

Enhancing trainee clinical scientists' self-regulated learning in the workplace

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Abstract

Background: Trainee health professionals must be competent self-regulated learners, particularly when learning in busy, unpredictable clinical settings. Whilst research indicates self-regulated learning (SRL) is influenced both by learners' individual actions and their interactions with others, how these combine to foster SRL requires further exploration. We have used Zimmerman's learner-focused SRL model and the situative perspective of communities of practice (CoPs) to investigate how UK trainee clinical scientists regulate their learning. Our aims were to develop a holistic understanding of SRL in the clinical workplace incorporating both individual and social aspects and to suggest ways of maximising learning for trainee clinical scientists and other health professionals.

Methods: Semi-structured interviews were conducted with 13 trainees on the Scientist Training Programme. Transcripts were analysed both inductively and deductively (abductively) using Zimmerman's model and CoPs to explore how trainees regulate their learning.

Results: Thematic analysis yielded four themes: approach to learning, engagement and execution of tasks in practice; self-reflection and reaction; and autonomy and role construction. Themes linked concepts from Zimmerman's model and CoPs, as illustrated by our trainee-workplace congruence model. Our model suggests optimal conditions for SRL, and we highlight the importance of trainers in supporting trainee development.

Conclusions: Our trainee-workplace congruence model links concepts from Zimmerman's model and CoPs to provide a framework for understanding how trainee clinical scientists regulate their learning and navigate its social aspects. Whilst trainees must take responsibility for their learning, trainers can facilitate SRL through attention to trainee-workplace 'fit' and encouraging trainee participation in communities of practice.

1 | BACKGROUND

UK clinical scientists are registered health professionals in over 40 specialties whose roles are vital to effective patient care: their work

underpins over 80% of all clinical diagnoses.¹ Most UK clinical scientists register after undertaking the 3-year postgraduate competency-based Scientist Training Programme (STP) that combines clinical workplace learning with a masters degree in their scientific specialty (Box 1).

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Box 1

The UK Scientist Training Programme

- The UK Scientist Training Programme (STP) is a 3-year postgraduate level programme; it is the main entry route for individuals pursuing a career in healthcare science.
- Trainees undertake a part-time Master of Science in their chosen specialty with competency-based learning in the clinical workplace, overseen by a trainer. The masters degree is delivered and assessed by a University (see setting and participants for further information).
- Trainees are expected to take responsibility for their learning. SRL is enabled by:
 - Agreeing a training plan with their trainer (goal setting)
 - Monitoring and tracking progress through an e-portfolio, which includes a reflective log of their activity (self-assessment and reflection).
- On completion of the programme, trainees are eligible to register as 'clinical scientists'; this is a protected title that covers wide-ranging roles.

Like other healthcare professionals, trainee clinical scientists learn primarily in the clinical workplace and must be competent self-regulated learners in order to navigate these busy and often unpredictable settings. Self-regulated learning (SRL) requires individuals to assess necessary tasks and set goals, to be selective about their use of learning strategies, and to engage in self-reflection.² Understanding the SRL habits of trainees will help educators to optimise trainees' clinical learning. However, although research indicates that SRL is influenced by both an individual's actions and by their social interactions,^{3,4} how these combine to foster learning requires further exploration.

It is recognised that relationships made in clinical departments influence trainees' use of SRL,⁵ and self and co-regulatory mechanisms are regarded by some as interdependent.⁶ Existing research, predominantly with medical students, suggests SRL is embedded in workplace social interactions,⁷ with SRL mechanisms helping trainees to follow particular learning paths.⁸ The use of SRL theory with a situated learning theory has been proposed to enhance understanding further.⁹

We have investigated trainee clinical scientists' SRL using Zimmerman's cyclical phases model for SRL¹⁰ and the theory of communities of practice (CoPs).¹¹ These are both well-recognised conceptions that are appropriate for the learning context of these trainees. Zimmerman's model focusses on the individual level,^{12,13} whereas CoPs focusses on learning through participation,¹¹ providing a complementary situative perspective.

