Regular Article

Improved learning outcomes and teacher experience: A qualitative study of team-based learning in secondary schools

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A B S T R A C T

Based on the benefits of Team-Based Learning (TBL) in higher education, our project investigated possible benefits of TBL in secondary education. We found that, despite challenges, the benefits of using TBL in secondary schools make it worth teachers' time and effort. We conducted a year-long qualitative study with 13 teachers from Ireland, Spain and UK. While teachers found preparation time, institutional requirements, and managing student team dynamics challenging, challenges were outweighed by benefits including improved student engagement, quality of learning, skill development, and teacher job satisfaction. We recommend further TBL training for secondary-level teachers and further research into this topic.

1. Introduction

Team-Based Learning shows potential for significant benefits in secondary education for both pupils and teachers. Based on the well-known benefits of Team-Based Learning (TBL) in Higher Education (Fatmi et al., 2013)– (Liu & Beaujean, 2017), the Erasmus-funded TALENT Project aimed to investigate its use at Secondary level. The past work of a project partner during their MSc at Oxford University, which included practice-based research on their experience using TBL in secondary education in Spain, showed promise for the use of TBL at this level. To expand upon this previous work, this project (made up of partners based in Ireland, Spain, the Netherlands and the UK) secured funding from the Erasmus+ programme to further explore the use of TBL in secondary schools in partners' respective countries. The aim of the TALENT project was to form transnational strategic partnerships to develop resources and train teachers to use TBL as an active and collaborative pedagogy in a number of schools in Europe. The research presented here forms part of the project's academic aims to investigate secondary teachers' experiences of TBL.

1.1. Team-based learning

Team-Based Learning centres around active, experiential learning and draws on constructivist learning theory. Through individual preparation and problem-solving in small teams, the method allows students to construct new knowledge and new "mental frameworks built upon previous knowledge" [6, p. 796]. Several studies and comprehensive reviews note TBL's documented effectiveness in promoting increased *knowledge acquisition* (Fatmi et al., 2013), (Swanson et al., 2019), (Liu & Beaujean, 2017)– (Nelson & Tweddell, 2020), although these articles also note that further or more rigorous research is needed to fully interrogate the reasons and conditions for these effects. Another major claim for TBL's effectiveness centres around much-improved *student engagement* in TBL classes compared to other pedagogies. Key factors in this engagement identified by authors include TBL's learner-centred 'flipped classroom' structure, regular assessments, and group accountability (Swanson et al., 2019), (Haidet et al., 2014), (Sharma et al., 2017)– (Nelson & Tweddell, 2017), with one study finding that students reported moderate to high levels of cognitive engagement across the various TBL activities, with the highest levels of engagement during

collaborative activities (Rotgans et al., 2018). Other important effects of TBL identified in the literature include increased *student confidence* (Nelson & Tweddell, 2017), (Gryka et al., 2017), (Michaelsen & Sweet, 2008) and enhanced development of transferable skills including *critical thinking* and *teamwork skills* (Hrynchak & Batty, 2012), (Nelson & Tweddell, 2020), (Frame et al., 2015)– (Levine et al., 2004). Finally, studies focussing on instructor experience note a striking increase in *instructor satisfaction* when teaching using TBL (Nelson & Tweddell, 2020), (Nelson & Tweddell, 2017), (Tweddell, 2017). Liu & Beaujean note, in their 2017 meta-analysis, that the use of TBL also necessitates the use of several other effective, evidence-based teaching methods and pedagogical techniques such as active and collaborative learning.

Team-Based Learning was developed in the United States by Professor Larry K. Michaelsen, who developed the teaching strategy in the 1980s and 1990s in his business and management classes at the University of Oklahoma in response to increasing class sizes (Michaelsen et al., 1982), (Khogali, 2013). The approach is mainly used, so far, in U. S. post-secondary and professional education (Haidet et al., 2014). It has become popular in medical education in the past twenty years (Khogali, 2013), (Compton et al., 2016), although it is also used in a wide variety of disciplines including the social sciences (Sweet and Michaelsen, 2012). In the UK, Team-Based Learning is relatively new – although growing in popularity – with the first published pedagogical research relating to TBL in the UK dating in the 2010s (Nelson & Tweddell, 2020), (Nelson & Tweddell, 2017), (Khogali, 2013), (Branney & Priego-Hernández, 2018; McMullen et al., 2014; Middleton-Green & Ashelford, 2013; Nation et al., 2016; Tweddell et al., 2016).

1.2. Principles of TBL

Team-Based Learning as prescribed by its developers (Michaelsen & Sweet, 2008) requires students to work in teams of five to seven people, chosen carefully by the instructor for a heterogeneous mix (Principle 1). Having studied pre-set prep materials, students first take an individual Readiness Assessment Test (iRAT), followed by a tRAT – the same quiz, but together as a team. The RATs ensure students are made accountable (Principle 2). Following this, a short lecture by the instructor addressing any obvious areas of misunderstanding completes the RAP, or Readiness Assurance Process. Next, students work together on an Application Exercise (AE), a problem-solving activity requiring teams to use learning from pre-set prep materials to address a *significant* problem and make a *specific* choice for their answer. All teams work on the *same* problem and report their team's answers *simultaneously*. Both the RATs and these AEs must promote learning and team development (Principle 3), and students must receive immediate feedback (Principle 4). The instructor facilitates a class-wide discussion about the application activity, with teams allowed to debate each other and put forward their arguments, whilst the instructor ensures that key concepts are reinforced and understood by everyone by the end of the session. TBL creates a notable shift in the role of the instructor, from imparting information to designing and facilitating learning. The final key element in TBL is peer evaluation, which can be implemented in a number of ways. Like the individual and team Readiness Assurance Tests and the application activities, peer evaluation may make up a percentage of each student's own mark/grade, or simply provide formative feedback, adding to the accountability which is key to TBL's effectiveness (Michaelsen & Sweet, 2008), (Michaelsen & Sweet, 2011).

