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Unrealistic Expectations and Compromised Observations in School Mathematics Research

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Abstract: It is not often acknowledged that educational research increasingly places unrealistic expectations on teachers, especially teachers of mathematics. This paper explores issues relating to idealism within educational research, especially in terms of how it manifests as potentially unrealistic expectations academics may have of, and place on, classroom teachers. The paper draws on reflections from observing an international panel of mathematics education researchers observing classroom teachers at work. It outlines some of the philosophical complications of observations, especially it's theory-laden nature, and outlines some potential implications such idealism can have for teachers, and how this may be linked to mathematics culture.

Keywords: school mathematics, unrealistic expectations, classroom observation, educational research

1. Introduction

Idealism within educational research can dramatically skew perceptions of a common data collection tool, namely classroom observations and teacher interviews. It is worth relating an episode experienced by the author which motivated this analysis. It involved a panel of international scholars observing a number of mathematics classes. The finer details are unimportant here, with the main point arising from when the visitors were very critical of the lessons of one of the more experienced and engaging teacher participants. This teacher's efforts were criticised for not making the most of the learning opportunities that presented in the lesson, for not 'nailing' the mathematical concepts. Such stark criticism raised brought to the fore the difficulties teachers face in living up to the expectations of educational researchers. It seemed that regardless of how skilled a teacher was, they would always be subject to criticism for not meeting one or other set of criteria of which they were oblivious – that what constituted a good teacher lays entirely in the eyes of the beholder and the theoretical framework to which they subscribed.

Arguably, this tendency towards there being a set of ever-changing goal posts evidences the prevalence of unattainable idealism in education research. This concept is explored in the context of 'nailing' lessons, as well as investigating the idea of the good-enough teacher in terms of data captured on teachers' work patterns and how they judge their own performance.

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2. Teachers 'Nailing' Lessons

This incident of observations of lessons by visiting scholars is representative of a common theme amongst mathematics education researchers that teachers do not quite 'nail' their lessons, that is, teachers often do make the most of 'teachable moments' and drive home the key mathematical learnings of the task in hand. For the scholars, this failure appeared to occur for a variety of reasons, including teachers' lack of content knowledge relating to the focus of the task; teachers misjudging what the key point of the task was; teachers being distracted from the key focus of the lesson; or teachers running out of time for a variety of reasons such as interruptions, equipment failure, activities taking longer than anticipated and so on.

In the lesson alluded to above the teacher had posed the task: "the perimeter of a rectangle is 20 cm. What might be the area?" The class worked productively on the task, with most students working with a partner. It would not have been obvious to the teacher, but some students were calculating the area of their rectangles by counting, rather than by multiplying, and it was this aspect that the observers took exception to. While it does expose a weakness in the task, in that the numbers involved were too small to prompt multiplication as an efficient strategy, it is hardly grounds for criticism of the teacher, particularly given that many of the students using a counting strategy were intentionally discrete and hid their counting from the teacher.

Despite the use of a rubric by the observers to help structure their observations, it was nevertheless the case that judgments about the success or otherwise of a lesson were largely subjective. Several of the sessions which were not nailed were arguably successful in other ways, however, nailing the lesson was given priority as one major area of concern when judging lessons.

From a methodological perspective there are important assumptions built into the notion of judging whether a lesson has been nailed or not, and it would seem that there are three possible scenarios:

i) Teachers don't nail lessons (Observers are correct);
ii) Observers don't nail observation (Teachers do nail lessons);
iii) Teachers don't nail lessons and Observers don't nail observation.

Each of these will be considered further below.

2.1. Teacher Don't Nail Lessons

There are several reasons why i) could be correct and that teachers don't nail lessons:

- Teachers may try to nail lessons but are incompetent;
- Teachers may not actually try to nail lessons;
- Teachers may try to nail lessons, and may be competent at doing so, but nailing lessons may be very difficult or impossible in reality; or,
- Teachers may try to nail lessons, and even be competent at doing so, but nailing the lesson may sometimes/often/always be a lower priority than other goals or constraints teachers have or face during the lesson.

2.2. Observers Don't Nail Observation

A similar list exists for ii):

- Observers may be incompetent at observing;
- Observers may not actually try to nail observations (of course this raises the question of 'then why bother observing?', although there may be other psychological or political factors involved);
- Accurate observation may be very difficult/impossible to achieve in reality; or,
- Observers may try to nail observation but doing so becomes a lower priority than other factors that arise during the session.

