Exploring Trainee Science Teachers' Assessment as Learning (AaL) and Assessment for Learning (AfL) Practices in a Teacher Training Program

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This exploratory study provided insight into trainee science teachers' (TST) assessment as learning and assessment for learning practices and their differences and similarities. The participants included secondary school trainee science teachers on an initial teacher training program in a university in England and school mentors supporting them. Data was collected through interviews, lesson observations and focus group. The data were analyzed using thematic analysis with recurrent themes identified and coded to create relationships and links on the differences and similarities in TSTs' classroom assessment practices. The findings included dichotomization of AaL and AfL, assessment as a mastery teaching process, and coordinated collaborative professional development support for the TSTs by the university and the school experience mentors. The result highlighted the issue of assessment competence and literacy and the need to further support TSTs in developing their assessment practices.

Keywords: assessment for learning, assessment as learning, formative assessment, teacher professional development, assessment literacy, assessment competence

INTRODUCTION

This study highlights various classroom assessment practices carried out by science trainee teachers (TSTs). It focuses on assessment for learning (AfL) and assessment as learning (AaL) as means to promote effective teaching and learning by helping TSTs (pre-service teachers) to understand formative assessments and implement them in their classrooms. Formative assessment and assessment for learning (AfL) are used interchangeably meaning the same process in this study (Schildkamp et al., 2020; Izci et al., 2020) and AaL can be considered a part of the formative assessment (Earl, 2013; Yan, 2021). This clear link is necessary for the TSTs as both AfL and AaL can promote the learning of students. At the heart of this study is a focus on formative assessments as experience has shown that trainee teachers may find it difficult to distinguish between AaL and AfL (Dann, 2014). AaL is a form of formative assessment that involves students in self-regulating their learning and using feedback to improve outcomes, it is student-driven and occurs throughout the lesson (Yan & Boud, 2021).

Dann, (2014, p. 159) argues that any 'attempt to promote AaL must recognize that for the learner, there may be conflict and resistance to learning as they may regard it as uninteresting or peripheral'. Assessment should be an ongoing practice in the classroom involving teachers and students, but it becomes more difficult and irrelevant to students when teachers dominate the assessment process, and students lose invaluable opportunities to develop self-regulation competence (Yan, 2021). Therefore, we need to move away from teacher-centered practices and encourage students as co-assessors of their learning by playing an active role through AaL.

During formative assessments, teachers collect data on students at any moment of instruction to assess their learning (Black & Wiliam 1998; Swaffield, 2011). The assessment helps identify where students are in their learning and how best to support them (Assessment Reform Group (ARG), 2002; Van der Kleij et al., 2015; National Foundation for Educational Research (NFER), 2019) and can be achieved through formative assessments. Therefore, TSTs should be directed on those aspects of formative assessments that constitute AfL and AaL, especially developing AaL using strategies such as feedback, discussions, and self and peer assessments (Black & Wiliam, 1998; Panadero et al., 2016; Gan, He & Mu, 2019; Yin, Chen & Chang, 2022). Feedback is an effective means of supporting the process of AaL and TSTs should consider various ways to implement it in their classrooms.

Af L is used by teachers daily in the classroom (Shavelson et al., 2008; NFER, 2019) to gather information on students' learning. However, Buck, Trauth-Nare and Kaftan (2010) argue that many teachers have a very limited understanding of the nature of formative assessments and Yan (2021) avers that AaL is underused in classrooms. In both situations, teachers lack the pedagogical strategies required to implement assessments and hence, advocate for professional development support. Very little is known about TSTs' experience of AfL and AaL and how these processes are similar or different, therefore, the focus of this study is to look at those aspects of TSTs' practices where AaL and AfL are used to promote the learning of students. Especially considering ways that TSTs' assessment competence and literacy can be developed (DeLuca et al., 2019; Schildkamp et al., 2020). Hence, this study would answer the research questions: i) are there similarities and differences between TSTs' assessment for learning and assessment as learning practices, ii) how does it impact their classroom assessments and students' learning? and iii) what are the experiences and activities of the participants in an Initial Teacher Training (ITT) program run by a university?

AfL and AaL in the classroom.