1.3. TBL in secondary education

Existing literature on TBL in secondary schools is sparse, but research outcomes suggest similar outcomes as in higher education settings. The first study on TBL in a U.S. secondary school setting found that, "Overall, students participating in the classes with TBL significantly outperformed students in the typical instruction classes in content knowledge," whilst also noting that TBL benefitted those students with the most background

knowledge the most significantly, and made the least difference to those with the lowest scores on subject-specific pre-tests (Wanzek et al., 2015, p. 198). The second study, conducted with younger U.S. middle school students, found that students who learned with TBL produced more comprehensive and accurate content in essays, but did not perform better in multiple-choice exams (Wanzek & et al., 2014). This second study also noted the necessity of good institutional support and time for teacher instruction to support effective implementation of TBL for the best outcomes (ibid). A third study conducted by some members of the same research team with students with high-incidence disabilities – defined as specific learning difficulties and speech/language impairments – found that TBL had a significant effect on vocabulary knowledge acquisition for these students, though not on general factual content knowledge. Notably, this effect was stronger for students with disabilities than those without disabilities (Kent et al., 2015).

Apart from these three studies, all the literature reviewed in this paper relates to research in the higher education context – highlighting the need for more research on TBL in the secondary context. This research sought to explore the following questions: What benefits of TBL did participating secondary teachers perceive through using the method, specifically with regard to student engagement, quality of learning, and teacher satisfaction? And, what challenges or barriers did secondary teachers face in implementing TBL? The research presented in this paper contributes to the nascent body of literature on TBL in secondary education, providing insight into the experiences of schoolteachers in Europe using TBL as a novel approach.

2. Theory

2.1. Relevant pedagogical approaches and theories

2.1.1. Active learning approach

TBL is based on a student-centred, active learning approach which is designed to encourage development of independent teams working together to learn (Michaelsen et al., 2014). Active learning can refer to any teaching methods focused on engaging students in the learning process through activity, whether as individuals, in pairs, in informal small groups, or through cooperative learning (Prince, 2004), (Zayapragassarazan & Kumar, 2012). Team-Based Learning distinguishes itself from broader pedagogies of cooperative learning and problem-based learning through its specific focus on generating independently functioning teams. This in turn hinges on its unique processes of assessment-based readiness assurance and feedback, as well as the facilitative role of the instructor in providing appropriate resources, activities and incentives for such teams to develop (Michaelsen et al., 2014). Active learning as a broad approach has proven to be effective across a broad range of disciplines, particularly in developing critical thinking skills in older students and engaging so-called 'digital natives' less tolerant of lecture-style learning (Prince, 2004), (Nelson & Crow, 2014; Roehl et al., 2013; Rosenthal, 1995; Walker, 2003).

2.1.2. Constructivist learning theory

Constructivist learning theory posits that learners create and retain knowledge by building upon existing experiences and understandings of the world, adding new information to established mental frameworks. By consolidating the new with the old, learners construct novel or adapted conceptual understandings and ways of behaving based on those understandings (Pieper & Pelech, 2010). Constructivist learning requires facilitation (not just information dissemination) by educators, opportunities to compare new ideas with previous conceptions, relevant applied learning activities, and time for reflection on new experiences (Kaufman, 2003). Hrynchak & Batty (Hrynchak & Batty, 2012) argue that constructivist learning theory is relevant to the goals of effective applied learning in healthcare education and that "TBL is an effective and economical teaching method based on constructivist learning principles [which] enables students to develop critical competencies of

critical thinking skills and teamwork abilities" (p. 800).

2.1.3. Collaborative learning

Collaborative learning can help students grasp new knowledge at any level from foundational information through to conceptual theory (Alwi et al., 2012; Apul & Philpott, 2011; Korkmaz, 2012; Melkert, 2003; Stanford et al., 2013; Villa et al., 2013). The opportunity to discuss in small groups allows students to interrogate ideas and deepen understanding (Higgitt, 1996). Working independently with a collective of peers encourages knowledge consolidation and analytical thinking (Higgitt, 1996)– (Healey et al., 1996).

One study explored the fluctuation of cognitive engagement during different TBL activities, finding the students reported moderate to high levels of cognitive engagement across TBL processes, but these were highest during autonomous group activities (Rotgans et al., 2018). The researchers pointed out that this finding in relation to TBL "is supported by research suggesting that cognitive engagement is positively influenced by feeling autonomous from the direct influence of a teacher and when students take the lead in their learning" [12, p. 349].

In addition to promoting knowledge acquisition, collaborative work can foster the development of academic and practical skills (Apul & Philpott, 2011). Critical, analytical and creative thinking skills, as well as time-management, project management and technical skills, can be developed and enhanced through collaborative work as a result of having to apply these skills in an interactive context. More complex skills, such as interpersonal communication, conflict resolution, critical analysis and problem-solving can also develop through applied collaborative work through the need to react to the circumstances of a given exercise, draw upon existing and new knowledge, and interact with others to take action (Melkert, 2003), (Chau, 2007; Ellis & Weekes, 2008; Kim & Tan, 2013; Panelli & Welch, 2005). The experiential learning that takes place through applied collaborative activities appears crucial to both knowledge acquisition and skill-building, as well as promoting changed perceptions.

For example, several studies find that students grow in awareness of real world issues and the complex interlinkages between them – for example, environmental issues, institutional contexts, or social structures – through applied collaborative work focussing on real-world situations (Levine et al., 2004), (Melkert, 2003), (Ameta et al., 2010; Glassey & Haile, 2012; Simm & David, 2002; Stanier, 1997). Collaborative projects which ask students to evaluate their peers, themselves and their own experiences engender still more personal development by helping students grow aware of their own strengths and weaknesses, the social dynamics of teams, and the value of taking part in interactive work (Panelli & Welch, 2005), (Burkill, 1997), (Maguire & Edmondson, 2001).

