool for exploration and for thinking otherwise’ (Ball, 1995, p. 268). Educational researchers have spent considerable time on the question of why theory is rejected so vehemently.

PSTs are often seeking “tricks” or ways of “surviving” in the classroom (Davis, Petish, & Smithey, 2006; Moran, Dallat, & Abbott, 1999) and can come to ‘dismiss their training as idealised’ as ‘it is unconnected to the reality of survival’ (Stronach, Cope, Inglis, & McNally, 1996, p. 80). This poses a challenge for teacher educators who need to achieve a balance of providing something that is immediately useful for classroom practice and helping their students to expand their concept of what is “useful” (Counsell, Evans, McIntyre, & Raffan, 2000).

PSTs may not have enough experience in school to anchor their thinking about educational issues from a theoretical perspective, and thus theory remains abstract (Dewhurst & Lamb, 2005; Korthagen & Kessels, 1999; Veenman, 1984). Doyle and Carter suggest that if PSTs do not have ‘real and rich experience of performance as a teacher that can be brought to bear on their teacher education’ (2003, p. 134), then any teacher education which front-loads theory or even practical wisdom is ‘doomed to fail’ (p. 134). In this case, PSTs draw on their “lay theories” (Sugrue, 1997) about teaching and learning formed through the “apprenticeship of observation” (Lortie, 1975). Sugrue argues that ITE all too often seeks to ‘supplant’ these ‘unarticulated tacit images of teaching’ (1997, p. 222) with educational theory. But as these are durable preconceptions (Korthagen, 2010) that act as filters to new information (Luft & Roehrig, 2007; Postlethwaite & Haggarty, 2012), ITE would be better served to acknowledge

and work with these pre-existing beliefs rather than trying to directly challenge or replace them (Joram & Gabriele, 1998; Pajares, 1993; Sugrue, 1997).

Teaching practice, during ITE and post-qualification, can lead to a “wash out” of educational theory (Zeichner & Tabachnick, 1981) as pre-service and newly-qualified teachers may experience socialisation to existing cultures and norms (Zeichner & Gore, 1990). There are also issues of professional identity, where a teacher may feel that to engage with theory

can be to deny the validity of ones’ own experience-based craft knowledge,  
contradicting their experience of themselves as a source of expert knowledge  
(Watts, 2009, p. 689)

Teachers can perceive a hierarchy where theory is ‘aloof within the ivory tower, espousing ideals and the principles that govern them’ (Smagorinsky, Cook, & Johnson, 2003, p. 1399), and practice has little reciprocal impact on theory (Knight, 2014). Thus, McIntyre (2005) suggests that few teachers would claim that their practice was influenced by educational research. There is a sense of separation between university and school, as well as a lack of teachers’ ownership of knowledge that permeates the educational literature (Berry, 2008; Hascher, Cocard, & Moser, 2004; Knight, 2014; Segall, 2001).

Many researchers have attempted to research the varying, more nuanced, ways in which a teacher can perceive, engage with, or value educational theory and research (Dye 1999; Hobson, 2003; Sjølie 2014). Author et al. (2017) categorised PSTs on a two-dimensional plane resulting in 4 distinct categories: “automatic adopters”, “automatic dismissives”, “considered adopters”, and “considered dismissives”. This refinement restructured the issue from a simple dichotomy of acceptance and rejection to a more complex understanding of the issue, and in doing so illuminated a group of students that had not been examined before – the “considered dismissives”, who have critically engaged with educational theory and research but have chosen to reject this Education Studies knowledge on the basis of a reasoned

professional evaluation. The critical question is raised that maybe, despite their apparent “rejection”, the critical thought demonstrated by these “considered dismissives” is a positive outcome of teacher education.

Clearly, the issues of negative perceptions of Education Studies and educational research are complex and multifaceted. It is the aim of this paper to contribute to the previous and ongoing research in offering a new perspective on these persistent issues. We begin with a discussion of epistemic beliefs.

### **Epistemic beliefs**

An individual’s beliefs about the nature of knowledge and the nature of knowing, have been described as acting as “filters” when encountering new information (Fives, 2011; Hofer & Bendixen, 2012). It has been suggested in previous research that these beliefs are vitally important in learning science, developing scientific literacy, and learning to become a teacher (Fives, 2011; Walker, Brownlee, Whiteford, Exely, & Woods, 2012).

Our focus on epistemic beliefs derives from Hofer and Pintrich’s (1997) “Personal Epistemology” which they theorised as being a multidimensional set of beliefs about the nature of knowledge and knowing. The term “epistemic beliefs” is used in this paper as an arguably clearer term than referring to epistemologies or epistemological beliefs that may indicate more formalised philosophical positions (Greene, Sandoval, & Bråten, 2016; Kitchener, 2002). The dimensions of epistemic beliefs, described below, are thought to be “more or less” independent (Schommer 1990, cited in Hofer, 2016), meaning that while there may be some relation between these dimensions, an individual can have more developed beliefs in one dimension than in another. Additionally, these epistemic beliefs can be discipline-specific, such that individuals can hold different epistemic beliefs in different disciplines or domains (Hofer, 2000). The dimensions of epistemic beliefs have been

considered with respect to more recent critiques of the dimensions (e.g., Chinn, Buckland, and Samarapungavan 2011). Table 1 briefly summarises the epistemic belief dimensions considered in this research.

Table 1. Dimensions of Epistemic Beliefs (Hofer & Pintrich 1997), adapted to include 'structure' (Chinn et al. 2011).

<b>Dimension</b>		<b>Traditionally considered 'naïve'</b>	<b>Traditionally considered 'sophisticated'</b>
Certainty [C]		Fixed, unchanging, certain, stable	Fluid, changing, tentative, evolving
Structure [St]	Simplicity [S]	Unrelated, discrete, concrete facts	Relative, contingent, contextual
	Universality [U]	Applicable globally regardless of context	Specific to the context in which it was generated.
Source [So]		Outside the self, from authority	Constructed by the knower, in interaction with others
Justification [J]		On basis of authority and/or observation	Use of rules of inquiry and evaluation of expert views

*Certainty of knowledge* – The extent to which knowledge is viewed as fixed or fluid. An individual may consider knowledge to be existing with certainty. In such cases, knowledge cannot be doubted, all experts would come up with the same answer to a question, and that answer would not change over time. At higher levels of development, individuals would be open to the idea that theories are modified over time as more information is gathered, and that knowledge is not certain or absolute.

*Simplicity of knowledge* – This continuum ranges from beliefs in knowledge as an accumulation of facts through to highly interrelated concepts. Less developed perspectives consider answers to be straightforward; knowledge is considered discrete, concrete and easily knowable. At higher levels of development, the knowledge is understood as complex, relative to other concepts, and dependant on context.

*Universality of knowledge* – Chinn et al. (2011) have suggested that the dimension of “simplicity” is a sub-dimension of a larger one, the structure of knowledge. Drawing on philosophical analyses, they posit that there are additional pertinent issues relating to the structure of knowledge. Code (1991) provided an account of such additional sub-dimensions.



