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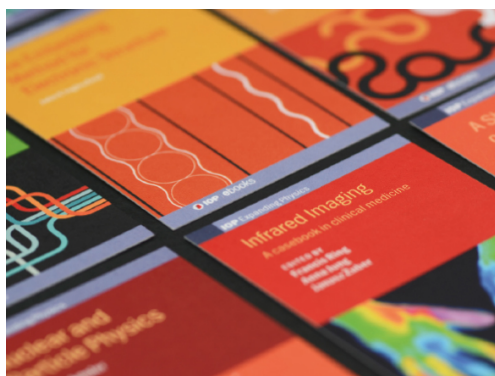
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Harnessing the potential of recently retired physics teachers to mentor new physics teachers

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Abstract

Three new physics teachers graduating from a university provider of initial teacher education in England were paired with a recently retired physics subject specialist teacher in order to provide informal mentoring during their first year of teaching. The aim of this was to explore if a mentoring intervention of this kind could support teacher knowledge growth of the new physics teachers and influence their retention in the teaching profession. Qualitative data from the study suggests that substantive content of the mentoring discussions that took place addressed issues of general pedagogy and pedagogical content knowledge. The retired teacher mentors were enthusiastic and able to act as mentors. Suggestions emerge for ways of facilitating the mentoring.

Keywords: physics education, mentoring, teacher education

1. Introduction

In this article I will explain an approach to mentoring new physics teachers using retired physics teachers that I hope can help to address the retention crisis in physics teaching in England and around the world. I will argue that in the light of the challenges early career physics teachers

face, recently retired teachers are ideally placed to address the areas of physics teacher knowledge that will have most impact on retention. My hope is to stimulate further debate about the most effective ways to increase the numbers of physics teachers.

2. Physics teacher shortage in England and internationally

That there are shortages of physics teachers around the world is a well-established fact. From the United States [1] to Uganda [2] recruitment is difficult and attrition rates are high. In England, physics has the highest turnover rate of teachers



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for any secondary subject [3]. According to current data, the percentage of early career physics teachers (ECTs) still in service five years after qualification in England stands at 60% [4]. This is not only lower than the current rate for all teachers in England which is 67.4% [5] but is also in addition to longstanding shortfalls in the recruitment of physics teachers. Only 45% of target numbers were recruited in 20/21 [6]. The reasons for the shortage are many and complex, but one factor acknowledged internationally is the demand in the wider economy for physics graduates in careers that are not only attractive but can also offer better salaries [7]. Government policy in England has therefore focussed on providing financial incentives to entice new entrants into the physics teaching profession. Unfortunately, there is only weak evidence of any positive impact from this strategy [8]. On the contrary it seems that teachers' stay in their roles because of 'perceived professional mastery' and 'altruism' [9]—confirming what for many might be an obvious finding, but worth stating clearly: teachers are happy when they feel like they are good at their jobs and can see that they are making a difference to the children they teach.

There are indications that the first-year post-qualification is a particularly significant time for new teachers who decide whether teaching is really for them [10]. This is increasingly being recognised by government in the adoption in England of a formal early career framework [11] for developing the knowledge and skills of new teachers. For new physics teachers however, embedded in schools lacking other experienced physics teachers, there is a danger that this crucial time is spent feeling isolated, without physics specific pedagogical support [12] potentially preventing the necessary development of the sense of professional mastery that may influence the new teachers' intention to stay in the profession. Whilst there are no magic bullets to solve these seemingly intractable problems I suggest that there is a potential gap for external mentoring from retired specialist physics teachers who have the availability and professional knowledge to connect new physics teachers to a professional learning community, where the sense of professional mastery can be inculcated in such a way that their intentions to remain in the profession may be influenced.