2.1.4. Deep learning

The multiple processes at work in applied collaborative work, such as in Team-Based Learning – including knowledge acquisition, skill building, social interaction, decision-making and reflection – are similar to the processes involved in 'deep' learning, as opposed to 'surface' learning (Chin & Brown, 2000), (Marton & Säljö, 1976). Five aspects – generative thinking, in-depth explanations with reference to experience, open, conceptual questions, reflection on learning, and persistence in problem-solving – characterise deep learning, in which "[t]he development of rich, domain-specific conceptual knowledge depends on the successful integration of the learner's prior knowledge with the domain knowledge" [60, pp. 110–111]. More research is needed to thoroughly explore students' cognitive approaches during TBL (Rotgans et al., 2018) and the effects of TBL on knowledge retention (Emke et al., 2016), (McInerney & Fink, 2003), (Cevik et al., 2019). However, recent studies suggest that the improved engagement of students through types of learning processes they experience in TBL, including assessment approaches which incentivise active participation, can help engage learners in deep learning processes (Nelson & Tweddell, 2020), (Rotgans

et al., 2018), (Bevan et al., 2014).

2.2. Challenges and critiques of TBL

2.2.1. Student experience

Some research finds that – though student learning outcomes overall improve with TBL – student perceptions of TBL can be mixed, and some students dislike the method (Fatmi et al., 2013). On the other hand, Nelson & Tweddell's (Nelson & Tweddell, 2017) instructor participants perceived that students were "won over" to TBL with increased experience of it. Frame et al. (Frame et al., 2015) found that when TBL was introduced earlier in a curriculum, prior to traditional lecture-based teaching, student perceptions were more positive, possibly because they had more time to develop teamwork skills and realise the benefits of learning through TBL. Remington et al. (Remington et al., 2017) find that "… some learning styles may not be as adaptable to TBL as others …" and suggest, "… it is still important for faculty to consider and try to accommodate these minority views to create an inclusive learning environment that optimizes outcomes for all students" [p. 8].

2.2.2. Instructor experience

It is well-documented in TBL literature that, at least initially, TBL requires a significant time investment from instructors, as well as institutional support or 'buy-in' from administrative and management staff and attention to practical details such as space and technology (Kibble et al., 2016), (McMullen et al., 2014), (Dearnley et al., 2018), (Parmelee et al., 2012). Studies focussed on instructor experience found that instructors did perceive an increased workload, at least in the initial stages of switching from traditional lecture-based teaching to TBL (Tweddell et al., 2016), (Kebodeaux et al., 2017). However, the same and related studies also found that instructors experienced beneficial development of skills, as educators and scholars as well as increased enjoyment of teaching (Nelson & Tweddell, 2020), (Kebodeaux et al., 2017).

2.2.3. Learning outcomes

Several studies have examined the effect of TBL on knowledge retention specifically. Emke, Butler and Larsen (Emke et al., 2016) found that, although TBL improved knowledge acquisition, it did not improve long-term retention of factual knowledge for the study's participants in the context of medical exams. Conversely, Cevik et al. (Cevik et al., 2019) found that "TBL as part of a blended learning environment facilitated improved knowledge-based performance in an emergency medicine clerkship … following end clerkship and medical school exit assessments, suggesting TBL stimulates long-term retention" (p. 7). Other studies found that TBL improved students' long-term information retention as well as critical thinking skills (McInerney & Fink, 2003); enhanced students' content knowledge of subject matter (Swanson et al., 2019); and improved students' long-term performance and peer evaluation scores as part of a medical team (Zgheib et al., 2016). Liu & Beaujean's (Liu & Beaujean, 2017) meta-analysis of TBL concluded: "… the evidence currently available … puts it at the upper end of influences on postsecondary student achievement" (p. 9). These long-term and meta-level studies are concurrent with the literature discussed above detailing the benefits of TBL for the development of both content knowledge and applied skills.

3. Methods

The research presented here was conducted using a qualitative, action research approach (Yin, 2011; Cho and Egan, 2009; Creswell, 2013). These approaches are common in educational or pedagogical studies (Creswell, 2012) and produces rich, in-depth data well-suited to exploring the experiences of participants seeking to introduce a change in their professional practice and reflect on the results to improve future work. The part of the study reported here included a small cohort of 10

participants, and the data discussed in this paper was collected over the course of a year.

Individual participants were identified through convenience sampling (Creswell, 2013). The TALENT Project partner organisations approached schools via existing professional networks. Schools which agreed to participate in the project identified teachers within their staff teams with skills and capacity to undertake the proposed training and mentorship programme. All participants agreed to participate in this research through a standard ethical consent process approved by a UK university ethics committee. Sample size is limited to teachers participating in the TALENT project; the literature would suggest no others are known with experience of using TBL in European secondary schools. Although sample size was expected to be 16, ultimately only 10 teachers were able to complete the TBL training and implementation and all phases of this research, due to COVID-related effects on project timescale and needs of participating schools, as well as changing personal circumstances.

This cohort of teachers participated in "before and after TBL" questionnaires, focus groups, and individual interviews. The first questionnaire was collected online just prior to participants taking part in a week-long Fundamentals of TBL training course. 13 teachers attended training. The first set of focus groups was conducted just after participants completed training, and further in-depth interviews were conducted in the following weeks. 11 people attended focus groups, and 7 participated in in-depth individual interviews. Training, focus groups and interviews were all conducted online via video call because of COVID-19 restrictions.

This process of pre-training questionnaires, and post-training focus groups and follow-up interviews, was repeated a year later, in person, when participants were undertaking mentoring training to mentor a second cohort of teachers training in TBL. (This second cohort did not take part in the research discussed in this paper.) This mentoring training and data collection took place after the participants had used TBL to teach a number of units in their secondary school classes during the intervening year. Although this first cohort initially included 13 participants, two dropped out of the project because of competing work commitments or changing jobs. A third delayed participation until the following year and became part of the second training cohort.