In this study, however, we have chosen to consider one additional sub-dimension concerned with the universal or particularistic nature of knowledge. This is specifically included because previous research seemed to suggest that contextual variation is an important consideration for teachers in evaluating the applicability of educational research (Gore & Gitlin, 2004; Joram, 2007). The sub-dimension of “universality” acknowledges that individuals can believe in knowledge as universally applicable across contexts, or particular to a single context (Chinn, et al., 2011).

*Source of knowledge* – Ranges from beliefs about knowledge residing outside the self, transmitted from expert/authority to the learner and should not be questioned. Further along in development, individuals might consider knowledge as constructed in interaction with others. An individual would move from being a spectator to being an active participant in constructing knowledge, using logic and evidence.

*Justification for knowing* – This dimension is concerned with how individuals evaluate knowledge, how they use or evaluate evidence, authority, and expertise. It was originally suggested that earlier stages of development on this dimension would involve belief in knowledge as justified by expert opinion, progressing ‘to the multiplistic acceptance of opinions’ and then ‘to reasoned justification for their beliefs’ (Hofer & Pintrich, 1997, p. 120).

As they are currently framed, each dimension ranges along a continuum from a “lower” end to a “higher” end, from “less developed” to “more developed”, from “simple” to “advanced”, or from “naïve” to “sophisticated”. The labels are numerous and pervasive. While researchers are conscious of the value-laden nature of such labelling, it is generally defended as necessary when considering a uni- or multi-dimensional epistemological development (Schommer-Aikens, 2002). Schommer-Aikens acknowledged it is somewhat audacious to suggest one can know the correct epistemological stance but made an appeal for balance

rather than extreme dichotomous thinking. For example, she explained that an advanced learner may believe in knowledge as generally tentative and complex while also believing that some knowledge is more certain and unchanging. More in-depth and detailed descriptions of individuals' beliefs may therefore be useful for avoiding such value-laden term and provide a more accurate understanding of the individual.

### ***Epistemic Beliefs in Learning and Teacher Education***

There have been multiple efforts to examine the process of ITE through the lens of PSTs' epistemic beliefs (Bondy, et al., 2007; Brownlee, Schraw, & Berthelsen, 2011; Buehl & Fives, 2016; Joram, 2007; Löfström & Pursiainen, 2015; Merk, Rosman, Rueß, Syring, & Schneider, 2017). These studies use various conceptions of personal epistemology, epistemic beliefs, and epistemic cognition, but all argue the importance of such epistemic issues to the process of learning to teach, and to the act of teaching. Bondy et al. (2007) used personal epistemology as a lens for understanding how teachers learned during the first year of their ITE. They provide accounts of 3 teachers to demonstrate how the PSTs' epistemic beliefs seemed to influence their aims and expectations, and consequently, their engagement with knowledge in their ITE. Joram (2007) compared the epistemic beliefs of professors of education, in-service teachers, and PSTs. She noted the differences in beliefs between the three groups and showed the apparent influence on their attitude towards educational research. Research on teachers' epistemic beliefs in science on these dimensions has also been quite visible in recent literature (Cheng, Chan, Tang, & Cheng, 2009; Deniz, 2011; Kang, 2008; Lee & Tsai, 2011; Topcu, 2013; Elby, Macrander, & Hammer, 2016). Examining the processes of ITE with the construct of epistemic beliefs has resulted in the identification of a range of beliefs which are not preferable or "nonavailing" (Muis, 2004), particularly where 'they could become obstacles' for PSTs learning what they 'need to know in order to teach effectively' (Bondy et al., 2007, p. 77).

In light of findings that such “nonavailing” beliefs are present among PSTs (Yadav, Herron, & Samarapungavan, 2011), and that teacher education programmes have rarely considered PSTs’ epistemic beliefs (Brownlee, Purdie, & Boulton-Lewis, 2001), the calls for teacher educators to focus on the epistemological development of PSTs has grown. For example, Yilmaz-Tuzun and Topcu said ‘it is clear that teacher education programmes must concentrate on the determination and development of PSTs’ epistemological beliefs’ (2008, p. 82) and that it is now ‘necessary for teacher educators to help students be aware of their beliefs and change them if necessary’ (p. 81). Fives (2011) also argues that teacher educators need to be more alert to the influences of epistemic beliefs during their programmes, particularly ‘when educational theory or practice is re-interpreted by future teachers to fit within an unchanged belief system’ (p. 125).

It is increasingly being recognised that mere persuasion will not suffice in closing a “theory-practice gap” or encouraging PSTs to engage with the latest in educational research; teacher educators instead need to address the underlying epistemic beliefs of PSTs (Wong, Chan, & Lai, 2009, p. 13).

## **Methodology**

### **Research Aim**

The aim of this paper is to explore the role of PSSTs’ epistemic beliefs, in science and Education Studies, in evaluating Education Studies as professionally useful or not. The study was not interventionist in nature, seeking only to elicit participants’ epistemic beliefs in science and Education Studies, and perceptions of Education Studies at one particular point in time. The research reported here forms part of a larger funded research project.

The following research question was addressed:

*How are PSSTs perceptions of Education Studies influenced, if at all, by their epistemic beliefs in science and/or Education Studies?*

## **Participants & Research Context**

This research was conducted in a university, in the mid-west region of Ireland, which is the largest provider of post-primary teacher education in the country (O' Doherty, 2016). The university offers ITE programmes through both a 4-year concurrent bachelor's degree programme and a 2-year Professional Master of Education (PME) across a range of subject areas including science, technology, engineering, math, languages, and physical education. The curriculum of teacher education in recent times has been broadly regulated by the Teaching Council of Ireland (Teaching Council, 2017), though with scope for local control of the selection of material to be included under the guidelines in ITE institutions (O' Doherty 2016). The place of Education Studies, under this framework, was mandated to comprise 25% of the programme. Prior to this regulation, Education Studies had also been prominent and referred to as the 'spine' of ITE programmes in Ireland (Author et al., 2017b). The participants of this study were PSTs in their final year of a science teacher education bachelor's programme. Graduates of this programme would be eligible to register with the Teaching Council as post-primary (second-level) teachers of science, biology, agriculture and their elective subject of either chemistry or physics. "Education Studies" (bolded in Table 2) and science content knowledge are studied concurrently in 6 of the 8 semesters (Table 2). School placement was scheduled in Semester 4 and Semester 7 for 6-week and 10-week periods respectively. During these placements PSSTs generally have responsibility for a small number of class-groups and teach 15 lessons per week as the sole teacher, with varying levels of supervision from a mentor teacher, depending on their school context. Students also engage in a short placement in primary school between semesters 1 and 2 and engage in an alternative educational placement (e.g. community, adult, or special needs education setting)

in semester 6. These additional experiences are associated with the Education Studies module of those semesters. Three dedicated science pedagogy modules were included in Semester 4 (before placement) and Semester 6. Science content modules are shared with other undergraduate students on pure science degree programmes, so their exposure to science content is of equivalent difficulty to a standard bachelor's programme. There are no specific programme components that explore the nature of scientific or educational research, or the relationship between them.

