Teaching through textbooks: Teachers as practitioners of a discipline?

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Abstract

What is the role of textbooks in promoting teaching, and how does this role relate to teachers' subject knowledge, qualifications, and autonomy? In this article we study one aspect of the relationship between the use of textbooks and good teaching by examining how teachers' subject knowledge in the subject they are expected to teach relates to how they use and rely on textbooks. To do so we draw on ethnographic data including classroom observation of geography lessons and teacher interviews in upper-primary government school classrooms in Bihar, India. We analysed teaching episodes in terms of distinct pedagogical strategies, viz. ostensive teaching, acquaintance knowledge, and memory. These categories were identified through normative content analysis which recognises the distinct forms of knowledge, and specifically, different types of inferential relationships. This categorisation enables us to distinguish between teachers with and without a postgraduate or undergraduate qualification in geography in their use of the textbook and pedagogical strategies. Our findings support the claims of those who maintain that textbooks can be a powerful pedagogical tool, and not simply a teaching script in the hands of poorly-qualified teachers.

Keywords: geography teachers, textbook, ostensive teaching, pedagogy, memory and teaching

Introduction

The topic of the relationship between the use of textbooks and quality of teaching has not always received the attention that it deserves. In the UK in particular, but also in the US,

textbooks have been thought by some commentators and allegedly by those in authority such as Ofsted (Wynter, 2015) to mandate an ‘executive technician’ approach to teaching resulting in teacher lesson scripts which leave little or no room for teacher discretion (Winch, 2017). Hostility to textbooks is thought to arise from a variety of sources, including ‘progressivism’ in pedagogy and an associated craft conception of education, which emphasises the teacher’s autonomy and creativity and denigrates routinized approaches to teaching. Hence hostility to them by many advocates of the craft conception of teaching.

Questions on the role of textbooks are part of a larger debate on structured, standardised materials such as lesson plans, which critics including Apple (1982, 1993) maintain curtail teachers' autonomy, even though their widespread implementation suggests that policymakers believe in their benefits for students’ learning. This debate exists in developed countries such as the USA, but also in developing ones. For instance, Shalem et al (2018) argue in the context of a lesson-planning policy reform in South Africa that prescribed standardised teaching approaches only work well when teachers have the capability and capacity -- in terms of adequate knowledge -- to take autonomous decisions.

An important capacity needed to enact textbook content and curriculum more generally is disciplinary or subject knowledge. It is tempting to think that a teacher with good subject knowledge has good insight into how and what should be taught and is correspondingly less reliant on resources such as textbooks. However, there is broad evidence that places some doubt on this claim. For example, Schmidt and Prawat (2006) argue that effective educational jurisdictions depend on an authoritative source of educational objectives and that this, rather than detailed syllabi, is a significant factor in promoting curriculum coherence if combined with the availability of textbooks which conform to those objectives. Such attributes are associated with high performance on the TIMMS international mathematical test.

A further point, also drawn attention to by Oates (2014), is the fact that some high performing jurisdictions not only combine authoritative prescription of objectives with the use of high quality textbooks, but also with a highly qualified teaching force capable of autonomous practice. This is an interesting finding as it seems to contradict the view that textbooks are fit only to provide a pedagogical crutch for poorly qualified and motivated teachers. Oates goes on to argue that high quality textbooks allow teachers considerable professional discretion as to how they are used, which allows teachers to apply their subject knowledge to their ability to use textbooks to convert their knowledge into a pedagogically effective form for their students. In other words, the pedagogic content knowledge (e.g. Shulman, 1986) of highly qualified teachers with good subject knowledge can be enhanced by the judicious use of high quality textbooks.

In this paper our focus is on textbooks, but it is important to differentiate between textbooks and scripted teaching material. The latter are an important aspect of contemporary education reforms. For example, it has been noted that during the period of American Legislation, No Child Left Behind, scientifically-proven and commercially-developed scripted programmes to improve student achievement were popular (Wyatt, 2014; Ede, 2006). More recently, with the aim of providing Common Core State Standards in the U.S.

and as a corrective for “education by zip code”, that is to say constraints caused by children’s engagement in topics in school based on where they live, the New York State Education Department developed teaching materials in English and mathematics to encourage teachers to follow the common core with the aim of increasing equity (Timberlake et al., 2017). Teachers were expected to use these scripted materials, which, Timberlake et al. argue, led to compromised notions of teachers’ expertise. This implies that the expansion of scripted curricula internationally and its avowed aims of equity ought to be critically examined. Likewise in the UK, raising standards through scripted learning -- i.e. children and teachers working through printed lessons at a swift pace -- has been enlisted in schools (Abrams, 2017). Conceptually, what is the difference between a textbook and a manual of scripted lessons? One way to approach the distinction is to look at the intentions of the different parties. The intention of the author of a scripted lesson is to guide the teacher who uses it through a lesson, minute but minute, with minimal knowledge requirements on her part. The intention of a teacher using a scripted lesson is to follow the sequence indicated in the lesson, relying on the resources provided in the lesson, with minimal deviation from the sequence outlined.

With textbooks the situation is more complex. Sometimes the *author* of a textbook intends it to be used as a sequence of scripted lessons. This is sometimes the intention of *teachers* who use the textbooks, even if it was not the author’s intention. It may also be the case that *administrators* of the education system intend that teachers use the textbook as a scripted lesson, thus economising both on teacher preparation and on ancillary teaching resources. However, this need not be the intention of the author, who may intend that the textbook be used as a conceptual, factual, explanatory and activity resource for teachers to be used according to their professional discretion. Likewise, teachers who have the necessary knowledge, experience and confidence may intend to use the textbook in this way within the structure of the lessons that they have themselves prepared. We see examples of teachers acting in both ways in our data.