Zimmerman's model elaborates on Bandura's social cognitive theory,¹⁴ which emphasises triadic reciprocity between the individual, behavioural and environmental factors that influence learning. Zimmerman proposes that SRL occurs in three phases: *forethought*, *performance* and *self-reflection*.^{10,15,16} *Forethought* involves task analysis, goal setting, planning and motivational beliefs. During *performance*, trainees carry out tasks and monitor their progress, and in *self-reflection*, they evaluate their performance and attribute success and failure, leading to *forethought* of future tasks. Although some have considered Zimmerman's description of learning sub-processes comprehensive,¹⁷ the model has been criticised for de-contextualising learning from its social context.^{3,13}

CoPs propose three interrelated dimensions: 'domain'—the area of shared interest; 'community'—the individuals involved; and 'practice'—shared knowledge, methods and tools.¹⁸ Trainees can join a community through legitimate peripheral participation, a term that describes how newcomers become experienced members and learn through immersion.¹¹

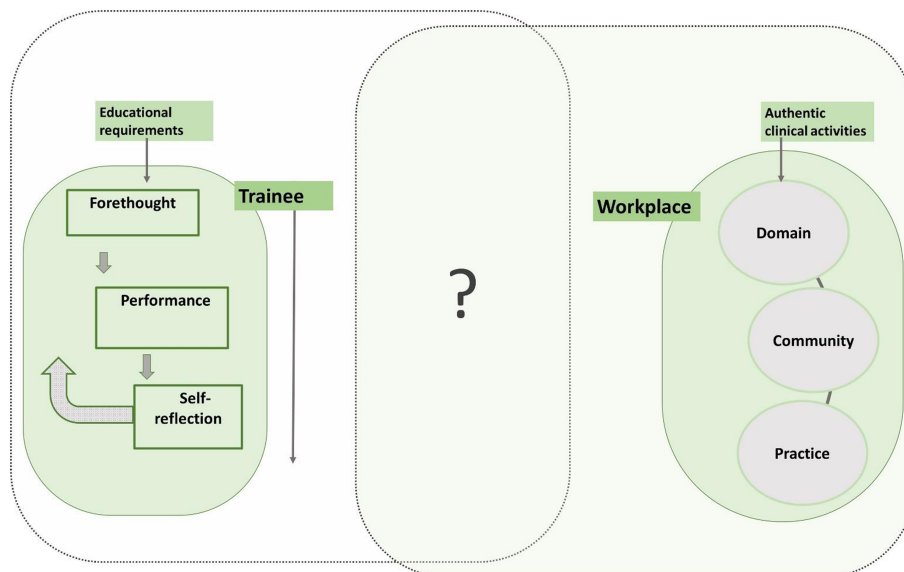
Our aims were to develop a holistic understanding of SRL in the clinical workplace that incorporates both individual and social aspects and to suggest ways of maximising learning for trainee clinical scientists and other health professionals. Our overarching research question was as follows: how do trainee clinical scientists regulate their workplace learning and to what extent can CoP concepts enhance our understanding of how social interactions contribute to this?

How do trainee clinical scientists regulate their workplace learning and can CoP concepts enhance our understanding of how social interactions contribute?

2 | METHODS

Our qualitative exploratory study (University of Birmingham Research Ethics Committee Ethical Review Number_18-1412) used thematic analysis (TA).¹⁹ Semi-structured interviews explored trainees' SRL during their workplace-based learning, including their social interactions (Appendix S1). The concepts central to Zimmerman's cyclical phases model and CoPs guided this study, as we sought to understand how far the situative perspective connects to the three SRL phases. Figure 1 presents our theoretical basis. We focussed on interviewees' understanding of SRL and how they create meaning from their workplace experiences. This subjective epistemological stance presented

FIGURE 1 An illustration of the integrated theoretical perspective. Self-regulated learning (SRL) is presented on the left and communities of practice (CoPs) on the right; we sought to understand the connections between the two theories, which are indicated by the overlap in perspectives. Figure 2 proposes these connections based on our findings



an 'interpretive approach to social reality',^{20,p.51} which is congruent with CoPs.

2.1 | Setting and participants

Interviewees were final year trainees from the UK Scientist Training Programme, a 3-year programme that combines workplace-based and academic components. Training is standardised and offered in over 40 specialties across four divisions: Life Sciences, Physical Sciences, Physiological Sciences and Bioinformatics. The specialties are diverse: some have direct patient contact and others predominantly laboratory based. Individuals train in one specialty and must generate evidence of their learning to meet required competencies in an e-portfolio¹; they are assigned a hospital-based training officer (trainer), who oversees their workplace-based learning, provides guidance and monitors portfolio completion.