Table 2. Structure of Participants' Science Teacher Education Programme

<i><b>Semester 1</b></i>	<i><b>Semester 2</b></i>
<b>Becoming a Teacher: Identity and Communication</b> Biology 1 General Chemistry 1 Science Mathematics 1 Mechanics/Heat/Electricity/Magnetism	<b>How Young People Learn</b> Biology 2 Inorganic Chemistry 1B Science Mathematics 2 Waves/Light/Modern Physics
<i><b>Semester 3</b></i>	<i><b>Semester 4</b></i>
<b>Planning for Teaching and Learning 1</b> General Microbiology Animal Diversity Soil Science Organic Chemistry	<b>Planning for Teaching and Learning 2</b> <i>Teaching Science 1</i> <i>Teaching Science 2</i> Horticulture Teaching Practice 1
<i><b>Semester 5</b></i>	<i><b>Semester 6</b></i>
<b>Curriculum Studies</b> Plant Physiology Crop and Grassland Science Cellular Biology and Biochemistry Inorganic chemistry 2B <i>OR</i> Optics	<b>Responding to Diversity in Education</b> <i>Science Teaching</i> Ecology 1 Physical Chemistry <i>OR</i> Science Maths 4 Analytical Chemistry for the Environment <i>OR</i> Semiconductor Devices
<i><b>Semester 7</b></i>	<i><b>Semester 8</b></i>
<b>Understanding Schools</b> Final Year Project (Part 1) Teaching Practice 2	<b>Teacher as Professional</b> Genetics and Molecular Biology Agriculture 2 Final Year Project (Part 2) Environmental Chemistry <i>OR</i> Thermal Physics

Twelve PSTs, from a cohort of 72, agreed to participate in the interviews with the first author. All participants are listed with pseudonyms in Table 3. Three cases are presented in this paper for depth and illustrative purposes (indicated in Table 3 with an asterisks). Ethical approval was granted by the authors' institutional research ethics committee. Participation was entirely voluntary, and participants were informed of their right to withdraw at any stage.

The authors were not engaged in teaching these PSTs at the time of the research. At the time of the interview, the participants were beginning semester 7 of their programme and preparing to leave campus for an extended placement experience in school. They were also engaged in the early stages of their Final Year Project, which was an undergraduate thesis involving research in pure science, science education, or education.

Table 3. Participants details. Asterisks to indicate case studies explored in this paper.

	<i><b>Name</b></i>	<i><b>Sex</b></i>	<i><b>Elective (Biological sciences + ...)</b></i>
1	Natasha	Female	Chemistry
2	Donna	Female	Chemistry
3	Penny	Female	Chemistry
4	Simone	Female	Physics
5	Clare*	Female	Chemistry
6	Bart	Male	Chemistry
7	Harvey*	Male	Chemistry
8	Lana	Female	Chemistry
9	Haley	Female	Physics
10	Monica	Female	Chemistry
11	Bruce*	Male	Chemistry
12	Lisa	Female	Chemistry

## Methods

In-depth multi-component interviews were utilised to elicit both perceptions of Education Studies and epistemic beliefs in science and Education Studies. The multi-component structure was adopted due to reported difficulties for teachers to articulate their beliefs (Joram, 2007). Numerous approaches were utilised within the single interview to probe participants' beliefs and perceptions, ranging from opportunities to implicitly demonstrate or reveal their beliefs or explicitly state them in response to direct questioning (Tsai, 2002). This interview schedule is included as an appendix.

The interviews probed participants' experiences in school and university, both learning and teaching, as well as their aspirations for future teaching. These were intended to provide opportunity for participants to demonstrate epistemic beliefs. Concept cartoons (Naylor, Keogh, & Downing, 2007) and statements from Hofer's (2000) Discipline-Focused Epistemic

Belief Questionnaire (DFEBQ) were used to draw out participants' beliefs and reasoning, as well as explicit questions about the nature of science and nature of Education Studies.

## **Data Analysis Procedures**

Data analysis focused on (1) epistemic beliefs in science and Education Studies, (2) perceptions of Education Studies, and (3) the connections between these elements, if any. The data were analysed using both deductive (top-down) and inductive (bottom-up) approaches; epistemic beliefs were coded with respect to an elaborated version of Table 1; while a form of open thematic coding was used for perceptions of Education Studies. Once all transcripts were labelled with respect to common codes and themes, narrative profiles could be created for each individual. These focused upon the key elements in question and allowed for an individual examination of the connections between epistemic beliefs and perceptions of Education Studies within the individual.

The reason for using two separate processes of analysis was that epistemic beliefs is a well theorised construct that allows for the creation of a coding framework to compare and organise data. While perceptions of Education Studies have been previously studied, there is not a well theorised framework available for this purpose. Perceptions of Education Studies thus required a more open approach that could capture any relevant commentary by participants. Such hybrid inductive/deductive approaches are not unusual in qualitative studies (Fereday & Muir-Cochrane, 2006). Thematic Analysis procedures are entirely appropriate for such studies and can be used '*to produce both data driven (bottom-up) and theory-driven (top-down) analyses*' (Clarke & Braun, 2014, p. 1948).

### ***Analysing Epistemic beliefs***

Deductive analysis was conducted for epistemic beliefs using the dimensions from Hofer and Pintrich (1997) with additional considerations from more recent literature (e.g. Chinn et al.

2011), as previously discussed. Codes were generated in NVivo for each dimension within each subject area. For example, Certainty of Knowledge in Education (“CertEd”) and in Science (“CertSci”), and Structure of Knowledge in Education, Universality (“StrucEd[U]”), and in Science (“StrucSci[U]”), and so on for each dimension. Transcripts were systematically coded for any statement that appeared to be relevant to these dimensions. Examples of these codes and the reason for coding are provided in Table 4.