The participants who took part in the research presented here teach across a range of subjects including languages, maths, sciences, business, arts and physical education (See Table 1 below.). Two work in schools in Ireland, four in Spain, and four in the UK. Four schools are non-religious (in the UK) and six religious (in Ireland and Spain). All but one are state-supported, which is broadly in line with overall proportions in Europe, where the majority (over 80%) of secondary school students attend state-supported schools (Eurostat, 2022).

It is important to note that four participants are non-native English speakers. Training, questionnaires, focus groups and interviews were all conducted in English, meaning these participants had a language barrier to overcome. The second round of training and data collection was conducted face-to-face instead of online, which made communication much easier for everyone.

The researcher analysed data both by hand and using NVivo coding

software to identify major themes. Themes identified from the data from the initial round of focus groups shaped topics which were explored in further depth in the follow-up individual interviews, allowing emergent data to shape subsequent data collection (Charmaz et al., 2008). Themes and topics which emerged through coding of all the "before" data then shaped topics explored in the "after" focus groups and interviews conducted one year later. Relevant literature also shaped design of research tools to ensure data collected would fully explore and respond to ongoing debates and questions in the field of TBL.

Qualitative data collected in this study represent teachers' own reflections and perceptions. Conclusions drawn about teachers' experiences are based on their self-reported accounts of their own experiences. Observations on student outcomes are also based on teachers' reporting their own perceptions of their students' behaviour and performance in class, as well as the results of formative and summative assessments. The focus group format allowed teachers to reflect on the topics covered through group discussion, which helped to deepen reflection as well as incorporating a broad range of viewpoints and contexts. The follow-up individual interviews allowed teachers to reflect more in depth on their own experiences. Online questionnaires, which were gathered prior to the focus groups and interviews in both periods of data collection, were used to gather contextual data about participants' teaching environments and previous experience to help situate the more in-depth data.

4. Results – 'before and after' TBL

4.1. Hopes, expectations and reflections

Teachers' hopes and expectations for using TBL centred around three major themes: 1.) student engagement and motivation; 2.) quality of learning; 3.) enhancement of professional experience.

After a year of using TBL, many of the same themes emerged. The most frequently mentioned benefits of using TBL in secondary level classes were: 1.) the quality of students' learning (based on their performance in class and on assessments); 2.) students' observable increased enthusiasm, participation, and collaboration; 3.) students' development of skills; and 4.) teachers' own enjoyment of class time when teaching with TBL. Table 2 presents a summary of major themes and sub-themes, which are explored in further depth below.

4.2. Challenges & barriers – pre-TBL

Teachers discussed their concerns and potential challenges to implementing TBL during the focus groups as well as in individual interviews. Firstly, some expressed a general uneasiness or lack of confidence with trying a new technique, including classroom management skills as well as new digital tools.

> *"… you have to leave your comfort zone … anything could happen in the class, because you are not just delivering content …"*

Table 2
Major benefits of using TBL perceived by participants – post-TBL.

Major themes	Sub-themes
Student engagement	Participation
	Confidence
	Collaboration
	Inclusion
Quality of learning	Improved learning outcomes
	Knowledge retention
	Deeper and higher-level learning
	Transferable skills
Enhanced professional experience	Novel role in classroom
	Career progression
	Job satisfaction

Table 1
Subjects taught by participants.

Arts & Design	1
Business & Marketing	1
Health, Wellbeing & Life Skills	1
IT & Computing	0
Language(s) & Literature	2
Maths	3
Physical & Biological Sciences	3
Religion & Philosophy	0
Social Sciences & Humanities	1
Sport & Physical Education	1

"I think I'd probably say that I'd feel quite confident if it was paper-based, but to try and incorporate the digital elements to it, when I'm not that skilled in that area …"

Unsurprisingly – as this concern is seen across TBL literature – many participants expressed apprehension about the amount of time and effort required for preparation. Some felt unsure they would have institutional support to allocate enough time for this work.

"I think a lot … will depend on the way that I design the pre-reading and the application tasks and put the groups together. A lot of thought processes need to go into that, so I just hope that I've got the time to be able to give it justice and for it to be successful."

"I'm worried about the time as well. I just think it's so planning-heavy, and our timetables are so packed as it is."

Another area of concern centred around team formation, with some participants feeling uncertain about how to handle unknown students, small class sizes, and potential COVID restrictions in the classroom.

"… the teams themselves, and just getting a balance amongst teams and making the right choices at the very beginning with that."

"At the moment, all of our desks are front-facing, and they all have to be a metre apart, and they have a desk each. So, at the moment, we can't actually do that where they move and face each other …"

Teachers also expressed worry about student reactions to TBL, including potential reluctance or stress on the part of students.

"I think, just from our experience of it this week, it's been really quite exhausting … So I think that there will need to be … a bit of rest time implemented in between the units, just to give them a break from that intensity … that's what I would expect, especially from the [SEND] pupils who I work with."

Finally – and importantly – participants emphasised their sense of the differences between TBL in higher education and in secondary education. They noted that more secondary-specific models would be helpful and spoke about adaptations that might be needed to meet institutional requirements.

"I find it's so prescriptive and so different from how I normally teach, that thinking through the application tasks for me is taking an amount of time that I would never justify. Because I don't have any models, really, and there's almost a shaken confidence … I'm like, 'I don't know if it's right or wrong. I don't know how I can check, and I don't have any examples.' … I think if it's to get into second level, we need more second level-specific information."

4.3. Challenges & barriers – post-TBL

Upon reflection after using TBL for a year, the most frequently mentioned challenges included institutional challenges with curriculum, timetabling and quality assurance requirements; managing team formation and dynamics; preparation time; the challenge of writing good Application Exercises; and learning the theory underlying TBL without secondary-specific examples and resources being available. (Teachers responded to this interview question in list format, so responses are

Table 3
Participant mentions of challenge factors – post-TBL.