2.2 | Data collection

Data collection took place in early 2019. There were 323 third year trainees, and the National School of Healthcare Science invited them to participate, via email.

Interviews took place over the telephone or face to face, and the duration ranged from approximately 30–80 minutes. The areas of questioning were the trainees' specialty and role, levels of interactions with others and the three SRL phases, with questions about how their social interactions influenced their learning.

2.3 | Data analysis

Transcripts were analysed abductively following Braun and Clarke's six stages, using a hybrid approach of inductive and deductive analysis.¹⁹

2.3.1 | Thematic analysis (TA) of participant responses was undertaken using NVivo 12 software²¹

This involved drawing conclusions from trainee perceptions and existing knowledge.²² TA focussed on the latent level by reviewing the data through the lens of SRL theory and CoPs to understand how social interactions influenced SRL. The movement from codes to themes involved identifying overlap between codes, grouping them into broader patterns and using ideas from memos to interpret trainee experiences. Analysis was an iterative process, with links made between the responses and concepts related to these theories. The development of the themes led to the subsequent construction of our model.

2.4 | Reflexivity

We have taken a socio-cognitive perspective.¹⁴ Though the focus was on the individual learner and their construction of knowledge, the application of CoPs allowed us to investigate social influences on learning. We are not clinical scientists and are not involved with developing clinical scientist training programmes; we were positioned as 'outsiders', but we do not think this impeded the research process.²³ ID and SB have considerable experience researching other groups of health professionals. The interviewer's (MS) lack of expert knowledge across specialties encouraged trainees to convey their experiences in simpler terms, allowing us to focus on SRL in the context of healthcare science.

3 | RESULTS

We received volunteers from all four divisions, and in total, 13 third year trainees participated. Throughout the analysis, we found it challenging to delineate between goal setting, planning and executing a plan in the workplace. Learning was often informal and opportunistic.

From trainees' insights, we constructed four themes involving social aspects of SRL: approach to learning; engagement and execution of tasks in practice; self-reflection and reaction; and autonomy and role construction. These themes link core concepts of Zimmerman's model and CoPs and highlight some important factors educators need to consider when supporting trainees in the workplace.

Approach to learning is about the ways in which trainees differed in how they addressed their competencies. It links domain (CoP) and forethought (SRL), capturing how trainees direct their learning within the routine workplace. Engagement and execution of tasks in practice draws on trainees' social connections and how others helped them generate and fulfil their learning goals set as part of the SRL forethought phase. 'Tasks' refer to the activities that trainees perceived to be pivotal to fulfilling both their workplace competencies and the role of a clinical scientist within their specialty. The trainees' perception of the 'tasks' to be executed was affected by their approach to learning. Reflection and reaction focuses on trainees' evaluations of their performance and how they adapted their learning processes. Finally, autonomy and role construction is about trainees' experienced autonomy and their subsequent 'positioning' and 'role' within the workplace.

3.1 | Approach to learning

Trainees described different approaches to learning: some indicated that the competencies determined their engagement with workplace activities, whereas others integrated their learning needs with departmental priorities and/or connected with their future role:

... you sometimes feel almost as if you are doing the placement for the sake of the competency, rather than what you are supposed to learn from it (T07).

Trainers' beliefs about the programme influenced the learning goals trainees set:

... something my training officer often says to me is, 'your competencies and your training is (sic) the most important thing, we just need you to get the competencies done and then we can get you out being a clinician' (T02).

Trainees who linked their competencies to their future professional practice valued their learning for their future roles:

... I have this vision of the Informatician I want to be. So it's more looking to the future, seeing what kind of skills I want to have, and what I think my gaps are (T11).

Trainees were both proactive and reactive day-to-day in the workplace and wanted to help others with routine work; they understood the wider shared interests of the community:

... I feel I'm still weak on vestibular training, so this month's rota has been altered so that I get the maximum amount of vestibular training possible (T07).

I also think I'm quite conscientious. So I want to help the team with the work that they are doing (T09).

3.2 | Engagement and execution of tasks in practice

Trainers and colleagues encouraged trainees to use SRL strategies to gain the workplace experiences they needed. Often when trainees asked for help, they felt they were actively involved in their learning processes:

When I did it [a dissection], I used to have my notes with me and if something was off, which normally happens, I would ask someone who's around ... 'Am I familiar with this? How do I do this?' (T01).