Assessment for learning (Black & Wiliam, 1998; NFER, 2019) is at the heart of teaching and learning, and research in this area focuses on ways to improve classroom assessment practices among teachers. The ARG (2002) defines AfL as the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go, and how best to get there. Improving assessments in the classroom spans many years and in different countries (See Black & Wiliam, 1998; Gan, He & Mu, 2019; DeLuca et al., 2019; Parmigiani et al., 2024) and will continue to steer dissensions among educators. The argument focuses

on what information teachers can collect on assessments and how to use the information to support learning. This aligns with Alonzo and Teng's (2023) notion of teachers' decision-making process in assessments which involves deciding the quality of assessment tools and strategies to accommodate students' diverse learning needs, differentiated learning tasks and the alignment of assessment to the learning outcomes. In agreement, Ismail and Osman (2024) also emphasized the importance of utilizing relevant assessment tools and teaching and learning approaches in formative assessment as prerequisites to effective learning. Assessment approaches such as self and peer assessments, questions and feedback, peer collaboration, active learning and students taking responsibility for their learning have been reported as effective in supporting this process (Black & Wiliam, 1998; Panadero et al., 2016; Gan, He & Mu, 2019; Parmigiani et al., 2024). For example, it is argued that allowing students to carry out self and peer assessments enables them to take ownership and self-regulate their learning and that of their peers (Wiliam, 2011; Wiliam & Leahy, 2015). Formative assessments can help students comprehend assessment complexity and motivate them to use various assessment strategies and improve their competencies (Parmigiani et al., 2024). Peer assessment provides cognitive and non-cognitive gains and evaluates students' performances in teaching and learning. It benefits both teachers and students; however, the results may vary depending on the design and implementation (Mumpuni, et al., 2022), and all of these can develop AaL experience among students.

Yan and Boud (2021, p. 13) define AaL as an 'Assessment that necessarily generates learning opportunities for students through their active engagement in seeking, interrelating, and using evidence'. AaL may be considered a part of the AfL process (Earl, 2013), however, Yan and Boud (2021) and Yin et al (2022) contest this, with the notion that both are different. Yan and Boud (2021, p. 14) suggest that AaL is 'assessment while learning' and AfL is 'assessment then learning'. In contrast, Yan (2021) avers that synergies between AfL and AaL can promote a successful assessment reform. This implies that classroom assessment is effective if it addresses the intended curriculum and assesses and supports learning and instruction (Black & Wiliam 1998, Hattie & Timperley 2007; Ruiz-Primo et al., 2012).

AaL and AfL are inclusive means of learning as they can help students develop the competence skills required for lifelong learning. The ongoing interaction between teachers and students is important in establishing the type of support that is relevant to promoting learning. AaL can create an environment that enables students to be honest about their weaknesses, handle peer feedback and support others (Brown, 2019; Yin, Chen & Chang, 2022). It is an integrated part of the teaching and learning process, rather than a separate activity occurring after a phase of teaching. Therefore, students may require help to understand what quality assessment is, just like their teachers. For example, Ofsted (2019) is interested in how schools use assessments to support the learning of students, and this is evidenced in its implementation. It involves checking students' understanding systematically, identifying misconceptions and providing feedback to improve learning.

Panadero et al. (2016) argue that formative assessments in principle stimulate students' active involvement in assessment but in practice, this is not the case as it is often

teacher-centered rather than the student. A lot more needs to be done to develop TSTs' AaL practices as portrayed in this study, and the challenges are corroborated by Swaffield (2011) and Kippers et al. (2018) who encourage teachers to apply different types of AfL strategies throughout the lessons to promote learning rather than employing specific ones. Schildkamp et al. (2020, p. 10) suggest three prerequisites for formative assessments such as 'knowledge and skills, psychological and social factors'. Psychological factor relates to teachers who demonstrate a negative attitude towards formative assessments and may not likely work on their data and assessment literacy. In contrast, teachers who exhibit social factors will collaborate with other teachers and students and learn from such interactions.

TSTs implementing AfL and AaL in the classroom.

Implementing AfL in the classroom may involve challenges such as defining assessment, its effectiveness and teacher preparedness (Siarova, Sternadel & Masidlauskaite, 2017), conceptual confusion of AfL, and a lack of effective models for professional development (Deluca et al., 2012; Pastore, 2020; Diaz et al., 2023). In the same way, there are challenges in implementing AaL and this includes a lack of flexibility in the curriculum for teachers to practice and engage in AaL activities, students' diverse abilities, teachers' lack of skills and concrete examples for AaL (Yan, 2021). In addition, Magaji and Ade-Ojo (2023) suggest that educators should create opportunities for trainee teachers to combine both new and existing experiences of assessments as this can help them to reflect on their practice and develop their assessment competence and literacy. This will make learning explicit to students, and promote self-reflection and motivation. Both challenges of AfL and AaL seemed similar, however, the difference lies in how AaL promotes students as active and autonomous learners (Yin, Chen & Chang, 2022) who can utilize information and close the gap between prior and current knowledge, monitor and assess their learning, set goals and achieve them. Therefore, AaL develops self-regulation and metacognition among students whereas AfL cannot develop this process as Perrenoud (1998) argues that the promises and goals of AfL are the result of multiple interrelated factors, not solely the use of AfL practices. The need to cover the curriculum contents may impede teachers from fully utilizing AaL strategies in their classrooms due to time constraints and can be a barrier to its implementation.