What we lack, however, is sufficient detailed knowledge of how teachers use textbooks in their classrooms and how their use varies with the subject qualifications of those teachers. The data that we have is a high-level correlation between system objectives, the use of quality textbooks and the qualifications of teachers. But how do teacher qualifications mediate the use of textbooks?

This of course is a very large topic, but the aim of this article is to provide some clues through the presentation of a qualitative study of geography teaching in Bihar, India. The close observation of geography lessons using textbooks by teachers with different levels of qualifications in geography, together with teachers’ own commentary on how they view their lessons provides some lines for further investigation of the relationship between subject knowledge and the effective use of textbooks. This is a context where teaching is known to be textbook-centred (Clarke, 2001; Rao et al., 2003; Sarangapani, 2003) and classrooms dominated by a ‘textbook culture’ (Kumar, 1988). We examine teaching episodes for geography lessons in terms of distinct pedagogical strategies developed through content analysis (Krippendorff, 2012) which recognises the distinct forms of

knowledge behind school subjects. We interpret these strategies to have meaningful differences depending on whether teachers themselves had a qualification in geography (postgraduate or undergraduate), and our findings bear out the claims of those who maintain that textbooks can be a powerful pedagogical tool, and not simply a teacher script in the hands of well-qualified teachers.

Conceptualising knowledge and subjects at upper-primary level

In this section we discuss philosophical perspectives on the types of knowledge and their relationship with school teaching. Through this discussion, we explain how forms of knowledge give rise to a categorisation of teachers' pedagogical strategies which we then employ to analyse how they use textbooks to teach.

School knowledge is widely categorised in terms of subjects, behind which lies the assumption that different subjects – or, in Hirstian terms, different forms of knowledge -- equip children with distinct tools of enquiry to verify knowledge in respective domains, a view explained by Hirst (1974, pp. 30–53). Subjects involve three different modes of knowledge;[1] knowledge by acquaintance, propositional knowledge and knowledge how (Hamm, 1989). This way of looking at subjects allows both practical and propositional knowledge in thinking about teaching and learning (Winch, 2013), and more than one mode of knowledge is required to know most subjects: knowing facts and propositions, knowing how to explain them, understanding the inferential nature of knowledge contained in propositions, and knowing the ways by which knowledge can be acquired such as through the senses, testimony, explanation and action (Hirst, 1974; Brandom, 2000). An understanding of the subject comes about from not only learning distinct propositions, but in turn, understanding the inferential relationships between concepts particular to the subject (Brandom, 2000) as well as those from other subjects.[2] Learning a subject is, among other things, acquiring central concepts relevant to the subject together with the inferential relationships between those concepts (Winch, 2013, p. 134).

Each subject has a conceptual structure which learners need to master if they are to progress in the subject.[3] This structure consists of different kinds of inferential relationships. *Deductive* relationships which can be modelled formally, such as relationships between laws and particular instances of those laws (Hempel, 1983). *Inductive* relationships such as those between observation and prediction (Hacking, 2001) generally describe empirical relationships between phenomena. *Material inferential* relationships on the other hand describe conceptual relationships that cannot be captured formally through a deductive system. These can sometimes be quite tightly specified, as is the case, for example, with colour concepts (Wittgenstein 1979, 1991) or they can be somewhat looser. This is often the case with key conceptual relationships that we find in school subjects.

Let us take an extended example. In order to understand the concept of a map and its potential uses, a child already needs some grasp of more primitive concepts, i.e. concepts which presuppose but are not presupposed by the concept to be explained. A map is a spatial *representation* of a segment of space. Thus, someone who understands what a map is, needs to have some grasp of what the practice of representation involves. We may

characterise this as the substitution of one entity for another in order to serve a practical, theoretical or aesthetic *purpose,* in this case the practical purpose of describing and orienting oneself in the space represented. But because using A to represent B is an intentional act, it is done for *specific purposes*. These include for example explanation or navigation and the map will *select* for representation those features of the spatial environment that serve those purposes. The practical imperative and the principle of selection will in turn determine *scale* and *symbolisation*. Symbolisation again depends on a grasp of a representational principle that allows the map reader to infer a token item in the space mapped using a symbolic typology underpinned by a convention which is used to match items in the space represented onto the map. Depending on its purpose, a map allows inferences to be made concerning distance, height, vegetation, transport links, urbanisation etc. But the child can only begin to make these inferences on the basis of a prior understanding of *spatial representation, scalar representation, symbolic representation* and *selection for a purpose,* together with their relationships, for example that scalar representation is a form of spatial representation or that choice of symbols and what they represent is purpose-dependent. The child does not need to articulate these relationships explicitly in order to use and understand a map, but does need to manifest an implicit understanding based on practical inference. Part of the work of a teacher explaining the principles of mapping is to facilitate the ability to make such inferences not only by developing know-how through acquaintance with the map and what it represents but also through explanation, making conceptual connections explicit so that the map can be used, for example, to infer distance between settlements or the difference in height between one hill and another.[4]

In general therefore, for teachers to explain inferential connections, they must not only have knowledge of that subject but also understand the nature of this knowledge. Teachers' subject knowledge can be understood as comprising a system of inferentially related concepts, norms and propositions (Brandom, 2000). It also involves understanding the terms on which these propositions are acquired, validated and rejected within the conventions of the subject (Hirst, 1974), and the conceptual debates about the nature of that subject (for example, Phillips (1970) and Hirst (1970) on religious education). In turn, teachers' pedagogical content knowledge can be understood as their ability to decide how best to explain subject content knowledge, given a conception both of the learners and the nature of that subject.