Table 4. Example Coding and Reason (Epistemic Beliefs)

Quote	Code	Reason
And in science, yeah definitely. Things change all of the time. There is always people doing research and changing answers (Simone)	CertSci	Explicit statement that knowledge changes over time as a result of ongoing research.
I know there are some where it is fairly, kind of, concrete...like, we like to learn with images. (Harvey)	CertEd	Referring to some knowledge as concrete. High certainty for some knowledge at least.
The sciences are more...they are all about facts... It is surrounded facts. (Haley)	StrucSci[S]	Language more indicative of a collection of facts.
And I chose to relate the teacher to...as a toolbox. And we have all the tools, we are going to be taught all of the tools to put into our toolbox (Bart)	StrucEd[S]	Suggests seeking knowledge in a more discrete fashion, as separate ‘tools’.
but I suppose science is universal as well. Science knowledge is universal. It doesn’t change in other countries. (Lana)	StrucSci[U]	Making a claim about the extent to which knowledge applied globally and across contexts.
I suppose, again, it is the same as the science is...like, it is universal. Like...people so tend to have similar ways of learning. (Lana)	StrucEd[U]	Explicit reference to knowledge being universal but could also be coded for broad claims in Education Studies.
I think it is very different in the university. Like, they do put more of a focus on the actual practice of science and how we know stuff, rather than ‘this is what we know’. (Bruce)	SouSci	Suggests knowledge exploration in learning moves from being told what is known to engage in the practice of science.
Because I could go ‘this is this group work, it is really good. it has got an effect size of this.’...I liked be able to know that there was a specific number associated with how effective things were (Harvey)	SouEd	Source suggested to be external – research to guide professional knowledge.
Because, yeah, you have to do the experiment and...but, like, someone has done it before as well... so you can just read what they have done. But, yeah, if you do it yourself, then you remember it and you understand ‘okay, this happening this way’ (Lisa)	JustSci	Refers to knowledge justified by others doing experiments, verified by self for understanding.
think the only place you can get that is experience. You have to see them fail and you have to see them succeed, I think. (Penny)	JustEd	Not only prioritises experience but suggests this is the only way to justify knowing.



### ***Analysing Perceptions of Education Studies***

Open and thematic codes were generated to capture a wide array of participant perceptions of Education Studies. Whether a participant is positive or negative about Education Studies will clearly be considered a perception of Education, but perceptions can be broader. For example, ideas about the function and purpose of Education Studies are also considered as perceptions of Education Studies. The analytic process ‘capture[d] both the semantic (surface) meaning within the data and latent (underlying) meaning’ (Clarke & Braun, 2014, p. 1948). Examples of coded statements include:

***How-to/Prescriptive:*** ‘It is learning how to effectively pass information on to other people...It is learning to be a teacher! How to be a teacher.’ [Simone]

***Facilitator/Non-Dominant:*** ‘On my second-year teaching practice I did do a lot of...I call it “role reversal” so, I had the students come up and, kind of, I wasn’t teaching the topic but it was inspiring their peers to cultivate knowledge about a certain concept.’ [Donna]

***Positive:*** ‘This is exactly what I want to be learning’

***Negative:*** ‘Not worth the time’

All of the codes pertaining to the perceptions of Education Studies would be used in the generation of narrative profiles.

### ***Construction and Analysis of Narrative Profiles***

Using the coded elements from participants’ transcripts, narrative profiles were reconstructed for each participant. These profiles constituted an interpretive step where the first author presented the story of the participant, using the relevant extracts from their transcripts, for the purpose of the research. The second and third authors acted as “critical friends” who would check inferences and connections being drawn (Stieha, 2014). The critical friends would continue to question, critique, and probe in an effort to attain “interpretive agreement” (Tappan, 1997). The presence of “availing” or “nonavailing” beliefs on any one of the

dimensions would not be enough to categorise that person entirely as such. Beliefs and perceptions are nuanced, and it is important to consider the individuals entire profiles as much as possible. This means also considering the context, assertiveness, and totality of their remarks. It was in this phase of analysis that the connections between beliefs and perceptions became more evident, particularly where comments of an epistemic nature were used to rationalise a perception or where the perception clearly followed from stated epistemic beliefs. It was also possible to group profiles in broad terms of perceptions of Education Studies and epistemic comparisons (i.e. differences or similarities between epistemic beliefs in Education Studies and epistemic beliefs in science). These groupings will be described in the findings.

## **Findings**

The findings of this study are presented in two sections. The first section briefly explores the broad categories to which all participants could be grouped on the basis of their perceptions of Education Studies, ranging from negative to positive (Table 5). This grouping precedes the more detailed profiles presented in the second, more substantial, section of the findings. The profiles, which report epistemic beliefs, are selected to illustrate a spectrum (Figure 1) that runs from extreme epistemic difference to extreme epistemic similarity between science and Education Studies. The grouping and spectrum are then considered with respect to one another.

### **Perceptions of Education Studies**

Each individual participant of this study communicated a range of perceptions of Education Studies. Individuals may hold complex sets of perceptions rather than an outright positive or negative disposition towards the entire domain. However, it is possible to group the individuals “on balance”, by considering the totality of their remarks and the relative strength

of their comments in either direction. Table 5 defines three broad categories for participants' perceptions of Education Studies, along with some indicative quotes, and a list of participants included in each category.

Table 5. Grouping of Participants on the Basis of Perceptions of Education Studies

	<i><b>Disengaged and Dismissive</b></i>	<i><b>Betwixt and Between</b></i>	<i><b>Passionately Positive</b></i>
<i><b>Definition</b></i>	Those with primarily negative perceptions which are represented through dismissing Education Studies, for any number of reasons, and/or disengaging from Education Studies in ITE or in practice.  Their conclusions about Education Studies are negative.	Those with mixed perceptions, or positive perceptions that appear negated by other factors within their profile.  Their conclusion is either very tentatively positive, or negative following positivity.	Those with primarily positive perceptions represented by explicit, often impassioned, statements of endorsement.  This position does not necessitate entire positivity: they can be critical, but the conclusion of these individuals about Education Studies is positive.
<i><b>Indicative Statements</b></i>	'I am not bothered'  'Not worth the time'  'Wishy-washy nonsense'	'It is good, but... but stuff can happen that makes it kind of moot'  'very useful. But again, like, then there is the whole contradicting of ideas'	'You are lost without it'  'this is exactly what I want to be learning about... was what I thought... other people didn't see the relevance of it and I found that very frustrating.'
<i><b>Participants</b></i>	Natasha, Clare, Simone, and Bart	Penny, Lana, Haley, Lisa, Harvey, and Donna	Bruce and Monica

Table 5 represents three primary groups from *Disengaged and Dismissive*, who either explicitly state a negative perception and dismissal of Education Studies or express negative perception through disengagement from Education Studies, to *Passionately Positive* who not only hold positive perceptions but state them with more impassioned terms (e.g. not just 'relevant' but '**extremely** relevant', 'you are **lost** without it' and so on). There is something very distinctive about the middle group (*Betwixt and Between*). It is not just about holding mixed views. The *Betwixt and Between* group were typified by their 'it is good, but...' statements. There would be a positive perception articulated, but unlike the *Passionately Positive*, something would be identified by the participant that negates this positivity (see examples in Table 5). These appeared to be "tipping points" where participants' seemingly

positive positions are tipped to negative ones, or at most a very cautiously positive position, as a result of some sort of negating factor.