3. Mentoring early career physics teachers to support teacher knowledge development

A working definition of mentoring as 'help by one person to another in making significant transitions in knowledge, work or thinking' [13] would suggest particular relevance for new teachers in their first year. Clutterbuck explores the benefits of mentoring as relational and having most benefit when there is no power inequality between mentor and mentee. The implication being that effective mentoring may be inhibited if there is a sense of authority between mentor and mentee—such as often exists when new teachers are mentored in school by more experienced teachers who are involved in observing their lessons or assessing them against teacher standards. To be effective, in this sense, mentors should be able to provide relevant help without a sense of accountability for the mentee. Specific mentoring for physics teacher knowledge development also has a strong historical precedent. In evaluating the national Stimulating Physics Network mentor program run by the Institute of Physics on behalf of the Department for Education between 2009 and 2012 [14], it was found that the mentoring (which in this case was by experienced teachers of physics, some of whom were still teachers and others were recently retired or combining the mentoring with other consultancy work) had extensive positive impact. This included: increased confidence in subject knowledge of physics, reassurance of having someone to turn to in times of need, reduced feelings of isolation and stress and some indications of positive effects on physics teacher retention. Many factors were identified that influenced the extent to which impact was realised including: the mentors having credibility, availability, the personal skills necessary to build trust, regularity of contact between mentor and mentee and the mentors' independence from the assessment of the mentee. All of these factors could be provided by recently retired physics teachers—potentially obtaining the benefits also described. Acknowledging that these findings are limited as they draw only upon the participants' own accounts of their experience they do appear to show a strong indication that external mentoring can be useful to influence the retention of early career physics

teachers. The role of mentors in this project also addressed self-identity issues of early career physics teachers [15] by providing links to a professional community facilitated by the Institute of Physics beyond and in many cases not available in, the confines of their own school [16].

4. Retired teachers as mentors

I would suggest that retired physics teachers are a neglected segment of the physics education community who may be willing and able to contribute. In literature there is one instance of a formal programme of utilising retired teachers in a mentoring role for new teachers. This was in the 1980s in New York City in the United States [17]. In this example, headteachers of schools nominated retiring teachers who could be paired with new teachers at schools identified as having poor retention. Evaluation showed this mentoring was highly valued by the new teachers and had a modest impact on retention. Strikingly however, the most significant finding was the enthusiasm of the recently retired teachers to participate. They were delighted at being still being able to contribute to the profession to which they had devoted their working lives. It is important to recognise the distinction between an experienced teacher and an expert teacher, [18] and the retirees involved in this project were selected by headteachers to address this. The applicability of this project resonates with my own personal experience as a new physics teacher in the early 2000s. The teachers in the school where I worked who were most available and most willing to support me as a new teacher were those in the later years of their career, none of whom had formal mentoring responsibilities in the school—not yet retired but all within two or three years of the end of their career. Similarly in the professional learning communities I joined, such as the Institute of Physics teacher network, the contribution made by teachers either at the end (or even beyond the end) of their careers was striking. These types of relationship are identified as the ‘teacher next door’ by Luft [16] who can provide empathetic and philosophical support as well as practical advice on pedagogical issues such as behaviour management or teaching activities. My proposal in this project is to explore more fully the ways and extent to which retired physics

teachers can be this source of professional knowledge and experience and influence the retention of new physics teachers.

5. A model of physics teacher knowledge growth

For new physics teachers to feel the sense of professional mastery that will allow them to make a difference, it is important to consider the actual knowledge that is required and if retired physics teachers are equipped to provide it. Etkina [19] building on the work of Schulman [20], in figure 1, proposes a structure of physics teacher knowledge that centres on pedagogical content knowledge (PCK).