Applying this conceptualisation to teaching and learning geography would mean that that which is inert for students needs to be made explicit by teachers, bringing out the relationship between the different concepts embedded in the practice of geography (examples of which we present below). Learning is not simply the acquisition of isolated concepts (in terms of their definitions or representations) or amalgams of lists of propositions; rather, it is a graduated way of grasping the interrelationships between respective propositions and making use of the concepts within these interrelationships. Good textbooks help ensure that concept acquisition and mastery of the relevant conceptual field occurs through the judicious use of examples and exercises.[5]

Study design

The data for this study were collected in Bihar, India, over eight months of ethnographic fieldwork in urban government schools in 2011-12. As part of a wider ethnographic study to understand conceptions of teachers' knowledge, one of the authors observed geography lessons taught by six teachers at the upper-primary level (grades 6-8; ages 11-14 years) and conducted semi-structured interviews to talk about their teaching. The analysis presented here is based on transcripts from 42 standard lessons, each of which lasted 30-40 minutes, and were usually based on one lesson from the textbook prescribed by the Bihar government. The choice of schooling level is significant, because upper-primary is the stage at which subject distinctions start to become important in the school curriculum. Most students had copies of the textbook while a few shared with one another. The medium of instruction was Hindi, which was subsequently translated into English for analysis. Classroom observations were focussed on understanding teachers' teaching strategies including the lecture, the use of teaching aids – primarily the textbook and blackboard -- and (occasional) interactions with students. The interviews with teachers focused on their classroom teaching in order to further understand their conceptions of propositional knowledge in the subject, the role and authority of the textbook, and how they understood students' learning.

At the upper-primary level in Bihar, geography forms part of the subject 'social studies' which also includes history and civics. Geography provides an opportunity to understand the teachers' world pertaining to forms of knowledge associated with both the physical and social sciences. In the physical sciences for instance, understanding notions such as cause and effect, time, and substance, require methods of observation and experimentation, while in the social sciences, notions explored could include purpose and will, to be studied through interpreting the reasons for action (Hamm, 1989, p. 69).

In common with most government-school teachers, the teachers in our study all held a pre-service teacher-training qualification. They also had a bachelor's degree in different subjects, and in our analysis we distinguish between the teaching of those who held a bachelor's in geography – the subject teaching we focus on – and those who held a degree in other subjects. To make this distinction clear we refer to teachers who held a bachelor's in geography with (G), and those whose bachelor's was in some other subject with (O).

Table 1: Teachers in the study

Teacher	School	Years of teaching experience	Qualification	Subjects currently taught	Teacher Training Completed[6]
Maya (O)	Kalidaspur	30	MA Hindi	Social Studies, Hindi	D.Ed.
Prakash (G)	Ramdaspur	15	BA geography	Social Studies, English	B.Ed.
Srikant (O)	Radhapur	14	MA Hindi	Social studies, Hindi	B.Ed.
Sukumar (O)	Radhapur	15	B.Com.	Social studies, English	B.Ed.
Umesh (G)	Mohanpur	15	MA Geography	Geography	B.Ed.
Sulekha (O)	Kalidaspur	20	MA Hindi	Social Studies, Hindi	B.Ed.

Studying the 42 transcripts of classroom teaching, we analysed the pedagogical strategies commonly deployed by teachers using philosophical and empirical literature, while also bearing in mind the Indian context.[7] Through this analysis, we develop the following pedagogical categories to analyse the teaching: ostensive teaching, the use of acquaintance knowledge in explaining a proposition or a concept, and repetition of facts and the role of memory. Below, we discuss teaching and interview excerpts to illustrate the role of the textbook in each category of pedagogical strategies.

Teaching through textbooks

The overall structure of teaching in these classrooms corresponded closely to that described by other researchers in this context. Echoing Sarangapani (2003) and Clarke (2001) teachers stayed within the ambit of the syllabus and the content of the prescribed textbook, and would usually use each lesson to teach a new chapter from the textbook, reading it aloud themselves or calling upon one or more students to do so. Following this, there would be sessions in which students would answer the questions given at the end of the lesson, either in written form in their notebooks, or by saying them out loud on invitation of the teacher.

The teachers used standard textbooks provided without charge too all government school students under the Sarva Shiksha Abhiyan, a national school education programme.[8] These were published by Bihar State Textbook Corporation in 2008, and are based on the

National Education Policy of 1986. Our study examines teaching episodes based on the grade VI and VII textbooks. For grade VI, the section titled “Our Earth”, which includes chapters on the solar system, movements of the earth, longitudes and latitudes; region-specific discussions on Africa, South America, Antarctica; and how to read maps. From the grade VII textbook, the episodes relate to the “Atmosphere” section with chapters focusing on the layers of the earth, air temperature, pressure belts; besides regional studies such as North America, Europe, Russia; and a section on maps, stars and how to read the weather.