Well-planned assessment activities can promote students' leadership and autonomy in their learning, and create an opportunity for students' questions, feedback, probing and evaluation (Magaji et al., 2018; Parmigiani et al., 2024). Creating such a learning opportunity is pivotal in classroom assessments, for example, Parmigiani et al (2024) conclude that peer and group assessment strategies are the most effective form of assessments and can help students to reflect on their assessment competencies. Teachers need to create interactive opportunities where students can self-regulate their learning, provide feedback to peers engaging in meaningful learning and develop metacognitive skills (Yan & Boud, 2021; Yin, Chen & Chang, 2022). Shavelson et al (2008) encourages teachers to listen to students' discussions during planned activities involving interactions and this can be embedded in the curriculum to promote AaL gains. In the same vein, Schildkamp et al. (2020) argue that proper planning and considering various

strategies to use in formative assessments can improve students' learning and achievement. Buck et al's (2010, p. 409) theoretical approach to formative assessment indicates that an 'understanding of relational processes inherent to formative assessment' can promote AaL in the classroom. Therefore, the Initial Teacher Training (ITT) program should provide TSTs with quality experience of what formative assessment is, especially AaL, to allow them to understand the processes involved and implement them in their classrooms. This can be considered as the benefit of engaging students in assessment practices as both AfL and AaL allow them to contribute to their learning.

Assessments in the science classroom may involve collecting information from practical work and investigations, self and peer assessments, homework, portfolios, questions, teacher and students' feedback, problem-solving and tests. The teacher decides how this information can be used to promote learning. Given the wide sources of assessment data collected, on the one hand, there could be a problem of assessment competence and literacy on the part of the TSTs and the other, issues of assessment competence on their students. This is because various assessment tasks may be needed to adequately assess students' mastery of performance expectations and develop the core knowledge across all areas of science subjects, and any given assessment task may assess more than one performance expectation (National Research Council, NRC, 2014). This difference may account for how TSTs promote AfL and AaL in their classrooms as Yan (2021) concludes that teachers' lack of skills and concrete examples of AaL and students' lack of initiatives to engage in AaL are challenges making it unsuccessful in the classroom. Consequently, the ITT instructor needs to work in collaboration with mentors in school placements (practicum) to ensure that TSTs are given further support in understanding and implementing AaL in their classrooms. This view is reinforced by the Department for Education (DFE, 2019) ITT Core Content Framework in England, which suggests that trainee teachers be given opportunities to discuss and analyze with mentors how to plan lessons to promote collaborative learning, plan formative assessment tasks linked to learning objectives, engage in feedback and provide time for students to respond to the feedback.

NFER (2019) and Diaz et al (2023) conclude that assessments of students must bring about the intended impact on their learning and progress. However, what is missing in the support provided for TSTs is the lack of knowledge of AaL in their school placements. DeLuca et al. (2012) state that the goals of assessments are a result of multiple interrelated factors and professional learning might vary for teachers throughout different stages including TSTs and experienced teachers. Both the ITT instructors and mentors in school placements play a significant role in supporting TSTs' professional learning on assessments to help them capture those moments in their classrooms where they can differentiate between AfL and AaL and develop their practices. The success, therefore, lies in the structure and delivery of the curriculum focusing on how assessment practices such as self and peer assessment activities can help promote AaL.

Module content and delivery

Formative assessments are incorporated as part of the Subject knowledge and Pedagogy module at this university in England. This is taught through workshops and seminars with inputs from the ITT instructor, visiting lecturers and as part of the Professional Studies module. The duration for the university-taught session components is 12 weeks and this is interspersed with school experience (practicum) that lasts for 24 weeks in any academic year. The academic year runs from September to June of the following year. The combined experience between university sessions and school experience provides trainees with the opportunity to locate theory in their practice. The university workshops on assessments are inspired by a theoretical framework of Buck et al. (2010, p. 409) to help TSTs to 'understand the purpose of formative assessment and relate it to students' conceptual development, use outcomes for instructional planning and demonstrate an understanding of relational processes inherent to formative assessments'. The structure of the module includes identifying and utilizing the various types of assessment practices; lesson planning with a formative assessment focus; marking, feedback and analyzing assessment data.

During the university-taught sessions, the TSTs plan lessons and deliver them through microteaching. They receive feedback from the ITT instructor and their peers. This is the first step of their teaching experience before starting at their placement schools. A further layer of support involves the TSTs completing an evaluation of their teaching by reflecting on assessment practices carried out.

The University has a robust system of supporting TSTs in developing knowledge of formative assessments. For example, in school placements, they observe experienced teachers and learn from them, plan lessons and share with mentors who give feedback by identifying where assessments need improvement. The trainees then act on the feedback to improve their lesson plans before teaching. The lessons are observed by mentors who give feedback on the outcomes and trainees can reflect on their assessment practices to improve them.