This simple and useful conception sees PCK as the overlap of physics content knowledge and general pedagogical knowledge. It resonates with recent work of de Winter and Airy [21] who describe a physics lesson on forces where the physics teacher is able to skilfully combine knowledge of the content of Newton’s laws (content knowledge), knowledge of how to manage pupil behaviour (pedagogical knowledge) into a coherent and compelling lesson that is effective in addressing the curriculum and engaging with the prior conceptions of the pupils (PCK). Thinking of professional knowledge in this way for this project makes it clear why retired teachers are potentially able to contribute so much. They have pedagogical knowledge; knowledge of the context of schools and of the experience of thousands of hours with pupils in the classroom, institutional knowledge, often of more than one school, and also a knowledge of teaching techniques, behaviour management, assessment etc. They also have physics subject knowledge honed by the taught curriculum and the limitations of the school environment. How these interact in PCK may not be developed formally but emerges in the study in the reasoning that retired teachers are able to provide for the advice that they give to new teachers about how to manage classes or teach various physics topics. Recognising that retired teachers will also have their own opinions and prejudices about the value of some of their knowledge is important, but positively, this brings a sense of detachment from the day-to-day life

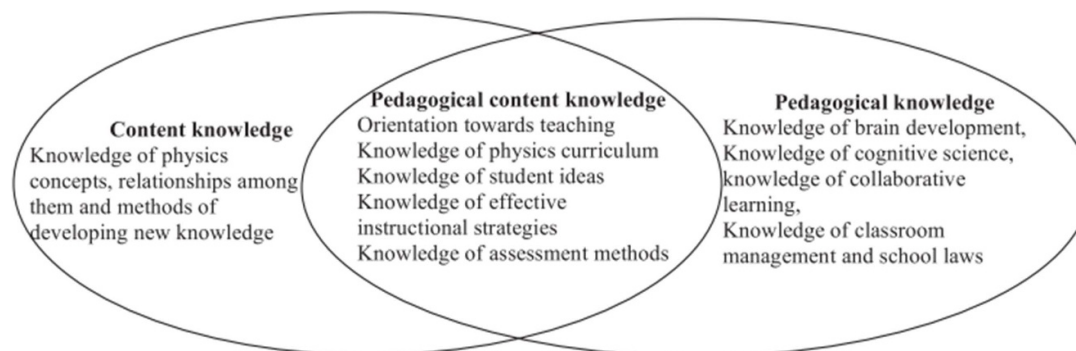


Figure 1. A representation of physics teacher professional knowledge [17]. Reproduced from [19]. CC BY 3.0.

of a school. In essence, in the type of mentoring offered by retired teachers everything in the Etkina [19] model of teacher professional knowledge is on the table. Just because the mentor is a physics teacher does not mean the mentee cannot ask questions about general matters of pedagogy such as behaviour management or assessment or whatever but it does mean that in addition the mentor is potentially able to provide support with subject knowledge and physics teaching repertoire as well as give support and a wider, dispassionate view on matters of school policy and practice the mentees might find challenging. In the cross over is a large (perhaps unexplored) area for the new physics teacher (PCK?) where the nature of the subject content of the physics they are teaching may lead them to want to discuss how to make pedagogical decisions and deal with the implications for their pupil. As an example, from the conversations that took place between mentors and mentees during this project, one might think of a lesson on waves where the teacher wishes to demonstrate transverse and longitudinal waves to a class. As well as advice on choosing a suitable activity (Slinky? Long piece of rubber? Simulation?), the teacher may wish to discuss how to position the pupils to best observe the demonstration, how to deal with any disruption or interference from pupils, what questions to ask of pupils to support their understanding, rehearse explanations or check knowledge of the underlying physics. Or indeed many more possible issues. The ability of expert, retired physics teachers to support in these ways becomes obvious.

6. Recruiting retired physics teachers

Recent retirees were sought for this project in three ways: through alumni links at a university with a long history of physics teacher education, advertising through university of the third age (U3A) groups, and advertising through professional physics teacher networks (Institute of Physics and Ogden Trust). An information sheet explaining the rationale of the project was produced and emailed out through these avenues asking for interested people to respond by email. These teachers were then emailed back with more detailed information (including making clear that there was no financial recompense for participating). Following 12 expressions of interest, six retired teachers joined the meeting where questions about mentoring, training and the ethics of the project were discussed along with commitments to providing data for the study. This process also allowed some degree of informal selection of mentors, bearing in mind the distinction between experienced and expert teachers. No guarantees of participation were made in view of the need to seek permission from potential mentees about the arrangement. One reflection from this process was that it was not difficult at all to find potential retired physics teacher mentors—this process was undertaken very quickly.