It is worth presenting one example in detail, which we draw on below as well. The chapter titled “Air Temperature” in grade VII begins by defining temperature (“the measure of heat in air is called temperature”) and offering various facts such as the use of degrees Celsius for measuring temperature using a thermometer. It then provides several facts about solar radiation in the space of a few lines:

> the sun radiates large amounts of heat which the earth receives, this is known as solar heat. The distance from the sun (15 crore kilometres) and the earth being much smaller than the sun means that our planet receives only one-billionth of the sun’s energy. The energy from the sun is reflected from the earth’s atmosphere, including reflections from the sea water.

This is followed by a section that discusses the different factors that affect air temperature, viz. latitude, distance from the sea, and altitude. Each of these is explained briefly. To illustrate, the role of latitude is explained as follows:

> As we move away from the Equator, where the sun’s heat is received maximally, the temperature decreases in both hemispheres. Near the poles the temperature is very low, and this is the reason why the temperature in Moscow is much lower than in Mumbai. There are two reasons for this. One, as we move away from the Equator (where the sun’s rays fall directly) the rays begin to slant. Two, in the higher latitudes, the sun’s rays have to pass through more of the atmosphere because of which more of their heat gets dissipated in the atmosphere and less reaches the earth’s surface. Also, some heat gets reflected by ice on the earth’s surface.

There is also a diagram representing the angles at which the sun’s rays can fall on the earth’s surface: slanting during the morning and evening, and perpendicular in the afternoon. These excerpts, and the structure and nature of how the material is presented, is suitably representative of the textbooks more generally, including for the lessons we draw on in this paper.

We now examine teaching episodes where teachers used the textbooks through ostensive teaching, acquaintance knowledge and memory.

Ostensive Teaching[9]

Ostensive Teaching, the act of pointing towards images and representations that are crucial to understanding concepts and associating them with the appropriate vocabulary, was an essential part of teachers’ efforts to explain the textbook content in all the teaching episodes we observed.

Maya (O; see table 1) frequently privileged the acquisition of factual knowledge through ostension in her teaching. For example, she would often try to introduce facts, diagrams or maps by reading out loud or pointing towards them (in the textbook). In one instance, while teaching a chapter on the earth's rotation and revolution, Maya copied a diagram from the textbook onto the blackboard showing the positions of the sun, the earth, and the earth's orbit and repeated their names while pointing towards them. In another instance, she asked students to trace out the political map of India (showing states' boundaries; in particular, the location of Bihar) onto a large sheet of chart paper.

In an interview discussing why she emphasised ostensive teaching, she explains how showing children a map from the textbook helps them remember what a map is:

> Suppose we say that this is a picture of *Munger*. Or this is… is *Bhagalpur*, this is *Satpura* and this is *Lakhisarai*.[10] If we tell him this... or [points out] the route from here to here... If he sees this it will have a greater impact. It'll have more influence… He'll remember it. If he sees it once he'll see that yes, this is the picture of Bihar, this is where *Munger* is, so he'll really get to know it...

The practice of specialist teacher Umesh (G; see table 1) was different. Umesh too, frequently employed ostensive teaching and copied out figures from the textbook, but appeared to recognise that something more was needed for children to understand a concept. The following instance is from a grade VII class taught by Umesh on the topic of pressure belts.

> Umesh [pointing to a diagram drawn on the board]: Polar winds blow from the high-pressure polar regions towards the low-pressure sub-polar regions… from the part of the polar region that has high pressure [walks towards board and draws on it]… that's where it starts from, and it goes towards here [points]. So it moves from up here to down here. And this region here is a high-pressure region in the polar area, and the low pressure area is the sub-polar region, meaning up until the sixty five degree latitude. That's how far these winds blow up to. Alright? In the northern hemisphere their direction is north-easterly. What is their direction?
>
> Students: North-easterly.

This excerpt shows that Umesh also used ostensive teaching as a starting point and structured his teaching according to the textbook. Yet unlike Maya provided more description, explanation, and factual information based on a diagram copied on to the blackboard. He did so using vocabulary and sentences which were his own, rather than reading the textbook aloud. We can reflect further on the differences in their practice by recognising the limitations of ostension as a pedagogical strategy. As Wittgenstein (1953) points out, ostension is an important part of acquainting students with new concepts, but on its own it is minimal so far as explaining a concept is concerned since it only works against the background of some conceptual field.

An associated problem with explaining by ostensive teaching is the potential for confusion in students' minds. In the case of maps, this could be about which particular aspects of the figure being shown constitutes a map: the boundary, the direction, or the colours used to show various districts. Ostensive definition may be needed, together with explanation, to

make these distinctions clear. In other words, mapping conventions need to be taught, partly through ostensive definition, before particular maps can be explained.

We can apply this to the examples with Maya's teaching above, where she attempted to explain a map or figure by pointing towards it yet did not attempt to point out interconnections between the attributes (e.g. map boundaries and colours; or the earth's orbit and the sun) and how they come together in a specific spatial representation. Her 'common-sense' explanation of pointing towards something is not enough for a student to know or understand a map or figure, without also being able to understand its relation to the space that it represents, or the idea of scale which makes it intelligible as a representation of reality. A student might still be able to copy the map from her book, or from the blackboard as a sample of what was pointed out, without gaining a functional understanding of a map.

We might suggest that Maya's practice reflected limited use of the textbook content, where the textbook was used as a 'crutch' -- the basis to ostend -- and the teacher herself did not move beyond it in terms of providing explanations and specifically drawing out interconnections between the facts she was presenting. Maya did not go on to explain this diagram further, and so the students were left with ‘isolated ostensions’ instead of a conceptual understanding built upon the basis of connecting multiple propositions: the spatial arrangement of the solar system; the movement of the earth around its axis and along its orbit; the consequences of these movements in terms of day/night and the seasons. At the end of a lesson students may have memorised a set of propositions as expected, in the sense of being able to recall them, but they would have remained unaware of their interrelationships and would be poorly equipped to construct explanations based on them.