This combination of positive perceptions with negating factors is quite important, particularly for our later discussion of the role of epistemic beliefs, because it suggests that these PSSTs recognise potential value of Education Studies for their practice, but something hinders further engagement. Many of these negating factors, or “tipping points”, were epistemic in nature. Greater detail is needed to understand how epistemic beliefs facilitate or hinder PSSTs’ engagement with educational theory and research. The following section will explore the role of epistemic beliefs in three individual profiles, one from each of the three categories of Table 5. It is worth noting that frequency counts are intentionally avoided in this paper, as to do so would be to suggest these frequencies carry meaning. It is our intention to illuminate cases that exist rather than make claims about their prevalence. It is interesting that such cases exist in any frequency, exploring the detail of these cases will be of benefit to other teacher educators who may see similarities in their student teachers in their own contexts.

### **Case Profiles**

A helpful advance in understanding is achieved when considering the participants in terms of the comparison between their epistemic beliefs in science and their epistemic beliefs in Education Studies. Figure 1 maps participants in terms of this comparison, rather than in terms of their perceptions of Education Studies (which was represented in Table 5). Three profiles are presented in this section to illustrate different states along a spectrum of epistemic comparison between science and Education Studies, from epistemic difference to epistemic similarity. The profiles of Clare and Harvey illustrate the differing ends of the spectrum, difference and similarity respectively, while Bruce represents a middle ground comparison (Figure 1). The implications of this new perspective for the perceptions of Education Studies

will be illustrated through these profiles and summarised later. Additional profiles are mapped to this spectrum where comparisons could be established, these are reported in greater detail elsewhere (Author, 2018). Presenting individual profiles allows for a more detailed exploration of how epistemic beliefs influence perceptions of Education Studies. Epistemic belief dimensions are indicated using letter codes from Table 1 in square brackets.

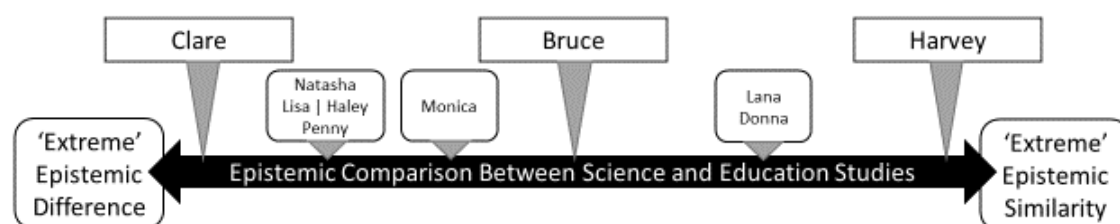


Figure 1 - Spectrum of Profiles in Terms of Epistemic Comparison

### ***Clare: Epistemic Difference***

Clare, like many of her peers, went from school directly into teacher education. In general, she liked school and felt successful with little effort. Clare described herself as *‘scientifically and mathematically brained’*. Clare’s profile illustrates an individual who believes the domains of science and Education Studies are epistemically very different.

Clare viewed science as highly certain. She described science as *‘more definite, it is a lot more facts, a lot more concrete’*, and *‘science is all about proving things’*. She believed that ideas in science *‘can’t contradict each other’* [C], providing the following example to explain:

*But you couldn’t say that light travels in waves and I say that light travels in straight lines and that we will both be right... They can’t both be right. Light can’t travel in a straight line and also be a wave. There is ‘a’ right answer... It is one or the other. [C]*

In contrast, she thought that ideas in Education Studies were *‘not very concrete...more conceptual’*, *‘constantly changing’* and better described as *‘theoretical beliefs rather than*

*facts*' [C]. In Education Studies, Clare believed that *'you can contradict someone and still be right, you could both be right'* [C].

In science, Clare trusted some sources of knowledge without question. She says *'if my experience conflicts [with a textbook]...it's more likely that their results are going to be true'* [So]. This demonstrated a received view of knowledge from an expert source, which she emulated in her teaching as she commonly referred to herself as *'passing on knowledge'* [So] in her role as a teacher. The way that Clare interacted with scientific knowledge suggested that she believed science was universal, as she sought *'tricks'* for conducting experiments to achieve the *'results you are supposed to get'* [U]. In this sense, knowledge is received and justified from an authority source external to herself:

*It follows the **scientific method**. It is observed. The observers, **they** make the hypothesis, **they** examine the hypothesis, **they** get the result, **they** make their decision based on the results and then **they** do it all again. And it is reproduced and reproduced to be actually called a scientific fact. [Emphasis added] [J/So]*

In Education Studies, Clare alluded to some quantitative justification for knowing by referring to effect-size research but with little detail: *'There would be some studies carried out into what works... And things would be rated on scores of what works'* [J]. She doubted that Education Studies could actually provide certain knowledge as she thought *'they will get an answer, but is it a true answer? It is hard to tell in Education'* [C]. She broadly felt that claims in Education Studies were supported by little else other than reference to another theorist's opinion: *'Whereas in Education it is a lot more "he thought this"...more "what people think is this"'* [J/So]. In Education Studies, her view of researchers as external sources of knowledge is different as she referred to them as *'so-called experts'* and doubted them on the basis that *'some of the researchers in education haven't been in school in 20, or 30 years.'* Thus, she said, Education Studies knowledge for her as a practitioner is *'learnt through actually doing'* [J/So] and *'by looking at students and observing students'* [J/So] in

the classroom. Thus, rather than relying on or evaluating knowledge claims from external sources, Clare resorted to justifying her practice solely based on her own intuition. For example, when discussing ICT and iPads in the classroom Clare said *'I would keep them out of it completely'* and justified this educational decision with reference to personal experience: *'You know yourself when you're reading, it is harder to actually take in information from the screen'* [emphasis added] [J/So].

Clare evidently saw science and Education Studies in very different epistemic terms. Education Studies appeared to be compared with science as less certain, less universally applicable, less rigorously justified, and less reliably sourced from experts. This comparison appeared to support her perception of Education Studies as *'wishy-washy nonsense'* that are *'not worth the time they are given.'* These comments appear to indicate a rejection of Education Studies knowledge.

### ***Harvey: Epistemic Similarity***

Harvey generally described himself as successful in school in an academic sense. He had experience helping other pupils in his class to understand what was happening and this was influential for Harvey in choosing to study science teaching. He also entered the programme immediately following his second-level education.

He believed that scientific knowledge had a high degree of certainty and admired this: *'the facts are there... I like to have things set in stone.'* [C] Giving a voice to science he suggested it would say: *'this is it and there is no other way to interpret this'* [C]. Harvey appeared to transfer this expectation of certainty of knowledge to Education Studies to an extent: *'I know there are some where it is fairly, kind of, concrete...like, we like to learn with images'* [C/St]. However, this statement was made with some hesitation, only 'some' knowledge is 'concrete' and the example he provided, that we all like to learn with images, is indicative of the types

of universal claims Harvey believes are made in Education Studies. That he thought knowledge claims in Education Studies were so broad appeared to form an important part of his evaluation of Education Studies later.