7. Recruiting early career teachers

Early career physics teachers were recruited from a graduating population of physics specialist trainee teachers from a university provider of physics initial teacher education. This recruitment

was done after the end of the program to ensure that participants were not influenced by any implication of assessment bias. The volunteers were sought by email and invited to a meeting to discuss participation. After this they were paired with mentors and a further introductory meeting was set up for mentors and mentees to meet and for training on mentoring.

8. Pairing mentors with mentees and project processes

This was done randomly but care was given to the mentoring relationship from the start. At the meeting where mentor and mentee met, significant time was spent in informal relationship building conversation over drinks and biscuits—recognising the potential social awkwardness of the situation. Then a formal meeting took place where the pairs discussed the following between them:

- The mode of communication that would be used e.g. email, phone, WhatsApp message etc (the introduction took place before the covid-19 pandemic made video calling commonplace).
- The expected frequency of communication and any convenient times and days.
- The situation of mentor and mentee—personal information, educational information, experiences, job details etc. Participants disclosed information to their partner that they felt comfortable with.
- Formal wellbeing and ethical implications of mentoring—what would be done if either party had any concerns about the other during the project.
- Expectations of participation in research of the mentoring.

9. The project

Over a period of a one year from the first meeting, the mentors and mentees committed to being in contact with each other as agreed above (the regularity would be one focus of the study) and to be in contact by phone call with the researcher for the purposes of investigating the content of the communications between mentor and mentee. For the first

two terms of the study this proceeded as planned however in Spring 2020 the impact of the covid-19 lockdown led to the disruption of schools and an early finish to the project.

10. Data

Data was collected in the form of semi-structured interviews with mentors and mentees each term. Participants were issued pseudonyms. The questions asked can be found in figure 2 and address the intentions of new physics teachers to remain in the profession as well as prompts to interrogate the substantive content of the mentoring conversations as well as the areas of physics teacher professional knowledge identified above. These were audio recorded and transcribed and analysed thematically. In addition, the retired mentors took part in a focus group held in person to explore their own experiences of the project. Qualitative data was collected in this way to explore the experiences of those participating in the mentoring by gathering rich data that would reveal information about how this type of relationship could be effectively facilitated.

11. Findings

Of the early career physics teachers who took part, one was able to engage usefully in the mentoring and two were not. I will explore the findings from each group separately. I will also discuss the views of the retired teacher mentors.

11.1. Engaged mentee

The example below between retired mentor ('John') and mentee ('Bryan') reveals the structure and content of the mentoring that took place:

Bryan made contact with John by email just after starting his new job in September. His particular concern at that point was how to set up and establish routines with his new classes in terms of practicalities like basic behavioural expectations. John responded by arranging to phone Bryan at an agreed time and they spent around 30 min talking. In this conversation John asked about each of Bryan's timetabled classes in turn and they discussed specific issues with each. An example is a

What are the contents of the discussions you have had with your mentor / mentee?
How many times and in what ways have you been in contact with your mentor/mentee? Are you currently intending to continue teaching next academic year? And in 5 years? What factors are influencing your thinking about whether you will stay in teaching?
What are the contents of the discussions you have had with your mentor / mentee? Can you give a specific example of a conversation you have had?
Have you sought/given guidance about any of the following topics? - Subject knowledge - General pedagogy - Subject specific pedagogy
Are there any ways that this type of mentoring could be better facilitated?