Institutional challenges	6
Team formation	5
Preparation time	4
Writing Application Exercises	4
Lack of secondary-specific TBL resources	3
Unprepared students	2
Peer evaluation	2

reported without direct quotes. See Table 3 below for the number of participants mentioning each factor.)

Participants mentioned a number of institutional challenges including meeting curricular or quality assurance requirements around assessment reporting; timetabling TBL classes alongside non-TBL classes; and interacting with colleagues who may not support the use of TBL (six mentions). For example, regarding curricular and quality assurance requirements, teachers using TBL found that the time it took to deliver TBL units did not always line up with the time it took other teachers to deliver the same material in the curriculum, creating additional administrative tasks. They also reported they had to 'translate' the results of iRAT and tRAT assessments to fit within assessment schema used by other teachers delivering the same curriculum via non-TBL teaching methods.

Teachers also spoke about the challenges of team formation and dynamics. This included team size – not too large or too small – as well as creating groups with a good mix and dynamic, and managing any unexpected circumstances with regard to students' relationships or interactions (five mentions).

Planning and preparation for TBL is time-consuming. One person initially felt this to be so much the case that it would be unsustainable, before finding ways to speed it up and deciding it was feasible after all (four mentions).

Related to preparation time, writing effective Application Exercises was challenging and time-consuming for teachers (especially the case for those who needed to write two different AEs on the same topic for two class groups to prevent answer sharing). Teachers noted that writing AEs requires creativity and can be more difficult for certain subjects – for example, Physics – where there is often only one factually correct answer (four mentions).

Learning the theory and multiple different criteria to create a TBL unit was challenging for teachers, especially with a lack of secondary-specific resources, face-to-face training (due to COVID-19), and local mentorship (three mentions).

A couple of teachers mentioned that students didn't always come to class prepared, and getting them to take responsibility for this was a challenge. Interestingly, teachers noted that this was more of a problem in less "academic" subjects, e.g. design and vocational training (two mentions).

Peer assessment and evaluation felt challenging to some teachers, in terms of the time taken, using it appropriately, and fostering students' peer evaluation skills (two mentions).

4.4. Student engagement – pre-TBL

4.4.1. Participation, confidence and collaboration

Within teachers' discussions of their hopes for TBL improving students' engagement and motivation, especially prevalent themes included confidence, enjoyment, and collaboration. Teachers spoke about their hopes and expectations that, through TBL, students would gain confidence and demonstrate more independence and empowerment. For some, this increase in confidence would also hopefully translate into raised aspirations for future education or employment. Teachers also expressed hopes that students would enjoy learning more (and learn better because they enjoy it). This was closely aligned to hopes of increased participation (and increased learning). Furthermore, teachers hope and expect that TBL will lead to increased collaboration amongst students, as well as increased peer learning, thanks to the teamwork they will do.

"I do think some students will have huge engagement, and it will be really, really interactive for them, which is great, because that's how they're going to learn best."

"I work in a school were about 30% of the cohort is EAL [English as an Additional Language], and I think the Team-based Readiness Assurance Test and the Individual Readiness Assurance Test, with that being the

same questions twice, that repetition, I think, will really help them with their confidence and be able to participate a lot more and overcome the language barriers there. So I hope that participation will actually increase, and that group of students within the school will be able to benefit quite a lot from this."

"My instincts are that that will enjoy this, that it will motivate them, that they won't want to always be the one who appears to be letting down the team a little bit. And the idea that they get to discuss and defend their ideas before they've committed to their product ... I think, will give confidence, especially to students who maybe have strong ideas but don't translate them to paper very well ..."

Some teachers emphasised the importance of competition between teams as an expected motivational factor for students, alongside the sense of challenge that the TBL format provides. Others spoke about accountability and reward as important motivational factors – both in terms of accountability to teammates and also the sense of reward they hope students will experience through good performance on exams or in-class exercises. Teachers also identified the real-world connection to the material students will be learning – provided through the Application Exercises in TBL – and workplace-applicable life skills they will learn through continued team work as important factors in the increased engagement and motivation they expect to see in students.

"I have had the opportunity to put it into practice ... They feel very motivated because they want to be the best. And it's obvious whether you are doing well or not, because you put the cards up, so everybody can see the results ... So they try to convince me, or the rest of the classmates, that their answer is the correct one. Sometimes their discussion is very good because, sometimes, even I realise that I haven't seen that point. So I have to say, 'What?! I didn't realise that, but you are right, yes.'"

"Competition will come up between the groups, and each group will want to be better than the next. Everyone will have to pull their weight and it will have to be a fully effective team. And if somebody doesn't get on board with that initially, the peer evaluation will show that, and I do think then there will be a change completely."

"I think they will like it and be engaged, as long as I am able to develop good application tasks that make them realise that Physics is not about formulas and numbers but about learning the world around us. And if they can make that connection, I think they will love it."

4.4.2. Inclusion

One teacher mentioned hopes that TBL would help create a more inclusive learning environment, where students' different strengths become valued within a team and this increases their engagement and motivation.

"I am hopeful that it's going to be a really inclusive practice and that pupils will learn at a higher level but be included in their classroom really well and be able to develop the skills which will help them in other subjects as well." Improved learning outcomes and teacher experience a qualitative study of Team-Based Learning in secondary schools

A few teachers also mentioned the possibility that students might find TBL 'stressful' or 'exhausting', leading to a potential de-motivation, at least at first. Some felt it would likely take time to see the positive effects on student engagement and motivation that participants hoped for.

Regarding team formation, teachers' expectations centred around creating heterogeneous teams and planning teams in advance (where possible) to achieve the desired mix of abilities, backgrounds and personalities. Teachers who would not know their students in advance expected to need to get to know them a little in order to form teams. Those with some pilot experience reflected that, while there could be challenges with teams, even imperfect team working produced worthwhile benefits. Some teachers mentioned an expectation that, at secondary level, students might need coaching in teamwork skills, to enable them to work together effectively.