Recognising these differences and commonalities of pedagogic strategy is a useful starting point for differentiating between specialist and non-specialist teachers. As we now discuss, the differences extend to the domain of other pedagogical strategies as well. While still adhering to the textbook so far as curricular content goes, specialist teachers frequently combined ostensive teaching with acquaintance knowledge examples, had a different understanding of memory compared to their non-specialist counterparts, and were more likely to use props such as a globe.

Acquaintance knowledge

All six teachers consistently used acquaintance knowledge as a pedagogic strategy. Unlike their use of ostensive teaching, they provided acquaintance knowledge examples which were not drawn from the textbook even though they were focused on explaining textbook content. The way they deployed these examples varied according to their backgrounds. Compared to their specialist counterparts the non-specialist teachers spent less time developing and explaining acquaintance knowledge examples, and in the instances we observed, these examples were less clear and in some cases potentially confusing. Specialist teachers also appeared more confident and flexible in their deployment of such examples.

The first episode presented below is from a grade VII lesson on Air and Temperature taught by Maya (O) using the corresponding textbook chapter that covers topics including temperature and radiation. Maya used acquaintance knowledge to introduce the chapter, reminding students that Munger -- where the school is located -- had recently experienced a severe cold wave due to which schools had been shut down. She then moved on to specific topics in the chapter, closely following the path defined by the textbook, reading aloud from it and pausing to give examples or reproduce diagrams from the textbook (such as the rays of the sun) on the blackboard.

Below, Maya was using the textbook to explain how the sun's rays reach the earth having passed through layers of the atmosphere, as part of the topic 'radiation'. After reading out from the textbook, Maya went on to introduce an analogy based on the environs of the classroom – viz. ceiling fans -- and drew again on students' acquaintance knowledge:

> Maya: Now, all the energy radiated from the sun does not reach the surface on earth… A big part of it gets reflected by the atmosphere, back into the universe. For example, the air blown by a fan from on top first touches you people and reaches the ground after that. Just like that, the sun's energy first touches the atmosphere, and after that it reaches the surface of the earth. Alright? You've understood this, right?
>
> Students (together): Yes madam.

This fan analogy is limited in its ability to illustrate the process of radiation, and seems to have the potential to mislead students by suggesting that atmospheric reflection was analogous to ceiling fans moving air around in the way that it reaches a person 'first' and the floor below them 'later' as if the individual managed to deflect some of the air. Maya did not follow this explanation with dialogue to assess whether students had understood the analogy, so it remains difficult to assess the success of this acquaintance-knowledge example.

The next episode is from Prakash's (G) grade VI classroom where the lesson being taught was 'Movements of the Earth'. Prakash began by initiating a discussion on what was apparently a background to the textbook content but did not reflect or draw directly on material in the textbook at this stage. He asked the students

> So what might the earth's revolution feel like in real life? It's similar to going round and round a temple.

Going 'round and round a temple' is an activity most children in the class would be very familiar with and would be able to picture immediately (perambulating a temple perimeter is a regular ritual before offering prayers inside), so that this constitutes an attempt to initiate students into thinking about possibly abstract and unfamiliar subject content by first linking it to a familiar activity they are well acquainted with. Prakash then went on to discuss how summer had long and arduous days and demonstrated the inclination of the earth's axis by drawing a diagram on the blackboard, pointing to the diagram to explain why, because of the tilt, certain parts of the earth are closer to the sun than others. In a second teaching

episode on the same topic, Prakash presented other examples of acquaintance knowledge to explain how the earth turns on its axis while the sun stays stationary:

> Prakash: And one of you might question the fact that I am repetitively referring to the earth moving, even though you have actually experienced is that the Sun moves from one side and sets on the other. Isn't that right?
>
> Students (together): Yes sir.
>
> Prakash: We can see somewhat obviously that the sun rose in the morning in one direction, then it was shining on our head, and when we were leaving school then it was setting on the opposite side. And school remained in the same place. Couldn't you raise such a doubt?
>
> Students (together): yes sir.
>
> Prakash: And if it is true that the earth moves, then why has the river Ganges not moved from its place? Haven't you travelled in a train...
>
> Students (together and loudly): Yes sir!
>
> Prakash: ... and as the train speeds along, so do the houses and trees? ...We say "Look this tree running behind!" or "Look! This house is moving"... This is what happens when the sun looks like it is moving along with the earth, and we feel that the sun is moving. But the sun is stationary in its position, and since our earth is tilted towards one side we feel that the sun appears to move from one side to the other. The reality is that the earth is continuously moving.

On their own, it seems unlikely that the classroom discussions initiated by Prakash are sufficient to enable a full grasp of how exactly days and nights are caused, or how seasons are caused by the tilt of the earth's axis.

In a third teaching episode, Umesh (G) was teaching the grade VII lesson *Earthquakes*.

> Umesh: What do we call this? (pointing to the textbook?)
>
> Students (together): EPICENTRE!!!
>
> Umesh: Yesterday when a scorpion bit me then it was just like this earthquake… the place where it bit me was the region of origin, and just above it was the epicentre. And how we experience an earthquake is that as we go further and further away... It bit me in the finger, and how far could I feel the pain? All the way here in my arm up to here. Alright? So it is the same thing with an earthquake. Directly above the origin is the epicentre, and from there as it expands in circles, the sensation of the earthquake goes on decreasing. The further we go from it… the furthest edge will have the least damage.