Trainers helped trainees generate and articulate their goals informally. For some, trainers and others provided scaffolded provision:

... I sit with different people quite a lot of the time, they say, 'right, what are you doing now?' I would say, 'right, so this is what I'm doing...' (T07).

... my training officer had said, for the first four months, focus on any cancers that come into the department and then for the next four months, focus on all the paediatric referrals (T08).

Both trainers and colleagues helped trainees by providing opportunities to meet learning requirements:

... if we had a quiet Friday and there were no patients in, they would come to me and say, 'okay, we are going to do a practice clinical examination' ... and I'd then be able to practice the measurements that we have to do (T02).

In some cases, trainees and trainers monitored the trainee's performance jointly and formulated plans to pursue relevant opportunities:

if there's any gaps, we [T08 and trainer] can identify those together and try and come up with a plan ... if I'm missing experience with particular conditions ... we might try and come up with a plan to resolve that (T08).

However, trainees reported experiencing variable amounts of engagement from their trainers and colleagues:

You learn who is going to be more enthusiastic about training so you learn that some people are better to approach for learning (T03).

Colleagues in some clinical contexts provided more enabling environments than others, giving trainees more responsibility in certain clinical scenarios or creating opportunities for them to learn. Whether in the role of 'observer' or 'doer', trainees needed support from others in the workplace to execute their learning plans:

It would be nice if people were ... keeping in mind the fact that I need to be seeing and doing and experiencing a wide variety of work ... it would be nice to see them a bit more engaged with the training sometimes (T03).

3.3 | Self-reflection and reaction

Some trainees assessed their own performance with trainers regularly, particularly after a patient encounter for those in patient-facing specialties. Others did not value self-reflection. Some were not exposed to a reflective departmental culture, where they could see or observe others assessing their own performance:

... we have gotten into the habit, with most of my colleagues now of immediately after the doors close and a patient has gone ... I will say what I think went well and did not go well, before getting feedback (T08).

I like very rarely get any positive feedback or anything like that without requesting it (T02).

Feedback given as part of the sequence of work enhanced self-reflection, helping trainees to direct their attention to areas/behaviours that needed improvement or adaptation:

So in different assessments, they'll ask generally how you feel things went ... So I feel like I do get the time to reflect, even if I resent forced reflection (T10).

Some trainers modelled self-assessment and therefore fostered SRL:

The person that is currently supervising me is very reflective herself ... I've learnt a lot just from hearing her reflect ... (T12).

Trainers' feedback on trainees' e-portfolio entries often focused on how they displayed evidence for competencies rather than their approaches to learning:

I get feedback on the work I submit which informs how I write these kinds of documents in the future ... I do not know if it's my learning though or it's just the way that you navigate the actual training scheme (T05).

3.4 | Autonomy and role construction

Trainees reported experiencing high levels of autonomy. They linked their experienced autonomy to their self-efficacy, sense of control and ability to meet learning requirements:

I feel incredibly in control of my learning. I feel like I have to set my own goals, to direct the learning to fill the gaps in my knowledge (T11).

Structure enabled trainees to direct their learning, to receive feedback, and provided exposure to others reflecting publicly. However, receiving too much autonomy from community members could inhibit use of SRL, depending on how much autonomy is experienced:

... if you are off doing things on your own, you are not going to know what you did not do well unless you can identify it yourself and that's a really hard thing to do sometimes (T12).

There appeared to be conflict between work requirements and training requirements, that is, disparities between trainees' approach and the community's domain:

... one of the things I had not quite sort of grasped was the disparity between the competencies and the actual requirements of the job (T06).

Trainees cannot simply learn from 'absorbing' all of the values of others:

I sometimes feel like I'm expected to learn to be a clinical scientist through osmosis just by being around clinical scientists ... but I think it's so much more about doing and failing and learning and being exposed to opportunities and being a bit out of your depth ... (T02).

4 | DISCUSSION

Our study investigated how far trainee clinical scientists regulate their workplace learning and the extent to which CoP concepts can enhance our understanding of how their social interactions contribute to this. These trainee health professionals operate in diverse environments, with elements of their clinical learning reflecting those of other health professionals. Their experiences have the potential to enhance our holistic understanding of SRL, including the self and social aspects. The themes generated capture trainees' *approach to learning, execution of tasks in practice, self-reflection and reaction, and autonomy and role construction in the workplace*: they connect SRL and CoPs.