METHOD

This exploratory study focuses on AfL and AaL in the classroom and is informed by a constructivist approach to learning (Savasci & Berlin, 2012). The study presents an opportunity to explore how the ITT program that supports teachers' training is run in a university in England, the contents and delivery of the module, and the experiences and activities of participants (Gray, 2018). Data were collected through interviews, lesson observations and a focus group. The research received ethical approval from the University Research Ethics Committee (UREC) where the study took place and all guidelines have been adhered to, such as consent from the participants.

Participants

This included 20 TSTs and 10 mentors from various secondary schools located in England. The mentors were science teachers mentoring one to three TSTs and carrying out lesson observations and feedback. Each mentor has over 8 years of experience in mentoring and has been trained by the University to carry out their roles.

Data collection

Each TST participated in the interview, followed by lesson observations and a focus group discussion. Collecting data from various sources furthered the course of triangulation (Robson, 2011). Each TST was interviewed once. The interview questions were semi-structured and carried out by a research assistant. This was necessary to avoid issues of reflexivity and bias in data collection by the researcher. The questions were structured following a framework of Buck et al.'s (2010) criteria for evaluating pre-service teachers' understanding of formative assessment. The interview questions were piloted on TSTs at a similar stage of training to those involved in this study to help refine it. Examples of the questions: discuss what you understand about AfL and AaL; describe examples of AfL and AaL strategies that you use to promote students' progress, and explain how the university workshops and Continuing Professional Development (CPD) in placement schools support your classroom assessment practices. These questions enabled the collection of rich data on TSTs' perceptions and practices of AfL and AaL. The interviews were audio-recorded to allow access when required.

The mentors at school placements carried out lesson observations on the TSTs. A lesson observation lasts between 55 minutes to 100 minutes and varies among schools due to the curriculum. The mentors carried out lesson observations on the TSTs every 6 weeks and the feedback was provided at the end of the observation cycle in the eighteenth week, while the researcher listened to the feedback without interfering. This was necessary as part of the university's quality assurance process. Each TST was observed three times during this study and a total of 60 lesson observations were conducted. The observations focused on TSTs' implementing AaL and AfL in their classrooms. The lesson observation criteria were provided by the university and it focused on the teachers' standards in England of which assessment is a part. The observation criteria included a plan for the effective use of assessment strategies to promote learning such as questioning, self and peer assessments, feedback, modeling, scaffolding, checking for prior knowledge and pre-existing misconceptions, plenaries and marking. Others included using assessment strategies to avoid overloading students' working memories, reducing cognitive load, stimulating thinking, and making good use of expositions. Based on these criteria, the observer can comment on the trainees' strengths and areas for development. Ofsted (2019) indicates that the evidence collected from lesson observation remains an important element of the teaching, learning and assessment judgment.

A focus group discussion with the TSTs was useful in establishing their understanding and implementation of AaL and AfL in their classrooms. The questions were semi-structured to allow probing and exchanging of ideas. Examples included can you explain any differences between AaL and AfL, and describe various AaL and AfL strategies that you use in the classroom and how? The researcher met fortnightly with mentors to discuss any concerns as per their engagement with the research and this does not influence the data collection process.

Data analysis

The interview recordings were transcribed and analyzed using thematic analysis (Braun & Clarke, 2006). This involves familiarization with the data, generating initial codes and searching for and reviewing themes. Recurrent themes were identified and coded to create relationships and links to similarities and differences between TSTs' AfL and AaL practices. The researcher and assistant went through the codes several times to ensure the reliability and validity of the outcomes and any discrepancies were resolved. The research assistant conferred with the interviewees to verify any expressions that were used as it helped for clarity. The comments from the lesson observations and focus group discussion were used as supporting evidence to confirm/validate the interview data. It will also help to identify how the TSTs carried out AfL and AaL in their classrooms. Collecting various data helps in furthering the course of triangulation (Robson, 2011) and ensures the validity and reliability of the data. The lesson observations were discussed by the mentors and TSTs to clarify any technical terms and useful information from their lessons. This professional dialogue is important in developing TSTs' knowledge and skills in assessments required to meet the teachers' standards in England (DFE, 2019).

The frequency of occurrences of the various AfL and AaL strategies used by the TSTs were collated from the interviews, lesson observations and focus group to form a framework for assessment that they can refer to (table 1).

FINDINGS

The two emerging themes that underpin TSTs' assessment practices are the dichotomization of AaL and AfL and assessment as a mastery teaching process (MTP). This responds to research questions one and two (table 2, appendix 1). For research question three, coordinated collaborative professional development support for the TSTs by the ITT and school experience mentors is the theme (table 2, appendix 1). The findings will be presented followed by discussions, and where applicable outcomes from the focus group and lesson observations will be used as supporting evidence.