Figure 2. Interview questions for mentors and mentees.

year 8 (children 12 and 13 years old) class which Bryan felt had children with a 'wide range of abilities'. Bryan was concerned about being able to cope with this—prior experience in his training year had been with classes who were divided into groups based on ability. John was able to provide some reassurance to Bryan by listening to his concerns and drawing upon his own experience of teaching to suggest some ideas for activities that might be suitable for different children.

Bryan also asked about ideas for a lesson observation he was timetabled for by his in school NQT mentor on the topic of waves. Bryan was clearly worried about this, coming so soon after the start of term with classes he was not yet fully comfortable with and the topic of the lesson was waves, something Bryan had not taught before during his training year. On this John was able to offer a great deal of advice including an idea to use a length of rubber tubing to provide and memorable

and descriptive demonstration of wave motion for the pupils. Bryan went away from this meeting and was able to act on the advice provided by John—including about the waves lesson which he reported as having gone well. Bryan and John then settled into a regular pattern of contact over the autumn term of roughly three weekly phone conversations. After each, John would write up a brief summary of the main points of their conversation and send it through by email, attaching to it any electronic resources he thought might be useful. Other issues that were the subject of later conversations were a discussion about some school policy documentation in which Bryan did not understand some of the language and terminology used. John was able to interpret these for Bryan. Bryan commented that he did not feel able to talk to anyone in his school about this because the formal meetings he had were ‘more of a checking up on me’ and he felt that lacking understanding of some of these things would reflect badly on him in terms of NQT assessment. Other examples of physics PCK discussed were; how to integrate some aspects of assessing student knowledge of electricity and magnetism and use of live marking in classes. When asked for comment overall about the mentoring he said ‘I think it is been more useful than I thought it would be, in terms of its like having an extra opinion on things...its good for running ideas past someone for reassurance or confirmation.’ Bryan is intending to stay in teaching at the same school for the next academic year.

A summary of emergent themes is:

- The engaged mentee established a regular mode and pattern of communication with their mentor.
- The significance of having someone with a perspective outside of the immediate school environment to discuss issues with.
- The relief of having someone to talk to who was separate from any assessment of the new teacher.
- The availability of the mentor compared to the perceived busyness of teachers providing in-school support.
- Most frequent themes of mentoring conversation that address teacher knowledge: support with physics lesson planning (suggestions

for activities, ways of assessing pupil knowledge, practical work), advice on behaviour management.

11.2. *Non-engaged mentees*

A representative example of the mentoring when it was not as successful is given below by the mentor (‘Greg’) and mentee (‘Charlie’):

Charlie started a job in a large secondary school where she was not the only physics teacher. She did initiate contact with Greg three times by email in the first three weeks to ask some questions on subjects including about how to manage pupil behaviour and how to introduce an element of challenge into her lessons where she felt there more able pupils. Greg replied to these promptly with useful advice. Charlie commented with a contrast to the support she was receiving from her in-school NQT mentor; ‘My school mentor asked more admin questions, “Am I doing this right?” “Am I meeting the teaching standards?”—I could ask Greg more about the subject teaching’. As the term progressed Charlie found other colleagues in her school who were willing to offer help including inviting her to observe some classes she taught with other teachers. She still expressed some self-doubt however ‘I do not know if what I am doing is good enough’ and was unsure if teaching was the right choice for her at the mid-way point of the first term of teaching ‘I was enjoying it but it got stressful. I am worried about losing my enthusiasm. I do not know if I intend to stay in teaching. If I get A level physics teaching next year then I am more likely to stay.’

As the year progressed Greg found it harder to get email responses from Charlie. When asked about this she explained that her school had started fortnightly subject based professional development for teachers and that her contact with Greg ‘would be useful if I had not got so much support in school’.

For the other mentee, issues of teacher knowledge were also discussed only fleetingly during the year. They had decided very quickly not to pursue a career in physics teaching which resulted in some problems engaging in the study and communicating the mentor. He acknowledged that he was facing challenges in his practice and that he had questions that he felt he could not ask within

his school but seemed focussed on just completing the year.