Trainees' descriptions indicated that they consider themselves as belonging to the healthcare science community and to smaller communities within their specialties and departments. We have sought to understand how trainees develop habits of SRL in the context of this belonging, using CoPs as a lens through which to situate their learning; in turn, our themes relate to both SRL and CoPs. Figure 2 presents our trainee-workplace congruence model for workplace-based learning derived from the themes generated from our data.

4.1 | A trainee-workplace congruence model for workplace-based learning

The phases of Zimmerman's model (left) and the structural characteristics of a CoP (right) are linked through a concept we have named trainee-workplace fit (centre). We propose that the quality of the 'fit' between the trainee's requirements for SRL and the CoP within their workplace strongly influences how well the trainee regulates their workplace-based learning and navigates its social aspects. Congruence

depends upon alignment between *forethought* and *domain*, recognition of learning opportunities, autonomy, engagement and feedback (Figure 2).

The phases of Zimmerman's model and the structural characteristics of a CoP are linked through a concept we have named trainee-workplace fit.

Trainees' approach to their educational requirements influenced their participation in authentic clinical activities (real and meaningful clinical exposure) in the workplace. Whilst their e-portfolio should provide structure and enable SRL, trainees reported experiencing conflict between the demands of education (completing competencies) and service provisions. When focused on completing competencies, the learning context became less meaningful to them, reducing their motivation. Thus, task analysis, motivation and participation seem to be interdependent, suggesting that the *domain* of the workplace should not be ignored.

In our model, 'alignment' between *forethought* (SRL) and *domain* (CoPs) promotes active participation in the workplace. This means the trainee's goals, plans and motivations need to fit with departmental objectives. This idea reinforces Billett's notion of the practice curriculum, which requires deliberate structuring to enable trainees to practise through workplace participation.²⁴ Trainers should encourage trainees to set and share attainable career-focused goals with others, increasing their engagement in clinical activities in the workplace,

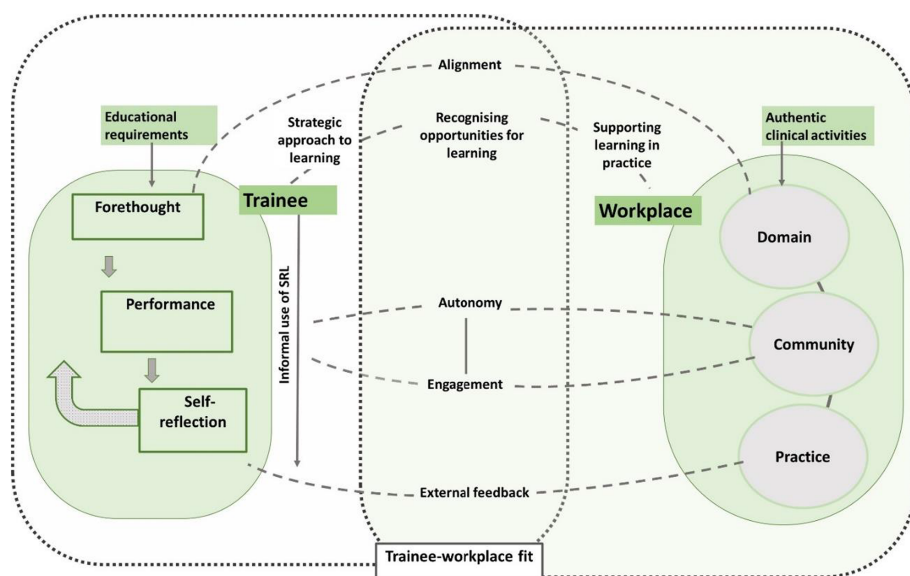


FIGURE 2 Trainee-workplace congruence model for learning in the clinical setting. An illustration of elements to be considered when developing trainees' self-regulated learning (SRL) habits in context. Links are drawn between concepts related to Zimmerman's SRL theory (left) and communities of practice (CoPs, right); the extent of congruence determines the 'trainee-workplace fit'. Congruence depends upon alignment between *forethought* and *domain*, recognition of learning opportunities, autonomy, engagement and feedback

whilst still achieving the required competencies. Congruence between *forethought* and *domain* and congruence between trainees' strategic learning approach and the working of the department may improve as trainees' participation in community work increases.¹¹

In our model, 'alignment' between forethought (SRL) and domain (CoPs) promotes active participation in the workplace.