Harvey described the justification of knowledge in science and Education Studies to be highly similar. He said: *'I think once the experiment is sound, and [there is] a reason behind everything then they are fairly similar. They are good things to go by'* [J] He discussed how knowledge is produced in Education Studies by relating it to the production of knowledge in science, demonstrating his beliefs in both areas simultaneously:

*If you approach educational studies in the same way that you approach a scientific study... you should be able to, after years of testing, arrive at a law.*  
[J]

There are two points of note here. Harvey appears to suggest that a) laws are produced by repeating a scientific study over a period of years but also b) that this process also takes place in Education Studies and produces the same type of knowledge. It is only after saying this that Harvey thinks to himself: *'But I have never heard of a law in education'* [St]. It seems that Harvey was actively processing this during the interview, revealing prior beliefs and potentially reassessing them in the moment. However, in the immediate he continued to view knowledge in science and Education Studies as of similar nature. He suggested that he has *'never actually heard of any theories that are not based on experiments'* [J] in Education Studies. Of course, Harvey would have come across many theories in Education Studies, during his ITE, that were not based on experimental evidence. It is not clear why he would not recall these. Could it be that his preference for knowledge that is "science-like" meant that he filtered the information he encountered? Or that such preferences influence his recall of the content of ITE? Or simply that he did not receive any specific indication from teacher educators about how the knowledge being presented was produced and thus he presumed it



was like science? In any case, his preference for knowledge that is “science-like” is evident when he began to recount elements of Education Studies that he found useful:

*I quite liked effect-sizes. Because I could go ‘this is group work, it is really good. it has got an effect size of this.’... So, I liked to be able to know that there was a specific number associated with how effective things were.*

These positive perceptions towards Education Studies were followed by considerations apparently driven by his beliefs about scientific experimentation that raised doubt, and even annoyance, about Education Studies knowledge. *‘But then you were going “what was the criteria for the experiment that gave it this number” and that kind of annoyed me about it’* [J/So]. He had explained that *‘you will never get the exact same class in the exact same context’* [U]. Harvey had originally displayed a sense of openness towards Education Studies as he described it as a scientific evidence-base for teaching and learning. However, his belief that teaching was context-specific, and particularistic rather than universal, generated irritation because it *‘can be harder to pin down certain aspects. I think that is something that really annoys me about education’* [C/U]. These considerations also appeared to factor into this evaluation of Education Studies as ultimately not useful for professional thought and practice. One of Harvey’s concluding sentiments about Education Studies knowledge was that it was little more than a set of *‘idealistic notions ...because we don’t live in an ideal world, some of these things won’t work.’*

Harvey’s profile illustrates some possible implications when an individual’s epistemic beliefs about Education Studies are largely similar to the epistemic beliefs about science. However, it was in believing that educational researchers sought to make universal knowledge claims that became a “tipping point” for Harvey as it conflicted with his concept of teaching and learning as highly contextual. What use could universal knowledge be when contexts could vary from classroom to classroom?

### ***Bruce: A middle ground comparison***

Bruce described his school mildly, saying '*I definitely wouldn't have bad memories of it anyway*' but also spoke about a predominately '*chalk and talk*' experience. Bruce initially studied for another degree in university but didn't find it appealing and left soon after. Before returning to university, he began to read '*Pop Science*' books by authors such as Carl Sagan and Ben Goldacre. He said that changed how he viewed science, developing a deep interest in it and encouraging him to become a teacher of science.

Bruce presented an image of science as a field which is not wholly certain. He believed science was argumentative and tentative, with '*differing opinions*' [C] existing about what the right explanations may be. However, his stance is not entirely relativistic; he says among different explanations '*something is still correct*' [C], there is still 'a' right answer to be found. He actively rejected the idea of science as an accumulation of discrete pieces of knowledge. He viewed science '*as more of a method than a collection of facts*' [St/J]. He believed in a hierarchical organisation from domains that can conduct investigations in closed systems at the top (e.g. physics) to domains with less control over variables that are positioned lower.

*Like, nice reductionist things lend themselves very well to science. Like, there is nearly a hierarchy when you go to physics. There is a very nice...it very easily lends itself to controlled experiments and you can go all the way down to psychology, economics, sociology...There are so many factors and confounding variables that it is hard to control them. [C/St/J]*

Domains that are lower down in this hierarchy were still sciences, to Bruce, but they operated differently and produced different types of knowledge. In all cases, though, knowledge in science was understood to be justified '*by empirical data...[which] is gathered by the scientific method*' [J]. Bruce did not externalise the scientific methods as much as other participants; the way he interacted with science, particularly in his teaching, suggested that the source of knowing was not restricted to expert sources. He aspired to teach in a way

where *'rather than me telling them...[pupils] use the knowledge that they have'* [So]. He gave an example from a class that he taught on placement where he said: *'they figured it out...they invented a solar still without knowing a solar still was a thing'* [J/So].

Bruce suggested that Education Studies was also argumentative, potentially more so than science. He said *'there are experts in education that have completely divergent views'* [C]. Bruce differentiated between varying forms of knowledge in Education Studies, saying that *'some of it is empirical...some of it is based on political beliefs'* [J]. He also recognised that the word "theory" is not used in the same way in Education Studies as it is in science, saying: *'I don't feel like a theory [in Education Studies] has as much weight'* [C]. Bruce evaluated knowledge with respect to its form and what justified that knowledge. He said that knowledge that comes from the those like *'Paulo Freire...is not the kind of knowledge you get in science'* [St/J]. When considering empirical research in education, he said the *'evidence is weak, sometimes'* [J]. He went on to note:

*'I have seen very few things where I would say it is anywhere near the standard of scientific knowledge... I am not saying they are wrong, but I am saying that that is not the kind of knowledge you get in science.'* [C/J]

Despite his critical evaluations, Bruce held positive beliefs about Education Studies. He described some knowledge in Education Studies as *'practically useful'*. Other forms, he felt, provided *'nice frameworks for understanding'* and broadened his perspective, giving him an *'informed'* or a *'wider view'* or even a *'vocabulary to think a little better'*. Bruce concluded that Education Studies knowledge is not just relevant but, with a more impassioned manner, *'extremely relevant'* for teachers. Furthermore, he lamented the rejection of Education Studies knowledge by other practitioners, and felt this would lead to teachers being powerless where they could otherwise be agents of change in the education system:

*I think you are lost without it. And I think it is huge problem...the most powerful force [teachers] that can be mobilised to prevent bad things from happening [in the education system] are asleep at the wheel, so to speak.*

Bruce represents a middle ground, a more nuanced, position between epistemic difference and epistemic similarity. The representation of his position on Figure 1 is not exact. The profiles are mapped relative to one another rather than relative to an absolute spectrum. Bruce is not proposed as “an ideal”. However, Bruce appeared to hold a more detailed and arguably more accurate picture of the nature of scientific knowledge, the nature of knowledge in Education Studies, and the relationship between them. Bruce explained that knowledge served different purposes, particularly in Education Studies where not all claims were about *what is* but *what could be* and *what ought to be*. Differing claims would require different evidence. His epistemic beliefs permitted a wider boundary of expectation for Education Studies, rather than expecting universal claims and how-to guides, he could also accept educational knowledge as frameworks for understanding and thinking.