A summary of emerging themes from both of the participants who struggled with engagement is that:

- Successful mentoring relationships require positive engagement from both mentor and mentee.
- Good subject based professional development available in school reduced the need for external mentoring of the sort provided in this study.
- Support from within the school context is particularly targeted at specific problems occurring in the school.

11.3. Retired physics teacher mentors

All three of the participant mentors were very enthusiastic about participating in the project. This echoes the finding of Gold [17]. In fact, all three mentors would have liked to be even more involved and as the project progressed through the year started to make suggestions about other things they felt they could do to support the new teachers. This included a lively debate in the focus group about whether informal mentoring of the kind introduced here would be better replaced with a much more formal programme involving meeting the mentees in person more often and visiting them in school. All of the mentors to one degree or another expressed some frustration with the communication from the mentees both in terms of regularity and responsiveness. There was no one, fool proof way found of communicating that was more effective than any other; email, phone, call, text messages of various sorts were all used. However the mentors agreed that the cycle of email from mentee with questions followed by follow up conversation and then summary email was a useful pattern to establish productive use of time. Video calls were not used in this study it having taken place just before the explosion in popularity of video calls during the covid-19 pandemic. The mentors took their role seriously and sought more contact with the mentees—who they often felt took the advice away and used it without getting back to the mentor with ‘how it went in practice’ which the mentors were itching to know. The mentors felt that they were being consulted primarily about matters of general pedagogy and

were comfortable that they had the knowledge and experience necessary to draw upon to answer such questions. They reported that these were often stated in the form ‘I have a problem with a class...’ or ‘I have a lesson observation with this class on this topic next week—any ideas?’. They were happy to give out this sort of advice and seemed able to describe their pedagogical reasoning for why they had suggested certain approaches.

All of the mentors were willing to continue with the study.

12. Implications

In the small study the external retired teachers were able to provide useful outside perspective and be a source of teacher knowledge in the model identified by Etkina [19] earlier. They had credibility, availability and the required professional knowledge. All three domains of knowledge; physic content knowledge, general pedagogical knowledge and PCK were represented usefully in the mentoring discussions. Behaviour management was significantly a frequent topic of discussion—something anticipated in other studies of early career teachers [22]. These could all be argued to contribute to a developing sense of professional mastery in the new teachers that has shown to be significant in the experience of teachers who stay in the profession for the long term [9]. The positive reports of empathy on feelings of wellbeing by the new teachers should also not be overlooked. There are therefore suggestions that this type of mentoring to some extent contribute to the kind of informal ‘teacher next door’ [16] interactions that support the knowledge growth of new teachers. For new physics teachers who often face professional isolation this could be a life-line [12]. When the mentoring did not work, in one of the cases it was because of the prior decision of the mentee. In the other case it was actually good news story—there was what seemed to be an excellent, regular subject specific programme of support provided in school. In terms of any direct link in this study between the mentoring and the retention of early career physics teachers there must be a strong degree of caution but for the record, of the three new physics teachers in the study two remained in the profession for at least a second year post-qualification.

13. Future directions

I believe the limited evidence captured by this study shows that there is a viable idea for harnessing recently retired physics teachers to provide mentoring for new physics teachers that can address relevant areas of professional knowledge and hopefully contribute to their retention in the profession. With recent European data suggesting that the teaching population is aging [23], a rising number of retired physics teachers may be available and willing to participate in similar projects. I also believe questions are raised by this study around who is best able and has the capacity to provide the mentoring that is to be statutory for new teachers in England as part of the early career framework from September 2021. There is of course a need to broaden and deepen the data set to explore in more detail how these mentoring relationships between new and retired teachers of physics can be formed and if there are ways they can be facilitated consistently. For example the data collection in this study relied on the recollection of participants of the conversations they had—often several weeks in the past. Concurrent data collection methods such as being able to observe or record the conversations as they happen would be useful if it could be done without interfering with the relational dynamic of the mentoring.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors.

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