Like medical students, the trainee clinical scientists in this study engaged with SRL to different extents^{2,25} and executed SRL informally, with trainers and others being pivotal influences. Some were better at planning, but all trainees used help-seeking, with responsibility for metacognitive monitoring mostly shared between trainees and their trainers. This is in line with previous studies. A number of people, including peers, consultants and nurses influence medical students' SRL through similar factors like role clarification, goal setting, learning opportunities, self-reflection and effort invested in learning.^{5,26} Our findings strengthen the notion that SRL is ingrained in social interactions.^{7,27,28}

Trainees' ability to make decisions about their learning (their autonomy) influenced how they directed their learning. Autonomy is recognised as important for SRL,^{4,9} but we suggest that the effectiveness of their SRL can be reduced if trainees are granted too much autonomy. Thus, in our model, autonomy is central, linking Zimmerman's sub-processes to the *community*. We suggest that trainers and others need to understand each trainee's ideal autonomy to optimise support.²⁸

In our model, autonomy is central, linking Zimmerman's sub-processes to the community.

Zimmerman's model only considers how the learner initiates contact with others to execute a task. Our findings indicated that trainers influence the sub-processes within *forethought*, *performance* and *self-reflection*. Our model adds consideration of trainers' (and colleagues) engagement with training and how they initiate contact with the trainee and signpost learning opportunities.

Zimmerman emphasises the importance of closing the SRL cycle with self-reflection.¹³ Our model links this (*self-reflection*) with trainees being provided with feedback on their performance in practice. Findings showed that feedback prompted trainees to reflect, even when they resented 'forced reflection', which implies that SRL can be encouraged extrinsically. We suggest that feedback should focus on the learning strategies used and tasks completed, as opposed to the mechanics of e-portfolio completion. Trainers could role model reflection by thinking aloud in front of their trainees, for example after a patient encounter or diagnostic test.

Our model links this (self-reflection) with trainees being provided with feedback on their performance in practice.

Studies suggest that trainers can foster trainees' SRL.³ Whilst it is important that trainees are active agents, our finding that trainers and colleagues were pivotal to SRL leads us to speculate that differences in trainers' use of SRL strategies may account for more of the variation in trainees' self-regulatory practices than differences between trainees themselves.

We suggest that trainers use our model from the start of the training programme, to inform their understanding of how their trainees learn, how they can initiate contact with trainees to develop their SRL habits and how they can prompt trainees to take ownership of their learning. The model could be incorporated within trainer guidance. Trainers should understand their trainees' competency requirements and any tensions that may exist between these and the routine demands of the workplace. Grasping these will help with the process of devising a training plan and encouraging goal setting. Day-to-day, trainers can assist with recognising learning opportunities that reflect the community's *domain*, understanding their trainees' optimal and suboptimal learning conditions.

4.2 | Strengths and limitations

Clinical scientists are a heterogeneous group composed of specialties varying in degree of patient contact; their insights are valuable and contribute to the expanding SRL literature. Interviews included a trainee from each of the four scientific divisions, and our sample size is comparable with other studies of this type. However, trainees may have overestimated their engagement with SRL and how much they are 'proactive' and 'self-directed': this is a concern others have shared.²⁹ The findings were not triangulated by trainers; future research could therefore explore their perspectives.

5 | CONCLUSION

Trainee clinical scientists' approach to learning and interpretations of 'optimal' learning conditions influence their workplace participation and propensity to engage with SRL. In our model, we have identified and illustrated how the situative perspective can complement Zimmerman's model, to enhance understanding of how social interactions contribute to SRL. Whilst trainees must be active agents, taking responsibility for their learning, trainers and others need to understand each trainee's ideal autonomy to optimise support. Trainers can facilitate the informal SRL process, enhancing trainees' use of effective self-regulatory skills, particularly in goal setting and planning. Trainers should pay attention to the 'fit' between the trainee and workplace, and by allowing them to participate actively in CoPs.

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CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

ETHICS STATEMENT

The study was approved by the University of Birmingham Research Ethics committee (ERN_18-1412).

DATA AVAILABILITY STATEMENT

The interview data generated and analysed during the current study are not publicly available due to the risk of identification of individual participants.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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