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2.3. Teachers Don't Nail Lessons and Observers Don't Nail Observations

The third option seems to be the most likely of the three, that neither teachers nor observers entirely nail their respective tasks. It seems reasonable to expect teachers to be constrained in their ability to focus on each mathematical nuance or, in some cases, significant mathematical point, to the same extent that a passive observer can imagine them to be capable of doing. Armchair coaches are notoriously adept at imagining that players can do more than they are actually able to do. By the same token, it seems reasonable to expect that observers are limited in what they can actually experience in any given lesson, and may miss or overlook aspects of a session that might have changed their impressions/expectations. It is also possible that since teachers are more familiar with the intended audience of their lesson (the students), that teachers are better judges of what to emphasise and when to emphasise it than the observers are. This suggests that observing lessons is neither a simple nor neutral task. In some ways it could be said that an attentive observer is observing themselves to the extent that the things they see are those of particular interest to them, while other events of minimal interest are missed or ignored. This also implies that the teacher comes to the classroom with a particular set of interests, and the extent to which they overlap with the observer's set of interests may determine the light in which the lesson is seen. A closely related concept is Kuhn's [1] description of observations as being theory-laden, in that observations are influenced by whatever theory they relate to. The next section explores this issue further.

3. The Theory-laden Nature of Observation

Classroom observers coming to a classroom interested in particular things and missing or underemphasising others is symptomatic of a broader, and more radical, problem with observation. Kuhn [1] pointed out that all observations are theory-laden. That is, what a person sees is partially determined by the worldview or paradigm they embrace. Kuhn's [1] famous example is that of the duck/rabbit gestalt figure (see Figure 1 below). If the observer is familiar with ducks, then they are likely to see a duck, if familiar with rabbits, then they will probably see a rabbit. If the observer is unfamiliar with such representations of either animal, then they may see a squiggly line and a dot, or a map of a harbour, or something else entirely. But each distinct experience arises from the same set of markings on the page, and no one interpretation can claim priority without further information or justification.

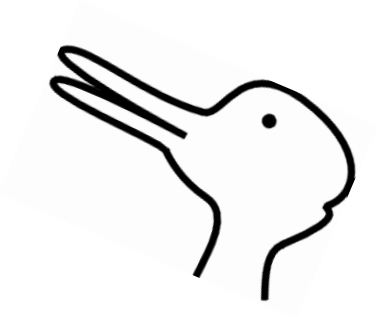

Figure 1: Kuhn's [1] (p.111) visual duck/rabbit analogy for theory-ladeness.

Theory-ladeness represents a form of bias that goes beyond an observers' preferences because it influences the way they perceive the world in the first place, and therefore help to shape their preferences and biases. In the case of mathematics educational researchers, arguably their primary focus is on the transmission of mathematics. For the mathematics teacher, particularly in primary schools, their primary focus is typically elsewhere, usually the students that they have been teaching all year. It is perhaps unsurprising, then, that observers and teachers focus on different things during

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mathematics sessions and come away with different experiences – one has been plausibly looking at ducks, while the other at rabbits.

There is, of course, a considerable overlap between the concerns of the observers and the teachers in this case. The observers hope to improve the way teachers generally can teach mathematics to students, and teachers often hope to be able to glean insights gained by such research. However, the theory-laden nature of observation led Kuhn [1] to further argue that competing explanations or theories of phenomena are, in fact, incommensurable. For instance, within Newtonian physics the mass of a projectile remains constant (assuming no other influences), whilst within Einsteinian physics the mass of an object changes with velocity. Whilst the two theories seem to share considerable common ground, even the same words for similar concepts, they are nevertheless speaking about completely different things. Even though it is possible to argue that Newton's physics is a special case of Einstein's, it is not possible to translate Newtonian physics incrementally into Einsteinian physics, rather the conceptual framework, or paradigm, needs to be replaced in its entirety.

The implications of the incommensurability of theories for scientific realism, naïve and otherwise, were profound – after Kuhn it was no longer tenable to assume the neutrality of observations, observational language, nor epistemic frameworks for preferring one theory over another. And this was within sciences dealing with 'objective' external realities. The problems of neutrality within social and human research are exponentially greater still.

A clear example of this is provided by Sullivan, Mousley, and Gervasoni [2] who provided a means of assessing the issue of classroom observation directly. In their study, 22 teacher educators provided written responses to a videotaped lesson complete with pre/post interviews of the teacher. In analysing the responses, the authors were struck by the disparity, and the quite individualistic (almost personal) basis of the critiques proffered, despite all observers having viewed the same material.