"I'm using what I know about the kids, basically, to put them into the teams. I'm looking at their target grades and their current operating grades, along with their behaviour in lessons ... So I've been trying to do the dynamics based on data and ability, but also based on the confidence levels and behaviour."

4.5. Student engagement – post-TBL

4.5.1. Participation, confidence and collaboration

After using TBL for a year, all participants reported good levels of student engagement in their TBL units. Most stated that participation and motivation increased markedly with TBL compared to other teaching styles. Students' enjoyment of the learning environment played a big role in this, with teachers mentioning a lively learning environment, healthy competition, motivation and enthusiasm evident in students' contributions. Increased participation and motivation also seemed to arise from having a role to play in the group, with all students contributing to the team's efforts. Teachers perceived that quick, continuous feedback encouraged and motivated students. Teachers observed that students showed more focus and concentration on the task at hand because the application activities were challenging and interesting for them, and they liked the autonomy and freedom.

Alongside the benefits and positives which formed the majority of responses, teachers did also mention some caveats. One found their students preferred an adapted version of TBL with a less structured approach – eliminating the iRAT and tRAT. Others noted:

"The excellent or highest-level students don't like TBL because they blame the groups for lowering their marks a little (below perfection)."

"The increase in engagement depends on the groups they're in and the activity design."

Some teachers noted 'tweaks' or adjustments which helped increase engagement, such as use of technology, linking the tRAT to a school-wide reward points system, or simply that repeating TBL over time increased students' engagement with it as they understood the process. Demonstrations of students' increased participation and motivation that teachers mentioned included coming to class well-prepared, pushing each other to contribute to collaborative activities, competing with other teams, and focussing on the task at hand.

"Students were very focused on their tasks during class because of the time pressure. It was never boring for them!"

"They are not 'in standby mode' – they are engaged."

"There are still passive and active team members, but less so than normal. They are pushing each other to contribute their knowledge and skills."

"The opportunity to be part of the winning team boosts engagement."

A particular aspect of increased participation that teachers mentioned was confidence. They noticed that TBL increased students' confidence to participate, and therefore their motivation to contribute and engage with the material. Teachers put this down to receiving more frequent feedback from teachers and peers, feeling part of a team, being able to access materials in a wider variety of ways, and being engaged in creative projects together.

"TBL made a difference to students' perception of and engagement with tough concepts. They engaged more broadly, it was more dynamic, and they gained confidence."

Collaborative learning seems to be key to students' increased engagement through TBL, according to participants' reports. The learning environment, accountability, and relational elements of the TBL learning process contribute to not only increased engagement but

also improved learning outcomes.

"Peer learning improved end-of-unit test results."

"They learn from each other – peer learning happens much quicker!"

"There is a closeness. It's interactive, a lively and dynamic environment. It builds relationships."

"Peer learning is one of the best things about TBL. They learned more through listening, discussing, and having to justify their ideas to each other. They were teaching each other."

4.5.2. Inclusion

Teachers noticed benefits for inclusion from several different aspects of TBL. They perceived that the advanced preparation makes the course content and materials more accessible. When groups work well – which most reported did – the team can support each other's learning needs. And the teamwork dynamic means that students with different skills and abilities can all play a role. However, teachers also noted that it was important to create teams carefully in order to maximise inclusion, and some students remained 'separate' from the group despite this. One teacher who specialises in working with students with Special Educational Needs has created TBL units focussed on team working skills, taught prior to using TBL to teach content, in order to prepare students for TBL by 'pre-teaching' skills needed for TBL.

"EAL [English as an Additional Language] students are more able to access the verbal aspects of the work, because they can do the pre-reading using Google translate, which makes the materials more accessible. Group discussion also helps them to understand better than if they were listening to the teacher."

"To ensure inclusion, I never start the course with TBL, in order to get to know the students and how they are. I create mixed groups – never at random. You must pay attention to different abilities and qualities."

"TBL creates group solidarity and support. If students have educational needs, their team supports them."

"What I have found … is that that initiation activity is so important to get the groups working together …. Within that initiation activity I then stop them and model what they've done really well, so they can see that social communication that's going on within the groups …. I think that's really important to develop those skills within those teams, and then the end result is that you have a better team. And it's about making sure that they know how to work in a team. It's not a given that they are going to be able to."

4.6. Quality of learning – pre-TBL

4.6.1. Improved learning and knowledge retention

Prior to using TBL, teachers expressed hopes and expectations of general improvement in meeting learning outcomes and levels of exam preparedness for students through TBL. Related to these expectations, teachers mentioned they hoped TBL would create improved focus on the content and learning outcomes, as well as contributing to greater permanence of learning. In addition, teachers expressed expectations that TBL would contribute to deeper learning for students through constructive and active learning experiences.

"I think to get the team dynamics really working every lesson and to engage them thoroughly in the application exercises will be a better use of the lesson time, because less will be theory input from me, and more will be them doing the application and discussing with each other and getting much more of a deeper understanding about the topic that they're doing."

"The fact that they are working in a team helps … all students – not only the strong ones, but those that are not that strong – to learn. On top of that, they are not just remembering or reproducing content, but they are

also creating things. I would say that you rate higher on Bloom's scale with TBL than with traditional teaching."

4.6.2. Skill development

Teachers also expect that TBL will help students develop skills, including critical thinking skills as well as life skills such as teamwork, problem-solving, and dealing with conflict.

"I think the possibilities of doing some really exciting critical thinking are what I'm most hopeful about."

"Starting this week, I was completely new to TBL … having seen it in practice for the week, I can really see the benefits of it for students. Not alone does it help them to … go up on the Bloom's taxonomy, but … they actually learn really important life skills. I suppose when I incorporate group work in my teaching … it's not always very productive … Whereas with this particular methodology, when they're in their group, there's always something more. They've their application exercise, and if they get that finished, there's still loads of space to have a debate about it … they don't just sit and learn something, they actually have to go and apply it then. And they actually learn loads of extra skills, like dealing with conflict or how to work productively in a team as well. I'm really looking forward to implementing it."