## Epistemic Comparisons and Tipping Points

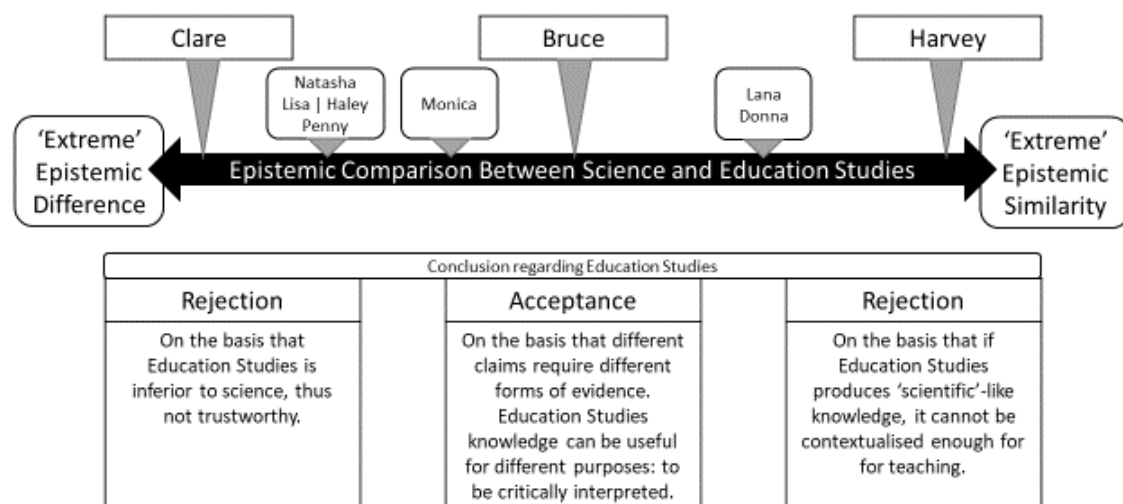


Figure 2 - Spectrum of Epistemic Beliefs Comparisons

The three profiles presented each arrive at somewhat different conclusions in terms of their perceptions of Education Studies. These conclusions are represented in Figure 2. Clare and Harvey could be categorised, in a rudimentary way, as having rejected Education Studies as professionally useful. These rejections appear to be facilitated by their epistemic beliefs.

Clare concluded that Education Studies was essentially less trustworthy based on its epistemic inferiority to science, while Harvey appeared to equate Education Studies with his epistemic standard of science, generating universal knowledge but later doubted the suitability of this for contextual educational purposes. Bruce's more nuanced position, where he recognised there were different types of knowledge claims that required different evidence and served different purposes, appeared to permit a critical yet positive perception of Education Studies.

When Figure 2 (representing the range of epistemic comparisons) is compared with Table 5 (representing the perceptions of Education Studies), the reader may question the shifting positions of participants. In Table 1, Clare has been categorised as *Disengaged and Dismissive* on the left, Bruce as *Passionately Positive* on the right, and Harvey as *Betwixt and Between* in the middle. These are distinctively different representations that illuminate different features of the findings. Table 5 illuminates the important *Betwixt and Between* group, of which Harvey was an example case to demonstrate an important point; That perceptions of Education Studies may be mixed or initially positive, but an epistemic "tipping point" (in Harvey's case, beliefs about the contextual nature of classrooms vs universal nature of Education Studies knowledge) appears to negate the other positive perceptions expressed. Figure 2, on the other hand, illustrates an additional important point about the relationship between epistemic beliefs and perceptions of Education Studies. It shows how there can be different epistemic belief profiles, not just one type, that generate obstacles for individuals to evaluate Education Studies positively. Both extreme epistemic similarity and extreme

epistemic difference appeared to facilitate negative conclusions in terms of perceptions of Education Studies. These extreme profiles, contrasted with more a nuanced middle ground profile of Bruce, indicates that epistemic development in both domains may be helpful to ameliorate obstacles to perceiving value in Education Studies.

## **Discussion**

Negative perceptions of Education Studies and the rejection of educational theory and research has been a perennial problem for teacher education (Darling-Hammond & Baratz-Snowden, 2005; Korthagen, 2010; Zeichner, 2010). Despite the growing understanding of the issue, it is as present today (e.g. Author et al., 2017) as it was over a century ago (Dewey, 1904). So, while it may appear to be a well-worn path in the research literature, new perspectives and greater understanding of the issue are still necessary. This paper does not test a “solution” but offers a new perspective with which to examine the issue; this is considering the role of epistemic belief comparisons between PSSTs’ subject discipline and other areas of professional knowledge. New perspectives such as this can be generative for the development of solutions or future research agendas.

Three key remarks can be made about the findings of this research. First, that epistemic beliefs were evidently important features of PSSTs’ evaluation of the utility of Education Studies. Second, that viewing science and Education Studies as either epistemically very similar or very different posed challenges for PSSTs’ positive evaluation of Education Studies. Third, that some PSSTs communicated positive perceptions of Education Studies but also experienced a “tipping point”, often epistemic in nature, where their positivity was negated. The implications of these remarks require some further elucidation.

The point that epistemic beliefs are important for PSSTs’ learning in their ITE has been cogently articulated by many scholars before (Bondy et al., 2007; Merk et al., 2017; Walker

et al., 2012). However, fewer scholars have considered the comparison between subject disciplines and other domains of teacher professional knowledge (Löfström & Pursiainen, 2015; Sjølie, 2014); even then, Sjølie did not specifically seek to explore such comparisons but noticed it emerge in her research and Löfström and Pursiainen's work investigated PSTs' epistemic beliefs in mathematics and pedagogy. This paper contributes to this literature by a) focusing on science PSTs, b) considering the domain of professional knowledge termed "Education Studies" as it is recognised in the Irish and UK context, and c) exploring *how* these beliefs are important through in-depth qualitative methods. Understanding the importance and influence of these epistemic beliefs has implications for ITE. Through the use of narrative profiles, differing combinations of beliefs and their influences have been illustrated. If teacher educators agree that positive yet critical engagement with Education Studies is a preferable outcome of ITE, then the middle of the spectrum in Figure 2 might be considered the preferred position. The findings of this study would suggest that PSSTs need explicit epistemic development, not just in their subject discipline but in other areas of professional knowledge too. Further, PSSTs may require support in crossing the boundary between disciplines and domains of knowledge. That is, there may need to be explicit support in comparing different forms of knowledge they encounter, often concurrently, in ITE.

Given the decades-worth of literature on a "theory-practice divide" and negative perceptions of Education Studies, it may be heartening to note that many PSSTs in this study held some positive perceptions of Education Studies from their ITE. Identifying the "tipping points", which can be epistemic in nature and lead to more negative conclusions, could be helpful in the generation of proactive solutions to assist PSSTs in reconciling these two bodies of knowledge for their future professional careers. Generating and testing such solutions offers fruitful ground for future research.