The question, then, of whether teachers really do or do not nail lessons remains open. As argued above, it is likely that they do not, at least not in the way observers anticipate, but they may well nail them in other ways that satisfy other criteria that feature more highly on their priorities, such as spending more time with a particular student, managing behaviour, or dealing with the latest interruption. In any case, the notion of objectively nailing a lesson remains problematic because of the inherent theoretical structures underpinning those making such judgments.

4. Does It Matter if Teachers Don't Nail Lessons?

Putting to one side the issue of whether we can ever know if a teacher nails a mathematics lesson or not, and assuming for arguments sake that we can know, it still remains to establish whether it actually matters if lessons are nailed or not. Is student learning contingent on lessons being nailed? If the lack of lesson nailing is as widespread as seems to have been the case in these observations, then there is a serious question of how students learn mathematics at all. There is, of course, data to suggest that students are not learning mathematics as well as they might, which may, in part, be due to this phenomenon [3] [4]. However, there are clearly students who are learning mathematics well, perhaps in spite of a lack of lessons being nailed. If it is possible for these students to develop thorough understandings of mathematical concepts in the face of poor teaching, then there must be other mechanisms at work.

It may be the case that these students benefit from the particular style of the teacher, or that the teacher focuses their energy on those whom they believe show promise or need the most help. Or it may relate to student motivation, access to resources beyond the classroom such as a helpful parent, sibling or friend, or an innate talent that blossoms despite a less than conducive environment.

One of the teachers (let's call him Lloyd), went to great pains to provide as much scaffolding and support as was needed to assist students in grasping the mathematics being taught. Lloyd would routinely spend 30 minutes or more working with a group of four or five students during mathematics

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sessions. He was extremely patient and persistent in identifying misunderstandings these students had developed. He would consistently listen to students, challenge them, and tease out generalisations and formulations. However, on these occasions the rest of the class was essentially left to their own devices, and whilst there was no evidence of disruptive behaviour, most of the groups were observed to be simply chatting socially rather than engaging in any of the mathematics tasks they had been asked to tackle. So, while Lloyd may have been able to nail certain concepts for some students, the others were left to their own devices. It would be interesting to investigate whether such intensive bursts of attention are better at developing mathematical understanding than more traditional methods, however, even in the small group working with Lloyd it was often observed that one or more of the groups were disengaged unless being spoken to directly.

It would be unreasonable to conclude that nailing mathematics lessons is essential to students learning mathematics, however it would seem reasonable to speak of nailing lessons as a more efficient means of teaching mathematics. The readiness of students to understand and embrace a new mathematical concept is inevitably as diverse as the students themselves. This entails that some students may well grasp the concepts even though the teacher has failed to nail the salient points. By the same token, nailing those points may only be sufficient to increase the understanding of a percentage, even majority, of students. The remaining students are likely to need even more assistance than nailing the lesson would provide. Tzur [5] provides an example of a motivated and competent teacher who seems to have felt that he had nailed a lesson only to find that few of the students had made the connections he had hoped for. So, whether a lesson is nailed or not may be in the eye of the beholder, or more correctly, the learner – and some students may learn when a lesson is not nailed, and others may not learn when a lesson is nailed.

5. Implications for the Teaching Profession

If many teachers are unable to nail lessons, for whatever reasons, *and* nailing lessons is crucial to student learning, then it would seem that students are being actively disadvantaged by having teachers who cannot nail lessons. In such a situation it would be vitally important to identify the reasons behind such pedagogical failings and seek to rectify them. If it is due to incompetence, then seemingly a large part of the teaching profession would need to be re-educated. If teachers are not attempting to nail lessons, then it is important to understand why, and to better understand what exactly they are attempting to do with their lessons, however, this seems the least plausible explanation.

It seems more plausible that teachers do attempt to nail lessons but have different priorities, or perhaps that they do not attempt to nail lessons because they have different priorities. The subtle difference here is teachers' intentions. In the case where teachers are attempting to nail their lessons it would appear that their intent is frequently foiled, whereas in the latter scenario, where nailing lessons has a lower priority, then any nailing would be accidental, either coincidental to achieving other priorities, or a by-product of achieving those other priorities.

It is important to be clear about the competing expectations placed on teachers, especially as they come under greater scrutiny from the community. Australian politicians have been critical of a lack of transparency around teacher quality, with one State Minister for Education quipping that teachers are naïve to oppose the publishing of data about their performance, "you…can know more about the performance of your air-conditioner than the progress of your local school" [6]. It remains unclear what impact such an approach will have on teachers nailing lessons or not, but it potentially assists in prioritising teachers' efforts. There have been a number of claims of cheating by teachers and principals attempting to skew the results of recent National Assessment Program – Literacy and Numeracy (NAPLAN) testing [7] [8], while reports of widespread 'teaching to the test' have also been made [9] [8]. For educators to respond in this way represents somewhat of an antithesis to nailing

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lessons in that rather than encouraging students to develop detailed mathematical understandings they are instead seeking to maximise their performance on standardised tests.