4.7. Quality of learning - post-TBL

4.7.1. Improved learning outcomes

After a year of using TBL, teachers observed improved learning outcomes for students when teaching with TBL. In some cases, this was borne out by better overall results in summative assessment, although in some circumstances it wasn't possible to evidence this as assessments hadn't yet been completed, or it wasn't possible to make a direct connection between TBL units and overall assessment results. However, almost all participants remarked on the higher quality of students' work through TBL, whether this was work teams produced in Application Exercises or individuals' performance on exams.

"The quality of the outcome was higher than if they'd worked alone. It especially improved the quality from those who wouldn't have otherwise done well."

"They use higher levels and quality of vocabulary. The visual records they produced showed the quality of their work."

"They are improving in areas of weakness."

"Stronger students develop more skills AND get good marks. Weaker students do better academically. Everybody passed! But the marks were still differentiated."

4.7.2. Knowledge retention

While some teachers said they would struggle to provide 'hard' evidence of improved exam scores, some did report a direct correlation between TBL and improved test scores. Many also said they could see that students had already learned more, and more deeply, on the topics they taught with TBL than previously, through assignments they completed during TBL units. Most teachers also felt the TBL process would aid students in revision and therefore contribute to better knowledge retention.

"It's too soon to say whether TBL improved their knowledge retention for the end-of-year assessments, but the Application Activities have produced physical products for them to refer to for revision."

"Peer learning improves their end of unit test results."

"The students said they feel they will retain the knowledge more for their exams."

4.7.3. Deeper and higher-level learning

Most teachers reported observing their students demonstrating deeper learning, higher up Bloom's taxonomy (Bloom, 1956), for example applying knowledge, analysing, and creating. Critical thinking skills were one of the most important improvements mentioned, along with creative and evaluative thinking demonstrated through assignments. Interestingly, one teacher noted that although students showed high-level critical and evaluative thinking in their work, they struggled to articulate critical evaluation of each other's work.

> "They have to create things, or search for a solution, and evaluate each other's work, so they develop critical thinking."

> "The students are engaged with producing creative products. This increases their critical thinking – for example, they even challenge the Application Exercise questions. They develop their own ideas and thinking. They drew each other out."

> "The critical thinking is great! They think in surprising new ways."

4.7.4. Transferable skills

Students' development of other skills, beyond academic knowledge of content, was another positive outcome mentioned by almost all participants. Teachers felt the types of tasks students must complete in a TBL process allow them to develop 'soft' skills transferable to the workplace or to other subject areas, as well as contributing to their understanding of social dynamics.

> "They learn … communication, respect, how to learn, empathy. TBL improves these skills."

> "It improves listening, sharing, learning from each other when they are wrong."

> "Students identified leadership vs. dominance."

> "They develop 21st century skills – communication, collaboration, debating. These are easy to develop with TBL."

> "Students gained transferable skills – this was down to task design. Listening, discussion, writing, thinking, presenting, communication, taking on board others' opinions, teamworking."

4.8. Enhanced professional experience – pre-TBL

Before implementing TBL, a repeated theme which emerged from teachers' sharing on their hopes and expectations centred around professional development and improving their teaching practice. More specifically, teachers spoke about hoping to implement TBL effectively and successfully, to create more structure for their teaching practice through TBL, and to foster a more student-centred environment. The broader hope underlying these specific intentions was to improve student learning through improved teaching practice.

> "I hope to be able to do it well so that I can decide what I want my students to learn to do. I hope to improve the way I teach."

Teachers also stated these hopes for professional development in the interest of their own advancement and enjoyment of their work. Furthermore, teachers discussed their hopes for support through their TBL practice – both from their institutions and workplaces, as well as from the community of practice they formed by taking part in TBL training together.

> "I want to develop my own set of skills and hopefully improve on them, understanding more about the pedagogical approach, so I can then support other staff ….I'm looking at this as something I can develop and hopefully use that as a platform for a promotion."

4.9. Enhanced professional experience – post-TBL

After using TBL for a year, most participants felt that TBL changed their role in the classroom. One, however, felt there was no change, stating:

> "The TBL role is similar to my own approach before using TBL, one of a 'monitor-coach'."

Most teachers felt that TBL shifted their role to one of more of a facilitator, observer, and helper. Some said they feel like a collaborator with students, because they too are learning.

> "TBL changes my own role absolutely! I observe, I focus attention on important points. Students ask more in-depth questions, and I am a facilitator."

> "My role in the classroom is completely different. It is a more collegial relationship with students, collaborating together on their learning … We are learning together."

> "My own role is more of a facilitator, observing. It takes some pressure off the teacher, creates a balance. In class I am looking for learning opportunities and listening to the students."

Several teachers mentioned TBL as an aspect of potential career progression. Three of the teachers did not feel this was relevant to them, with one stating:

> "For me it is not about career progression but becoming a better teacher."

However, others spoke about TBL as an aspect of personal development and playing a leadership role within their schools.

> "I feel I am making a difference at the school. The head teacher values TBL, and I will play a role in promoting TBL at the school."

> "Other teachers [in my school] are interested and positive, and senior management are open to the model."

> "It could lead to opportunities. It feels like using TBL is moving with and reflecting recent evidence and research."

Almost all participants stated TBL improved their job satisfaction significantly. Contributing factors included feeling re-energised or having a new attitude towards teaching; feeling challenged in a positive way; appreciating more autonomy in teaching; finding students' improved learning gratifying; enjoying better interactions and relationships with students; and feeling they were making a positive contribution.

> "I feel better when I'm teaching with TBL."

> "TBL has given me something new and different to re-motivate me and increase my enthusiasm. I enjoy classroom time more. Seeing the kids develop more is satisfying."