This analogy of the pain from a scorpion's bite radiating outwards in a pattern similar to the impact of an earthquake from its epicentre outwards -- drew upon students' acquaintance knowledge of scorpions and their painful bite based on others' testimony. However, it was limited by not conveying the notion of depth, in that an earthquake's epicentre lies below the surface of the earth whereas a scorpion's bite is on the skin.

A few points emerge from a comparison of how Maya (O), Prakash (G), and Umesh (G) used acquaintance knowledge as a pedagogic tool. All three used these examples to

support explanations of textbook content, and it is this content and sequencing which structured their lessons. But in contrast to Maya's fan-air analogy for radiation, the scorpion bite analogy for earthquakes is closer to being a simplified representation of the actual phenomenon. It too is not ideal since it conveys neither vibration nor depth which are both involved in explaining earthquakes. But unlike the fan air analogy, it does not convey a false notion, and it does convey some of the features of earthquakes. Prakash's analogies based on movement around a temple or on a train are likewise reasonably accurate and have the potential to explain the underlying phenomena to students. Unlike the examples given by Umesh and Maya, they relate directly to the events he is attempting to explain. Compared to Maya, Prakash and Umesh also spent longer introducing and discussing their acquaintance knowledge examples and provided more detailed descriptions. Prakash provided two or three related forms of his chosen example(s), and even Umesh used different turns of phrase in an attempt to convey meaning. The specialist teachers were thus more flexible and confident in their use of acquaintance knowledge, and arguably their examples were more useful too.

Memory

Indian school classrooms have long been characterised by teachers' use of memory-based pedagogical devices such as repetition and recall, and this phenomenon is heightened by the pattern of examinations that reward successful recall powers (Alexander, 2001; Clarke, 2001; Sarangapani, 2003). In this regard our data are somewhat typical. Even though the teachers in our study emphasised memory, there were important distinctions between how specialist and non-specialist teachers understood the role of memory in relation to the textbook.

To make sense of these distinctions we found it useful to think of the different roles played by memory in teaching concepts, viz. recall and remembering. Recall refers to the ability to recount something learned in the past, usually explained as the ability to store a replica or representation of a fact or image in mind, and reproduce it when called upon -- something that the teachers expected their students to do. Remembering involves accurate recall and can be manifested in different ways (Malcolm 1977). The ‘storehouse’ image, although tempting, is not necessary to account for remembering. As noted, remembering can take place in more than one way, but Wittgenstein's paradigm-shifting insight was that in most cases it involves attention or action on the part of the person doing the remembering and more often than not is an *ability*. For example, to be able to reconstruct a fact like 8 X 16= 128 requires remembering that 'X' stands for multiplication, and knowing the underlying concept and the steps involved in executing it. We can also relate this to the example of a map which we discussed earlier. Inferences about distance and other details represented on a map require a prior understanding of spatial and other types of representation. The child must be able to remember what representation does in this context, or in other words, be able to reconstruct what representation means; that two points A and B on a map correspond to roads, rivers or buildings A and B in the real world. Only then will she be capable of practical inference using the map. Her use of the map is a manifestation of her remembering what representation is in this context.

We found that specialist teachers tended to use memory in the sense of reconstructing facts, while non-specialists emphasised verbal recall. In the excerpts presented below, Maya (O) spoke of memory in the Lockean way (Malcolm, 1977, p. 17), as a place where sensations and ideas and impressions can be stored, viz. "[m]emory is as it were the storehouse of our ideas" (p.18). This kind of recall demands rote or focused memorization, and is not seen as a condition for successful remembering in current neuro-scientific conceptions of memory -- themselves heavily influenced by Wittgenstein's pioneering insights (Moyal-Sharrock 2009). Maya explained the emphasis she placed on repetition and memory as follows.

> When you repeat something, when you say something twice, then your confidence goes up, that yes this must be correct because madam has said it twice, three times. So it must be right. So this is something that the students also think about, and the speaker also says it twice or thrice so that the child will hear it at least the once.

She also explained that she was concerned about children who came from poor backgrounds who may not have the time or space when they went back home to revise their lessons. The repetition in her teaching aimed to counter this deficit. Explaining the importance of memory in 'grasping' knowledge, she gave an example of her experience as a student, wherein she benefitted from having a good memory and the consequent ability to reproduce several pages from her (Hindi) textbook without undue effort. She felt that memory is needed as an insurance against all eventualities that might demand recall: especially particularly hard exam questions. In particular, she felt that there was "no point writing it down in the notebook; might as well write it in your mind":

The following excerpt where Maya was teaching the lesson titled 'The Atmosphere' to Grade VII students, illustrates the emphasis she placed on repetition, periodic questions, and thereby the recall form of memory.

> Maya: We are going to learn about 'the structure and layers of the atmosphere'. What are we going to study today?
>
> Students (a few, together): The structure and layers of the atmosphere
>
> Maya: Yes. Its layers. All around the earth… What the atmosphere is, what kind of atmosphere is around us, right? ...So. What is the gaseous covering all around the earth known as? We call it the atmosphere. What do we call it?
>
> Students (together): Atmosphere!
>
> Maya: We call it the atmosphere right? First, how high is the atmosphere above the surface of the earth? ...it is considered to be up to seven hundred to eight hundred kilometres above the surface of the earth. It is considered to be seven hundred to eight hundred kilometres above. From the earth. The height of the atmosphere from the earth is seven to eight hundred kilometres. Right?