This study has implications for the three senses of “research-informed” ITE that were introduced in the beginning of this paper (Flores, 2016). Firstly, this research may inform teacher educators’ practice by illuminating obstacles for PSTs. Teacher educators may adjust their practice with the explicit goal of supporting PSTs’ epistemological development. Secondly, with the growing drive for PSTs to engage with research during their ITE experience, this study raises questions about how well PSTs are positioned to interact with such sources. It might be that in order to support PSTs’ effective engagement with educational research in ITE, such activities need to be infused with an acknowledgement of the epistemic nature of the research that PSTs engage with. Finally, with respect to PSTs’ engagement in research, it might be an area of future research and a focus for the practice of teacher education to consider research experiences as activities for epistemological development. Therefore, further research on this topic may consider the impact of research experiences on teachers’ epistemic beliefs.

The discussion about the need to support the development of PSTs’ epistemic beliefs, should not imply that all teacher educators have a “third person view” – unproblematic and objective – as they too will have epistemic beliefs about science and Education Studies. Research on teacher educators’ own epistemic beliefs will be central to the agenda that this paper advances and is a significant area for future research. For example, although research on science teacher educators’ epistemic beliefs about nature of science is fairly limited (Irez, 2006), existing research points to limitations in the preparation of teacher educators in dealing with epistemic issues. Author and colleague (2019) have problematised this point in the context of their own self-reflections on their career trajectories as teacher educators and researchers. They note that they are products of educational preparation that did not prioritise philosophical content, particularly in relation to epistemological aspects of science. Hence it



should not be taken for granted that teacher educators will necessarily be in a position to support PSTs' epistemological development in either science or Education Studies.

Beliefs and perceptions, particularly epistemic beliefs, are notoriously challenging to assess (Depaepe, De Corte, & Verschaffel, 2016; Mason, 2016; Pajares, 1992). This paper offers a methodological contribution in its use of multi-component interviews which are designed to approach the investigation of beliefs from different perspectives. We do not offer this as a complete or perfect approach, but an opportunity to reflect on the outcomes of another approach to assessing teachers' beliefs and perceptions. The multi-faceted approach gives researchers the ability to assess beliefs demonstrated implicitly by participants while also providing the participants opportunities to explicitly reflect on their beliefs and articulate them how they wish. It has been a useful tool in this study and offers a way of thinking about using multiple approaches to researching epistemic beliefs within a single interview. The drawback of this method is the length of interviews. With more components added to the process, the interview duration will naturally increase.

There are, of course, some limitations to consider when interpreting the findings of this research. Firstly, only three profiles are presented to illustrate a spectrum of beliefs. There is no indication of the proportions of students in the wider population who may fit into any one of these profiles. Connected to this, there is no way to claim generalisability of any of these findings. However, the findings may be considered "transferable" insofar as they may resonate with teacher educators who recognise similar statements from their own students in their own contexts (Tracy, 2010). The new interpretations given here provide a contribution to teacher educators' perspectives for their own contexts. We recognise that these new interpretations serve as only one piece of a larger puzzle when considering the "perennial issue" of the theory-practice divide and rejection of educational theory/research.

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# Appendix – Interview Schedule

## Interviewer Guide

*Italics represent primary questions. Bullet points represent probing questions, as needed.*

### Section 1: Own Education Experience

*Tell me about your own time in school as a student.*

- What was the school like for you?
- What memory stands out for you?
- Who was your biggest influence in school? What, from school, has influenced you in your learning?
- In what classes did you think you learn the most? Explain why.
- Does anything stand out to you about your science classes in school? Explain.

### Section 2: Teaching

*Tell me how you came to be a teacher.*

- What motivated you to pursue this teaching? Why a teacher of science?
- What appeals to you about teaching?

*Describe the best science lesson you have ever had as a teacher.*

- What was it that made this the best lesson?
- Probing for details depending on story. Who did what, how, why?

*Describe what, in your opinion, an **ideal** science class would be like? (Look/Sound/What would be happening?)*

*What do you think teachers need to know? How would a teacher come to know these things?*

*Tell me about what knowledge, if any, from your degree programme that you found useful to you as a teacher and why? [Can you tell me about when and how it was useful?]*

*In your questionnaire you talked about the supports you draw on for teaching as being\_\_\_\_\_. Can you tell me a little bit more about that?*

### Section 3: Learning

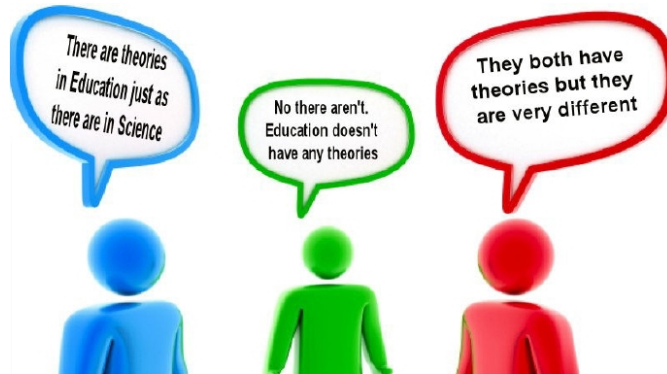
*Tell me about your learning...*

- How do you like to learn?/learn best?
- During ITE you have explored learning
  - Compare how you learn now to how you learned prior your initial teacher education.
  - Are there any differences?
    - If so, what are the differences and why do you think there are differences?
    - If not, why not?
  - Compare science learning specifically, if not already addressed.

*How would you compare learning in science to other subjects that you learn about in school or college? Are there differences or similarities?*

#### Section 4: Probing on Epistemological Beliefs

Show image:



Who do you agree with and why?

If someone asks you "what is science?", what will you tell him or her? (Tsai 2002)

- How would compare knowledge in science to other subjects or disciplines that you learn about in school or college? Differences/Similarities.
- What are the main characteristics of scientific knowledge?

If someone asks you "what is Education Studies?" what will you tell him or her?

- Could you describe for me any experience you have had with using educational theory, or where Education Studies has influenced your practice?
- What are the main characteristics of knowledge in Education Studies?
- What are the functions of Education Studies/ theory? What is the relevance of Education Studies/ theory?

#### Section 5: Probing Responses to DFEBQ Statements (Hofer 2000)

Example: In your questionnaire you responded differently on some questions when answering for science as compared to when answering for education. For example about Truth being unchanging in the subject. Show responses:

For Science

6. Truth is unchanging in this subject.				
Strongly Disagree				Strongly Agree
1	2	3	4	⑤

For Education Studies

6. Truth is unchanging in this subject.				
Strongly Disagree				Strongly Agree
①	2	3	4	5

Would you be able to explain what your thoughts are about this?