The dichotomization of AaL and AfL

TSTs' understanding of assessments is evidenced in how they define and implement them in their classrooms. Most considered AfL and AaL as similar while a few said they may be different but did not know why. Examples of AfL definitions by TSTs included '*what teachers use in the classroom to inform teaching and identify where students are and support their learning and progress*'. Another said it is '*all the activities that are geared towards appraising students' learning, collecting data on their performance to support progress*', while others said, '*it is the exposure to teaching and learning that creates feedback to support students' performance*' and '*It involves activities by teachers and pupils such as questions, feedback, self and peer assessments to support learning.*

The above responses show an understanding of both AfL and AaL such as the use of feedback, and self and peer assessments as means to promote both forms of

assessments. The responses mirror the focus group discussion which also had confusing ideas differentiating between AaL and AfL. However, merely stating the strategies to promote AaL does not mean the TSTs all have the relevant knowledge and skills to implement them. For example, a TST said, '*AfL and AaL may seem similar, it can be confusing when you describe formative as AaL because formative can be questioning and observation*'. Another said, '*AfL and AaL are semantics as they are different*'.

The feedback below from a mentor to a TST further shows the difference between their understanding of AfL and AaL:

> *This is a good practice because you have used differentiated questioning to check prior learning and close gaps in students' knowledge. You told the students to use green pens for self and peer assessments and instructed them to discuss their ideas with peers. How can this be improved and what strategies can you use to promote student-led learning?*

Some other comments to demonstrate TSTS experiences of assessment are presented in table 2, appendix 1

Assessment as a Mastery Teaching Process

The TSTs demonstrated an understanding of AfL and AaL from the preferred strategies that they implemented in their classrooms such as '*I use questions and feedback and plan the questions before lesson but some of them just pop up*', another said, '*using traffic light card or multiple choice with questions that are color coded helps me to assess students and address their misconceptions*' (table 2, appendix 1). A TST demonstrated how they have used AaL stating '*I employ verbal feedback more often and self-assessment and assess students before and after the lesson to check progress*'. Another said, '*I use group discussions as I get a lot out of them and use prompts for verbal questioning*'. Most of these assessment strategies were echoed by the TSTs during the focus group discussion (table 2, appendix 1), with AfL being the dominant strategy (see table 1). As earlier mentioned, the lack of knowledge and skills to differentiate between AaL and AfL may have affected how the TSTs carried out assessments in their classrooms. With regards to implementing AaL, examples of discussions that ensued between the TSTs and mentors after the lesson observations are highlighted below:

Mentor 1's comments to a TST: '*What assessment strategy did you use to demonstrate students' progress during that activity?*'

TST's response: '*I asked questions and directed them to students that I know may struggle as this will allow them to respond and share ideas. This led to using self and peer assessments and they marked against the criteria. I also told students to add information to their peers' work after marking*'.

Mentor 2's feedback to another TST: '*This is a satisfactory assessment practice; however, you may consider developing student-led activities involving feedback, role-plays, independent tasks, and instructions to make them self-reliant. You could spend*

more time on the nuclear reactor task and scaffolding to encourage all students to contribute and assess each other in a way that gives them ownership of their learning'.

Mentor 3's feedback: '*You have used formative assessments with questions developed using Bloom's taxonomy and feedback to challenge students and address misconceptions. A tracker is used to allow students to identify where they are and what has been achieved. You can develop this by supporting students to set their own learning goals providing ongoing feedback and using more student-led activities'.*

Collaborative professional development support

A collaborative professional development support is provided by the university and the school placement (practicum) as part of an ongoing process to support the TSTs. The activities that the TSTs are engaged in during their training have shown that they consider professional development as crucial to implementing assessments in their classrooms. Regarding support from the university, the following comments were made: '*in university, we spent a lot of time on the theory side whereas at placements we focus more on the practical side',* while another said, *'the university workshops have been very useful as it helps with a lot of strategies for lesson planning on AfL'.* Other TSTs said, '*the instructor uses AfL techniques during workshops by modeling and we get lots of feedback'* and *'the instructor creates an opportunity for us to hear other trainees' experience of AfL strategies in their placements to enable us to support each other'.*

As per support from the school placements, a TST said: '*most of the CPD sessions did not cover a lot of AfL but one CPD did, and no mention of AaL, but can be improved'* and another said, '*the AfL training I received from my placement school has reinforced what we learned from the university session'.* Other TSTs said, *'we observed experienced teachers and learned from them and implemented the AfL strategies in our lessons'.*

Responses by the TSTs from the interview, focus group and lesson observations show that AfL is the dominant strategy in their classrooms confirming the previous claim (see table 1). AaL may have been subsumed in AfL, and from the comment above, a TST said this was not covered in their CPD at placement. This could be due to a lack of pedagogical knowledge to implement it or not creating awareness of when AaL becomes a part of the formative assessment process.