Maya believed that this manner of repetition and recall formed a privileged pedagogical move as part of her teaching strategy: since these facts were part of a textbook written by experts, they were deemed testimonial knowledge (Chakrabarti, 1992; McNulty, 2013; Moran, 2013) that needed to be transmitted to students. This status was further reinforced

by the importance of these facts for evaluation since they often correspond to the revision questions at the end of the chapter, which in turn, students could reasonably expect to see in exam questions.

An additional aspect of memory relates to its links with mental images. In the interview excerpt below, Maya articulated the importance she places on television and visuals. She explained that in the contemporary world students are exposed to a wide variety of visuals, especially because of the prevalence of television, and are not limited by tales and stories about places. Unlike before, things can be seen now, and this seeing leaves a lasting impression. And so, she felt that sight played a major role in verifying the facts and information we may have heard about from somewhere, and visuals can thereby reinforce facts provided by the textbook:

> What I meant was what I hear... like 'India is a great country', there are so many states in India, Mumbai is so many kilometres from here, people in Mumbai have high standards. However, the same thing we watch on television, the big buildings in Mumbai, the educational institutions -- then we think, yes this is right. What we read can be forgotten, but what we see is more likely to have a lasting impact.

This image of the mind where knowledge can be written down in a way that the learner never forgets -- a storehouse -- tempts one to conclude that the mind bears imprints. It is possible that if one thinks of the importance of factual knowledge and the role of memory in remembering this, then one comes very close to an understanding of the mind that likens it to a place where impressions, images and ideas are stored. As Malcolm (1972) explains, this view is limited in explaining how learning takes place:

> Locke and Hume thought that we obtain concepts from "experience". We experience a sensation (or "impression") of red colour, and we draw out of the sensation, in some way, the concept of red. On their view the concept might be likened to a diaphanous membrane which we peel off from the sensation and store in our minds, where it serves as a pattern to guide our future recognitions. (pp. 39–40)

> Why should it be assumed that if I am presented a copy of something, I shall know how to make use of it? This is not true of the maps, drawings, or models that we can hold in our hands and study. Why should it be true of copies of patterns *in the mind*? If a picture is going to be useful to me, I have to know what to do with it. This is not guaranteed by the mere fact that picture is placed in my hand, or mind. (p. 42)

In the excerpt below, Prakash (G) was teaching a lesson on earthquakes and his pedagogical strategy suggested a reconstruction-based view of memory. While the textbook provided a technical definition of earthquakes, Prakash began by referring to a local, devastating earthquake which took place in 1934 and would have been familiar to students through family lore. Weaving acquaintance knowledge in this way in an attempt to get students to remember the textbook's lesson content highlights how he upheld the 'contextuality' or 'situatedness' of memory (Moyal-Sharrock, 2009, p. 220). In other words, the interaction between the person and the environment in which the act of memory occurs is important for remembering to take place (p.220).

Prakash: Have you ever felt an earthquake?

Students: no sir

Prakash: You haven't? ...the place we are living is part of the earthquake zone, and 1934 is witness to this, when Munger was devastated in an earthquake. The earthquake came in June, which we still mark as the month of the earthquake... So let's first find out what an earthquake is, and after that we'll move to why and how it takes place. No-one has felt an earthquake… but have you heard the term?

Students (together): yes sir!

Prakash: What happens?

Student: …the earth starts shaking... the earth is made up of small plates, and when these plates collide with one another then earthquakes take place.

Kampan, the Hindi version of the phrase "the earth starts shaking", communicates the sentiment that Prakash wanted his students to 'remember' including what they might have heard from their family members about this historic earthquake.

Prakash: That [definition] is something I hadn't learned even in my postgraduate [degree]! Okay thank you (laughs).... And many children would not have understood how plates come to collide with one another, or what plates are in the first place… But it was a very good answer. Would anyone else like to try answering the question?

Student: When the surface of the earth suddenly experiences vibrations then that is called an earthquake.

Prakash: Very good...

Prakash preferred to continue with the path of his original discussion (and in fact somewhat dismisses the textbook definition for being too complicated) even though one student offered the textbook definition. His emphasis remained on getting students to understand earthquakes first, and base the remembering of any definition for earthquakes on this understanding. We now discuss the wider implications of these observations.

Discussion

In this article we have examined how teachers use textbooks in upper-primary classrooms in government schools in Bihar, India. Our intention was to empirically study how teachers use textbooks in classrooms within a context known to be textbook-centred (Clarke, 2001; Rao et al., 2003; Sarangapani, 2003) and dominated by a 'textbook culture' (Kumar, 1988). Through this analysis our aim is to engage with the idea that textbooks are fit only to provide a pedagogical crutch for poorly qualified and motivated teachers, and underlying questions of teachers' expertise and the idea that effective teaching demands only an 'executive technician' wielding the appropriate textbook.

We analysed a set of geography teaching episodes in terms of distinct pedagogical strategies, viz. ostensive teaching, acquaintance knowledge, and memory. These categories were identified through normative content analysis which recognises the distinct

forms of knowledge, and specifically, different types of inferential relationships. The role of inferential relationships characterises disciplines more generally as well as school subjects, which are based upon the former. The aim of a learner mastering a subject is then to make, recognise, and understand these inferential connections.