This serves to underscore the competing pressures mathematics teachers face that complicate both their work and the work of those wishing to observe and understand what is going on in classrooms. It helps to support the view that out of the three possibilities above, it is the third that is most likely to be the case: that is, neither do teachers nail their lessons, nor do observers nail their observations. This leaves open the question of which phenomenon is dominant, and which is occurring in any given instance – it is quite possible that a teacher nails a lesson, but the observer misses it, or even a situation akin to Tzur [5] where both teacher and observer believe the lesson was nailed, but the students remain unchanged by the experience.

6. The Prevalence of 'Right Ways' in Mathematics

The notion of nailing lessons may stem from a common attitude in mathematics of there being a right way to do things. It could be said that such an attitude forms part of the dominant paradigm within mathematics generally. It is interesting to note another of Kuhn's [1] observations that what distinguishes science from non-science is the dominant paradigm that occupies the thoughts and efforts of practitioners during Normal Science phases. The received view of the dominant paradigm permeates the efforts of all research centres and there are accepted 'truths' that all embrace to a large extent. By contrast, humanities and other non-scientific areas of endeavour have no such guiding paradigm – everything is up for debate, and divergent views abound with little or no common ground. Interestingly, for Kuhn [1] the teaching of science is instrumental in bringing about the success of science since students are only exposed to the research success stories, as if science were a harmonious monolithic process moving smoothly from one breakthrough to another – none of the historical squabbles or cul de sacs are emphasised. Science is portrayed as a unified field of knowledge gradually uncovering truths through the scientific method, whereas the humanities emphasise personal opinions and views, and often rake over the coals of historical disputes.

Mathematics is an important adjunct to this process. In many ways it represents an even 'purer' form of truth in the sense that mathematical objects reside in human consciousness as abstractions that correlate with the outside world. Two plus two really does equal four by definition, and no measurements or other physical means are required to test this. A necessary corollary of this is that mathematical problems have right and wrong answers. It is commonly believed that there is no ambiguity in mathematics, you either get the right answer or you do not. This is one of the oft cited reason many people enjoy mathematics [10] [11].

Getting the right answer seems to be intimately bound to the field of mathematics, and to the mythos, or unstated worldview, underpinning mathematics. Students who consistently fail to get the right answers may quickly feel isolated from a potent part of society, while those who are proficient at mathematics can experience a form of social isolation from the majority and feel rejected and labelled as 'nerds' or 'geeks'. Socially speaking it seems better to be neither a 'vegie' nor a 'geek', rather it seems that being 'ok' at maths is the most socially acceptable option.

This attitude seems to spill over into the teaching of mathematics. Teachers can become concerned with whether they are 'doing it right' and it is plausible that anxiety about whether they were doing the right thing or not motivated, at least in part, the majority of teachers tend to opt out of classroom observations. Arguably mathematics education researchers seem to also view teachers in the light of whether they are 'doing it right' from their own particular perspective. For instance, in the study mentioned previously, Sullivan et al. [2] report that one of the criticisms raised by a scholar critiquing the recorded lessons was "why (choose a) capitalist model instead of a government funded hostel, hospital, school etc.?" (p.258). This was a clearer example of ideologically driven comment, but there were others – particularly with regard to the ceding of control to students rather than the teacher being

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particularly directive. Indeed, one of their conclusions of the study is that the academics all responded in terms of rights and wrongs rather than recognising that there is a spectrum of approaches where teachers might position themselves.

This suggests that some mathematics education researchers do consider there are right and wrong ways of teaching, and perhaps helps to explain why teachers are reluctant to be observed and judged. Teachers cope as best they can under the circumstances, including their workplace, their student cohort, the classes they are allocated, their own personality and mental health at any given time. Everyone has good and bad days, and it is well known that a lesson that worked well for one class may not work anywhere near as well for another – with or without the same teacher. This demonstrates the level to which personal ideology impinges upon observation, the theory laden nature of the exercise, and the range of topics over which teachers' actions can be found wanting. This level of pushing one's own perspective is perhaps a necessary part of research into Mathematics Education as evidenced by the considerable variety schools of thought within the field. The difficulty comes when teachers are expected to satisfy any number of criteria that they are largely oblivious to.