DISCUSSION

The dichotomization of AaL and AfL

The mentor's feedback in the findings shows that the TSTs utilize both AfL and AaL strategies to promote learning but are teacher-led despite encouraging students to share ideas. This trend may be seen in their definitions of AfL which centers on a collaborative approach to learning between teachers and their students, collecting assessment data and promoting learning using strategies such as questions, feedback, and self and peer assessments. However, the TSTs found it difficult to promote AaL among students because most of the strategies they utilized were teacher-led. There is a unanimous understanding that AfL involves knowing where students are in their

learning and what they need to do to improve and get to the next step (ARG, 2002; Dixon & Worrell, 2016; NFER, 2019). In contrast, when questions on AaL were asked, most TSTs did not identify specific strategies to implement AaL because they considered it similar to AfL except for the few who said they were different. They perceived AaL as engaging students in sharing ideas and using green pens for self and peer assessments, however, it is more complex in reality. Therefore, TSTs would require the necessary assessment competence and literacy to carry out AaL in their classrooms. This dichotomy to an extent may hinder TSTs from developing AaL further as they would need to understand what it means and how to advance their classroom practices in this process. Few TSTs recognized the role of students in complementing that of their teachers as joint assessors of learning and this exemplifies AaL to some extent, especially where students are given the lead role. This is an aspect that may be missing in the TSTs' practices.

The notion of assessment competence of both TSTs and their students can determine how AaL is developed and promoted among students. Especially promoting self-regulation, students' autonomy, utilizing feedback, and self and peer assessments. In this regard, the information collected on students' learning is important in informing the type of assessment strategies to implement. Consequently, assessment competence (DeLuca et al., 2019) and literacy (Schildkamp et al., 2020) become an issue of further professional development for TSTs. This is necessary as the TSTs lack initiatives, skills, and concrete examples to engage in AaL activities (Yan, 2021).

The ITT and mentors in placement schools should play a significant role in developing TSTs' pedagogical knowledge of assessments and promoting continuity of experience (Schmidt, 2010). This is authenticated by Tigelaar and Sins (2020) who suggest that to combat this situation, the trainer or instructor should have considerable involvement throughout the assessment program. Therefore, to make AaL and AfL effective, there needs to be a restructuring in the way it is promoted in schools and among teachers, especially in how we support TSTs to understand and implement both assessments in their classrooms. This is because any given assessment task in science may assess more than one performance expectation and develop core knowledge across all areas of science (NRC, 2014).

The differences between TSTs' AfL and AaL practices were due to a lack of, and varied experience during the course, especially from their school placements, and prior knowledge of assessment can be another issue to contend with. This difference was heightened on the one hand by mentors who may not have identified aspects of AaL in the TSTs' practices as such did not make it explicit how they can develop them. On the other hand, the TSTs were confused about how to assess students using a particular strategy on different tasks and outcomes. For example, in instances where feedback, discussions and self and peer assessments were used, it was not structured to promote self-regulation and autonomy that can develop students' zone of proximal development. Therefore, as Yan and Boud (2021) suggest, it would be conclusive to consider AaL and AfL as different practices and this study concurs with the idea. This will encourage TSTs to be more conscious and use relevant strategies to demonstrate AfL and AaL, and mentors should make it clear when discussing outcomes of lesson observations, the

aspects of TSTs practices where AaL could have been further developed. This may create a conscious effort on the part of the trainees as they complete the cycle of planning, teaching, reflecting, evaluating, and reteaching a lesson to develop their assessment competence and literacy

Assessment as a mastery teaching process (MTP).

To implement AfL and AaL in the classroom, TSTs should understand how various strategies can be utilized, especially in promoting synergies between both assessments (Yan, 2021) and developing students as active learners (Yin, Chen & Chang, 2022). The TSTs' responses in the findings show a preference for AfL strategies but AaL may have been sparingly implemented. This may be due to issues of assessment competence and literacy as they lack the skills to promote AaL activities in their classrooms. The notion of feedback as synonymous with AaL is encouraging but developing it to promote self-regulation, student-led learning, and autonomy in an active learning process becomes crucial to the trainees. In contradistinction, Burgers et al. (2015) argue that the quality of feedback and the way it is delivered must have effects on learning, how students interpret the feedback, and how their behavior is related to the feedback. This, therefore, means that teachers should train students on how to give and respond to feedback as this can pave the way for self-regulatory learning and autonomy among students.

Black and Wiliam (1998) and Panadero et al. (2016) argue that a combination of formative assessment strategies will support the learning and progress of students. Therefore, ITT instructors and mentors in school placements should help the TSTs identify the various assessment strategies and create awareness by making it clear when they are implementing AfL and AaL. This can be done through lesson observation feedback and modeling it to them. This would further help them to develop their assessment competence and literacy through a mastery process. This is evidenced by the discussions that ensued between mentors and TSTs. For example, mentor 1's comment is a confirmatory process to allow the TST to articulate the assessment strategies carried out in the classroom and create an opportunity for reflection. This type of professional dialogue (DFE, 2019) is relevant to support TSTs' knowledge and skills in assessments.