> "TBL affects my job satisfaction very positively. Seeing the students learn is gratifying. I want to do all my units using TBL within the next two years."

> "One of the positives of TBL is my own growth in confidence and attitude change. I was initially sceptical and overwhelmed. I would now definitely be excited to use TBL. I will try it with a second subject."

> "TBL can be stressful, but overall I'm pleased and satisfied. It makes me like teaching more. It's a refreshing approach ….I am thinking differently about teaching. I have more freedom. It's challenging but it's improving."

> "I am really, really happy!"

5. Discussion & conclusions

All 10 participants who completed this first phase of the study

carried on using TBL throughout the initial year post-training and have gone on to become TBL mentors to a second cohort of teachers who have also trained in TBL and will use it in their classes in the coming year. This demonstrates that, on balance, participants have found TBL a worthwhile addition to their teaching methods and skills. Overall our study shows that, despite challenges, the benefits of using TBL in secondary schools made it worth the time and effort of the teachers who participated in this study.

Challenges and barriers faced by secondary school teachers in our study were similar to those described in the literature on TBL in higher education – namely, workload and institutional support (McMullen et al., 2014), (Parmelee et al., 2012). Schoolteachers also reported the additional challenge of the lack of such literature to refer to specifically about using TBL in secondary education. Again similarly to higher education TBL literature (Nelson & Tweddell, 2020), (Kebodeaux et al., 2017), teachers in our study reported their own enhanced job satisfaction and professional development through TBL, despite its challenges.

The benefits to student engagement and learning outcomes reported by teachers align closely with the broader pedagogies embedded within TBL (Liu & Beaujean, 2017). Teachers' reports of students' increased focus on tasks and active participation in team activities demonstrate TBL's ability to engage secondary students in meaningful active learning (Prince, 2004), (Roehl et al., 2013) as well as indicating the moderate to high levels of cognitive engagement observed by Rotgans et al. in their study of TBL (Rotgans et al., 2018). Teacher's perceptions of students' improved quality of outputs and knowledge retention are consistent with a constructivist learning approach (Hrynchak & Batty, 2012), (Kaufman, 2003). These outcomes, according to teacher participants, stem largely from TBL's emphasis on collaborative learning in peer groups (Healey et al., 1996). Likewise, students' perceived developments in confidence, critical thinking skills, and teamwork skills such as communication and problem-solving, demonstrate the studied benefits of collaborative and peer learning (Apul & Philpott, 2011), (Charlesworth & Foster, 1996), (Ellis & Weekes, 2008), (Panelli & Welch, 2005), (Kim & Tan, 2013). Furthermore, teachers' perceptions of the increased quality and depth of learning achieved by their students through TBL point to the five aspects of deep learning - generative thinking, in-depth, experience-based explanations, conceptual questioning, reflection on learning, and persistent problem-solving – identified by Chin & Brown (Chin & Brown, 2000). Table 4 (below) compares the summary of benefits to students and instructors identified in existing, higher education-focussed TBL literature, with those reported by secondary teachers in our study.

In summary, our research with the TALENT project finds similar benefits from using TBL in secondary schools as those observed in higher education settings, including increased student engagement and participation; deeper learning through active, experiential learning and peer learning; development of soft and transferable skills; and increased job satisfaction for educators. Our research also identifies challenges which research participants felt were unique to the secondary teaching context, including the lack of secondary-specific TBL resources and the need to interface with national curriculum reporting requirements.

Existing training materials and theoretical background research focus on university-level teaching, leaving a knowledge gap for schoolteachers. Institutional requirements can pose challenges which teachers expect to have to adapt to by 'translating' or experimenting with TBL elements. Training should include both theoretical background and practical tasks. TBL requires experimentation and adaptation to the secondary school context. There is scope for wider use of TBL in secondary schools. However, more secondary-specific TBL research is needed – including strategies for overcoming institutional barriers – to maximise effectiveness of TBL training for secondary school teachers.

While teachers found TBL challenging in some aspects – most frequently preparation time, institutional requirements, and team management – these challenges were outweighed by positive benefits including increased student engagement, quality of learning, skill

Table 4
Comparison of benefits of TBL in higher and secondary education.

Benefits to students – higher education	Benefits to instructors – higher education
Knowledge acquisition	Curricular integration
Engagement; potential for deep learning	Effective for large classes
Course satisfaction	Professional development
Confidence	Communities of practice
Transferable skills	Job satisfaction
(Fatmi et al., 2013), (Swanson et al., 2019), (McInerney & Fink, 2003)– (Levine et al., 2004), (Maguire & Edmondson, 2001), (Haidet et al., 2014), (Liu & Beaujean, 2017)– (Nelson & Tweddell, 2020), (Rotgans et al., 2018), (Gryka et al., 2017), (Frame et al., 2015)	(Nelson & Tweddell, 2020), (Tweddell et al., 2016), (Kebodeaux et al., 2017)
Perceived benefits to students – secondary school	**Reported benefits to instructors – secondary school**
Improved learning outcomes and outputs	Professional development
Deeper and higher-level learning	Career progression
Confidence	Job satisfaction
Transferable skills	

development, and teacher job satisfaction. Despite its challenges, the benefits experienced and observed by teachers made it worth their time to use TBL in secondary schools and to champion its use in their schools. On this basis, we suggest that further research into the topic could produce valuable knowledge and resources to support the use of TBL in secondary education, including potentially training trainee secondary teachers in TBL during their teacher training degree study.

CRediT authorship contribution statement

Stella Darby: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Project administration. **David O'Hanlon:** Conceptualization, Writing – review & editing, Supervision. **Stephen Casterton:** Conceptualization, Funding acquisition. **Nuala Harding:** Conceptualization, Funding acquisition. **Anne-Marie O'Brien:** Conceptualization, Supervision. **Gemma Quinn:** Conceptualization, Supervision. **Oscar Urmeneta:** Conceptualization, Funding acquisition. **Simon Tweddell:** Conceptualization, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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