Even when most observers might agree on what is an appropriate response to a situation, it remains a uniquely subjective process. Bishop [12] demonstrated, there are an infinite number of responses to any given situation that a teacher might pursue. For example, the following diagram (Figure 2) illustrates a variety of possible responses to a hypothetical situation involving subtraction:

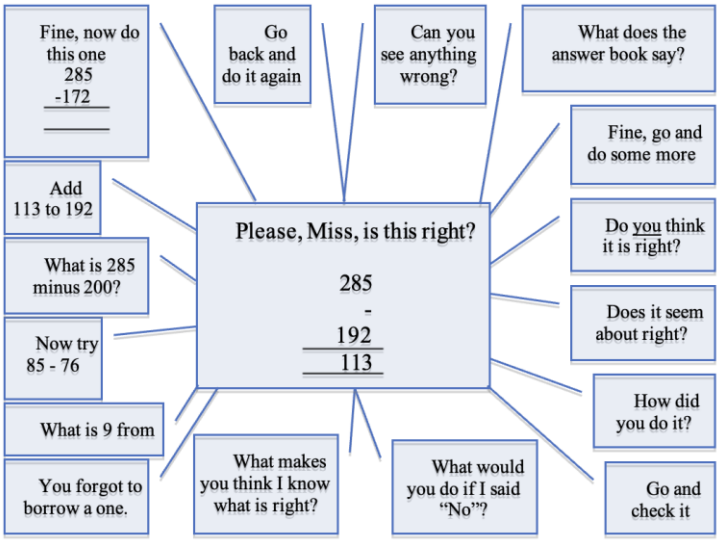

Figure 2: Bishop's [12] (p.42) hypothetical decision making situation.

Clearly there are many possible responses to such a scenario, of which these might be considered typical. However, each teacher will likely have well-rehearsed, preferred approaches to dealing with such situations. In fact, Bishop [12] claims that experienced teachers do, or they may respond in more spontaneous ways. There could be many justifications given for any choice, and many other justifications for why the approach selected was inferior. Beauty remains in the eye of the beholder. However, clearly, not all choices are equal. Corporal punishment is obviously unacceptable as a response to a child who asks for assistance. But such a response is already illegal. Giving the student a detention would appear unreasonable, but in some circumstances, this might be appropriate – perhaps if the question is asked repeatedly in the middle of a test. The point here is that any given response could have a context invented to make it sound reasonable – even extreme responses. It depends on the circumstances.

It seems reasonable to assume that Mathematics Educational Research looks to provide answers to 'typical' classroom circumstances where the desire is to enhance understanding of mathematics.

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However, this decontextualised advice must be operationalised by those who are immersed in context, namely the teachers and students. Observers of these interactions are unlikely to be fully aware of the underlying context and focus instead on the more abstracted elements of the interactions such as the content of the lesson and the mathematical concepts. This necessarily excludes a great deal of what is actually going on in the classroom. By contrast, the very thing that the observers/researchers are not privy to, the relationships and contextual content, is what constrains teachers in their 'delivery' of the abstracted content, bringing about the situation described by Sullivan and Leder [13] wherein students have significant influence on their teachers.

Such a view is also compatible with Leatham's [14] notion of teachers as having sensible rather than contradictory belief systems. The relationships and context of the classroom that can make sense of teachers' decisions are not typically available to observers, and teachers may not be conscious/feel comfortable/feel able to adequately explain the underlying issues. The politics of the classroom involve complicated relationships between teachers, students, parents, families, administrators, and others which defy simplistic analyses. Thus, the idea of judging whether teachers are 'doing the right thing' or whether they are good enough remains fraught with difficulty, especially when viewed from a narrow theoretical perspective.

7. Conclusions

It seems that classroom observations are fraught with difficulties in terms of making judgements of how successful teachers were in any given lesson and whether they 'nailed it' or not. The theory laden nature of observation entails that each observer sees different things, especially when their views are informed by different theoretical constructs and are not privy to the complexities of the relationships that exist within the classroom under observation. This can lead to ideologically driven judgements that devalue the teachers' efforts, which is suggestive of a practitioner/academic divide, which is consistent with the negative views many teachers seem to have of pre-service teacher education [15] [16].

Further evidence of this divide is perhaps encapsulated in the way that some teachers do not appear to satisfy the ideals of the reflection literature, and others failed to satisfy the expectations of academics wanting them to nail their mathematics lessons – even though the impact of nailing lessons on student learning remains a somewhat open question. It seems clear that teachers can be seen to fall short of any number of educational ideals. It is possible that these idealistic expectations are symptomatic of a broader practitioner/academic divide, or they may arise from the mathematics education culture itself, in which certain techniques become the right way to do things. Either way it underscores the contested nature of whether we need perfect teachers or good-enough teachers.

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