We focused on how teachers deploy these strategies in relation to using textbooks. We interpret these strategies to have meaningful differences depending on whether teachers had a qualification in geography (postgraduate or undergraduate). Both types of teachers relied heavily on ostensive teaching and followed the textbook to structure their lessons. Yet specialist teachers more frequently combined ostensive teaching with acquaintance knowledge examples, and drew upon a more relevant and wider range of acquaintance knowledge examples. Specialist teachers were also more likely to use props such as a globe. Crucially, they also differed in their understanding of memory, tending to use memory in the sense of reconstructing facts and reinforcing factual and conceptual connections through different activities, whereas non-specialists emphasised verbal recall in response to stand-alone questioning.

How should we interpret these findings amidst the broader debates on teachers' expertise and the role of textbooks? Our findings support the claim that textbooks can be a powerful pedagogical tool rather than a teacher script when used by qualified teachers -- in our case, those with a qualification in geography. It is worth recognising that the textbooks being used were fact and definition-heavy, and provided few instances of attempts to explicitly build inferential connections. It is against this background that we observe both types of teachers attempting to draw inferential connections largely of their own making, and our argument is that specialist teachers are more successful in doing so. Specialist teachers are then not technicians of the textbook practicing rigid rules and precepts based on it, but instead use discretion and judgement, bringing their craft to the fore. This also brings our attention back to considering teachers as disciplinary practitioners (for e.g. see the discussion in Dunne, 2003), even if supported by aids such as textbooks.

Yet in the context of the schools and teachers we have studied, it is apparent that neither type of teacher fully enable their students to participate in understanding geography owing to the limited extent of their competence in the subject matter, even if specialist teachers were better enablers. This brings us to a wider question of teachers' expertise in mass education systems, particularly since in Bihar and other parts of India the students attending government schools belong to socioeconomically disadvantaged sections of society. The extant policy in Bihar of geography being taught by teachers who lack a disciplinary background is embedded in a sort of settlement where teachers -- it is assumed and practiced -- only require a generic set of skills in pedagogy and not skills embedded in particular disciplines. This settlement is in contrast to Fordham (2016) who argues for recognising the relationship between teachers and their discipline, because teaching is not simply another type of generic activity. It also helps explain why the 'safety net' of the sort Alexandre (2016) refers to, where teachers provide consistency against a backdrop of changing educational policies and socio-economic realities because they have 'shared

beliefs and representations about the meaning and purpose of geography' (p. 167) has no visible counterpart in the schools we studied.

Where does this leave textbooks? In 2005 India's National Curriculum Framework was overhauled through a consultative process with wide participation, and a new set of textbooks were developed for all levels of schooling (see Batra, 2005). These represented a substantive departure from the past insofar as they adopted principles of child-centred education (Mili, 2018) and strove to move towards open-ended debate where feasible, away from rote-based learning. While certainly welcome, our findings suggest that these or better textbooks more generally are unlikely to lead to significant changes in teaching and learning in government schools. It is likely that the differences between specialist and generalist teachers would be even more pronounced if textbooks which are better at explaining inferential connections were available, and in this situation, good textbooks could be a crucial aid for teachers. However, our findings suggest that unless teachers' role as disciplinary practitioners is recognised and reflected in teacher recruitment, deployment, training and evaluation standards, it is unlikely that textbooks alone can steer classrooms towards effective teaching.

To return to our original comments on textbooks. They are neither a necessary nor a sufficient condition for effective teaching. However, if good quality textbooks, which: facilitate ostensive teaching and definition, clarify critical concepts and their interconnections, provide opportunities for developing acquaintance knowledge and promote enactive forms of recall which do not just rely on verbalisation in response to questioning, are combined with good teaching from teachers with sound PCK, then they can be effective.

Endnotes

[1] Not to be confused with Hirst's forms of knowledge.

[2] This is possible in light of seeing subjects (e.g. geography) as a social practice and as a field constituting propositions bearing inferential relation to each other (Brandom, 1997). Practitioners of geography (teachers, students and geographers) use a proposition (e.g. the earth's axis is at an incline) as a norm that functions within the practice (therefore, seasons change as the earth rotates around the sun and different parts are brought closer or further away from the sun).

[3] Strictly speaking, the underlying discipline or field of enquiry underpins the subject, which consists of a reordering of selected elements of the discipline for educational purposes. See Stengel, B. (1997).

[4] It does not follow from the fact that children can understand and act on a teacher's explanation that they can provide that explanation themselves.

[5] This approach can be applied to judge how teaching and learning propositions (in the sense of explanation, understanding and meaning) take place in a classroom when looked at alongside the role played by critical engagement with learning contexts (Habermas, 2000), and the importance of habits and skills through which learning progresses (Levine, 2012).

[6] D.Ed. is Diploma in Education; B.Ed. is Bachelor's in Education.

[7] The philosophical literature we have drawn upon includes Hirst (1974), Schwab (1983), Shulman (1986), Brandom (2000) and Winch (2010) and the empirical literature includes Elbaz (1981), Lederman, Gess-Newsome and Latz (1994), Newton, Driver and Osborne (1999), Gess-Newsome and Lederman (2001), Osborne, Erduran and Simon (2004), Paliwal and Subramaniam (2007).

[8] The textbooks are in Hindi, and all excerpts or quotes we present have been translated.

[9] According to Wittgenstein, ostensive teaching (hinweisende Lehren) needs ostensive training (Unterricht) to be successful. Children need to understand the significance of the pointing gesture accompanied by speech. Children in the study had been trained to respond to ostensive gestures.

[10] These are different regions in Bihar.

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None