Mentor 2's feedback acknowledges that AfL is carried out but with further suggestions on how to improve AaL such as promoting self-regulation and learning autonomy among the students. Mentor 3's comment is an appraisal of the assessment strategies implemented as it shows that TSTs demonstrate an assessment competency (DeLuca et al., 2019) by connecting the prior and current experience of assessments to create continuity in their learning. However, it also highlights the need to develop AaL such as helping students set their learning goals and providing ongoing feedback that promotes self-regulation. Therefore, assessment as MTP in the context of this study provided the opportunity for TSTS to combine various learning experiences from the university workshops and school placements. This was achieved through modeling by observing lessons, planning and teaching, and reflecting and evaluating the teaching and learning of students. As assessment is an ongoing process, the TSTs and their students can develop assessment competencies and explore deeper learning.

Collaborative professional development support

Collaborative professional development between the ITT and placement schools is effective in helping the TSTs carry out assessments in their classrooms. This is corroborated by Diaz et al (2023) who conclude that preservice teachers require further training on assessments and monitoring students' learning as part of the purpose of assessment. In addition, Yaakob et al (2020) stated that the professional development of teachers must meet the educational needs of students and be in line with teachers' strengths and weaknesses to strengthen their potential and reduce aspects of pedagogical practices that do not promote students' achievements. Thus, the activities that TSTs are engaged in, to some extent can influence the type of experience they develop in the process. TSTs concluded that the university workshops provided the opportunity to learn the theoretical underpinnings of assessments, gain experience through the modeling of AfL and microteaching, and learn from each other by sharing experiences acquired from their placement schools. In the same vein, Hwang (2021) suggested that there is a direct and positive relationship between the professional development of teachers and student-centered instruction. In essence, the more professional development teachers attend, the better they become in implementing classroom assessments. However, this may not be the same for the TSTs as some of them indicated the contrary, as such, one would argue that the contents of the CPD should meet their needs with regards to assessments especially AaL, which is missing in most instances.

The notion of experience is emphasized by the TSTs as responsible for developing their practices, however, the difficulty lies in maintaining and promoting collaborative learning support between the ITT and mentors in school placements. Ade-Ojo and Duckworth (2020) conclude that to develop trainee teachers' assessment practices, a review of the structure and content of assessment education beyond training programs should be considered. This may involve how the ITT designs its curriculum to cater to the needs of the TSTs and recognize their experiences as valuable in developing their assessment practices.

The CPD attended by TSTs in their school placements has been useful, however, this was received with mixed feelings due to the different experiences and the types of activities that they were engaged in, especially in schools where they did not fully engage with CPD on assessments. For example, some TSTs concluded that the CPD on formative assessments did not clarify differences between AfL and AaL as the focus was only on AfL. In contrast, they unanimously said '*we discuss AfL and AaL strategies during workshops and the instructor emphasizes how to use the strategies, and sharing AfL ideas from our placement schools with peers helps us to support each other'*. The TSTs were conscious of the role of continuous self-development (Murwaningsih, 2024) to improve their practices and collaboratively develop assessment practices among their peers. Therefore, there is a need to further engage the TSTs in CPD which may allow them to develop their assessment competence and literacy.

The quality of experience TSTs gained from their ITT program and support from mentors in school placements are required to promote continuity in their assessment

experience of AfL and AaL and how they can develop their teaching. This should go beyond implementing various AfL strategies (see table 1) to how they can develop AaL that promotes self-regulatory learning and autonomy. In resolving this issue, a collaboration between the ITT instructor and mentors can encourage TSTs to reflect on their practices.

Table 1
TSTs' framework of AfL and AaL strategies and tools in the classroom

AfL strategies	Questioning	Feedback	Self- assessment	Peer- assessment
AfL tools	ABCD cards 1 ABC quizzes 1 Plickers 1 Kahoot 1 Doodle online homework task 1 Mini-plenary 1 Plenary 1, 2 Mini whiteboard 1 True/false statements 1 Bloom's taxonomy prompts 1 Questions using lollipop sticks 1 Tests/quiz/exams 1 Hot seat 1 Articulate 1 Pose, pause, bounce and pounce 1, 2 Who wants to be a millionaire 1, 2 Scaffolding with questions 1, 2 Think-pair-share 1, 2	Verbal/oral 1, 2 Thumbs up/ down/sideways 1, 2 What Went Well 1 Even Better If 1 Dialogue 1, 2 DIRT- dedicated improvement and reflection time 1 Postcard activities 1 Bouncing answers 1, 2 Students respond to teacher and peers' feedback 1, 2 Post-it notes 1 Eavesdrop on students for information 1, 2 Talking/sharing ideas 1, 2 What I know, what I want to know, what do I know 1 Improving existing/new pieces of work 1 Writing frame 1	Using mark schemes 1 KWL grid 1 Mind maps 1 Webs 1 Venn- diagram 1 Man on the tree 1 Progress triangle 1 Progress chart on a continuum of 0-100% 1 Self-evaluation 1, 2 PMI plus/minus/interesting 1 Assessment ladder 1 Sentence to summarize knowledge 1 Exemplar work 1, 2 Mini whiteboard 1 Plickers 1 Concept cartoons 1, 2 List of criteria- tick if met 1 Traffic light cards 1 Exit tickets 1, 2	Modeling 1, 2 Role-play 1, 2 Drama 1, 2 Investigation/practical work 1, 2 Mini-games 1 Group work/peer support 1, 2 Talk partners 1, 2 Think-pair-share 1, 2 Group presentations 1, 2 Postcard activities with students adding more information 1 Students review in groups 1 Sentence to summarize knowledge and peer assessment 1 Two stars about work and a wish showing what can be improved 1 Constructive partners 1, 2

Key: AfL = 1 and AaL = 2

LIMITATIONS

A limitation of this study may involve interviewing and observing trainee teachers from other subject areas to get their views and experience of assessment practices and how they compare to the TSTs. What approaches to their assessments fulfil AaL and AfL and how do they support learning through these processes? Further research may consider exploring any difference between AaL and AfL and how can trainee teachers adopt these in their classrooms. This should go beyond carrying out assessment practices but identifying those moments of transformation from one assessment to the other, in this case between AfL and AaL. The role of the school placement mentors in helping the TSTs to actualize this transformative process can also be explored.

CONCLUSION

This research sets out to provide an insight into the similarities and differences between TSTs' AfL and AaL practices, and how they impact their classroom assessments and

students' learning. It also sought the experiences and activities of the TSTs in an Initial Teacher Training (ITT) program run by a university in England. The findings suggested that there were similarities between TSTs' AfL and AaL practices. However, the similarities may be due to a lack of an understanding of how they vary, especially how strategies such as feedback, discussions, self and peer assessments, and developing cues and prompts can promote self-regulation and autonomous learning. TSTs discussed how they used formative assessment strategies to support students' learning but, in most cases, they were teacher-led due to the lack of knowledge and skills to advance AaL activities (see table 2, appendix 1).

The assessment strategies in table 1 are not new and may have been discussed in various literature and practices but importantly, bringing together the TSTs' classroom assessments may further promote the AaL and AfL experience. For example, some of the strategies can be used in more than one activity, such as the think-pair-share in AfL can be developed further during AaL (table 1). This study, therefore, supports the body of research that suggests that AaL is different from AfL as creating this awareness would encourage mentors and ITT instructors to support TSTs in developing their teaching to address AaL. There may also be an opportunity to collaboratively design assessment practices between the university and school placements especially where the trainees may have been dissatisfied with the quality of CPDs they received.

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Appendix 1

Table 2

Themes from the qualitative data analysis with examples of comments.

Themes from data analysis	Examples of comments from TSTs' Interviews	Examples of comments from the focus group discussion	Examples of comments from the lesson observation
The dichotomization of AaL and AfL	*'AfL and AaL may seem similar, but it can be confusing when you describe formative as AaL because formative can be questioning and observation'.* *'AfL and AaL are semantics as they are different'*	*'I think both types of assessments are the same and you can use the same strategies, but I do not know how this can be through AaL'.*	*'Students were told to use green pens for self and peer assessments and discuss their ideas with peers. How can this be improved and what strategies can you use to promote student-led learning?'*
Assessment as a mastery teaching process.	*'Using a traffic light card or multiple choice with color-coded questions helps me to assess students and address their misconceptions. I ensure this process is repeated over again to promote learning'.* *'I employ verbal feedback more often and self-assessment and assess students before and after the lesson to check progress. Repeating these strategies helps students to become familiar with it'*	*'I use various strategies such as traffic light cards, and mini whiteboards to assess my students and this helps them to identify what they have done well and how to improve. I vary the strategies and use them in different lessons and my students are now used to them'*	*'I asked questions and directed them to students that I know may struggle as this will allow them to respond and share ideas. This led to using self and peer assessments and they marked against the criteria. I also told students to add information to their peers' work after marking'.* *'You can develop the assessment further by supporting students to set their own learning goals providing ongoing feedback and using more student-led activities.*
Collaborative professional development support	*'The university workshops have been very useful as it helps with a lot of strategies*	*'We discuss AfL and AaL strategies during workshops and*	*'The training we attended at placement the school was useful in supporting the*

for lesson planning on AfL'	*the instructor emphasizes how to use the strategies, and sharing AfL ideas from our placement schools with peers helps us to support each other'.*	*assessment practices, 'the training at placement school did not clarify the difference between AfL and AaL'.*
'The instructor uses AfL techniques during workshops by Modelling and we get lots of feedback'		
'in university, we spent a lot of time on the theory side whereas at placements we focus more on the practical side'.		