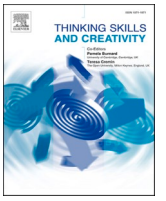
Thinking Skills and Creativity 47 (2023) 101230

Contents lists available at ScienceDirect

Thinking Skills and Creativity

journal homepage: www.elsevier.com/locate/tsc



Exploring task design to promote discipline-specific reasoning in primary English

Michaela Oliver *, Steve Higgins

School of Education, Durham University, DH1 1TA, UK

ARTICLE INFO

Keywords:
Reasoning styles
Discipline-specific
Task design
Meta-discursive rules
Dialogue

ABSTRACT

This paper draws upon a growing body of research emphasising the importance and prevalence of domain-specific practices in teaching and learning. Different disciplines have their own reasoning practices, conceptualised as reasoning *styles*, which are used to justify conclusions drawn. Although there is widespread recognition of the importance of teaching reasoning, this has proven difficult in practice. This is particularly challenging in subjects where reasoning practices have received limited attention. This paper focuses on reasoning in the curriculum subject of English in primary schools (as taught in compulsory education in England). Drawing on a theoretical framework of reasoning styles constructed for English, this paper asks: how can domain-specific reasoning styles be promoted in English for primary schools? It is suggested that engagement in domain-specific reasoning can be promoted through carefully selected and designed tasks, which foreground collaboration and dialogue. Empirical evidence illustrating domain-specific reasoning in student dialogue is presented. Evidence demonstrates the particular value of two task designs (diamond ranking and odd one out) to the realisation of reasoning styles. Sfard's (2001) participation metaphor and the concept of meta-discursive rules are used to explore the value of these task designs in promoting reasoning. Of particular value is their demand for explicit decision making, and the way in which visual aspects scaffold student thinking. To promote engagement with meta-discursive rules (or reasoning styles), students require structures which foreground and require participation in dialogue, collaboration and reasoning.

1. Introduction

The importance of teaching reasoning in schools is widely recognised (e.g. McPeck, 1981; Trilling & Fadel, 2009). Reasoning plays a key role in 21st Century Skills approaches which focus on preparing students to participate in democratic societies (Asterhan & Schwarz, 2016; Chalkiadaki, 2018; Joynes, Rossignoli & Fenyiwa Amonoo-Kuofi, 2019; Scott, 2015). Despite its recognised importance, teachers have experienced difficulties in the teaching of reasoning, particularly in primary education (Mercer & Howe, 2012; Nickerson, Perkins & Smith, 2013; Wegerif, 2010). There is also a limited focus on reasoning in the National Curriculum (Department for Education (DfE), 2014), and limited consideration of its importance in relation to specific curriculum subjects. This project foregrounds the importance and prevalence of discipline-specific practices, particularly in relation to reasoning.

The importance of domain-specific practices, including reasoning, has become increasingly recognised in education. Sociocultural theory (e.g. Vygotsky, 1978; Wertsch, 1991) argues that knowledge and reasoning develop first within cultures before becoming

* Corresponding author.
E-mail address: Michaela.oliver@durham.ac.uk (M. Oliver).

https://doi.org/10.1016/j.tsc.2022.101230
Received 14 April 2022; Received in revised form 14 November 2022; Accepted 29 December 2022
Available online 30 December 2022

internalised by individuals. Language and other tools are used to mediate knowledge (Mercer, 2000; van Drie & van Boxtel, 2008; Vygotsky, 1962, 1978; Wertsch, 1991) and emphasis is placed on communication and interaction (Fernández, Wegerif, Mercer & Rojas-Drummond, 2001; Howe, 2010). Reasoning in sociocultural theory is conceptualised as a cultural phenomenon developed by, and belonging to, particular cultures and contexts. In this project, academic domains represent these different cultures. It is argued that domains have developed styles of reasoning to draw conclusions and decide what counts as valid arguments in that discipline. Reasoning styles are defined as "a pattern of inferential relations that are used to select, interpret, and support evidence for certain claims" (Bueno, 2012, p. 657). These styles draw upon the epistemic and social norms established in academic disciplines as well as their conceptual and procedural knowledge bases. The concept of reasoning styles emerged mainly from studies of scientific reasoning practices (Crombie, 1995; Hacking, 1992; 2012) and has also been applied to reasoning practices in history (van Drie & van Boxtel, 2008).

Several areas of investigation draw on ideas related to discipline-specific practices. Within Communities of Practice (CoP) theory (Wenger-Traynor & Wenger-Traynor, 2014, p. 1; Lave, 1988; Lave & Wenger, 1991), knowledge is viewed as an element of cultural practice rather than as an objective entity in the world or in an individual's mind; it is through participation that learners become full members of a community (Hakkarainen & Paavola, 2009). *Disciplinary literacy* research also considers domain-specific practices. It argues that disciplines have their own ways of reading, writing, communicating and reasoning, which should be taught across the school curriculum (O'Brien, Moje & Stewart, 2001; Shanahan & Shanahan, 2012). This view therefore emphasises domain-specific elements of literacy, while also acknowledging domain-general aspects. It is argued that by developing literacies within disciplines, students can be supported to develop "disciplinary habits of mind… practices consistent with those of content experts" (Fang, 2012, p. 20). These habits refer to the different ways of knowing, doing and communicating expected in each subject (EEF, 2019; Shanahan & Shanahan, 2012). Guiding and shaping these participation practices in classrooms are meta-discursive rules.

1.1. Meta-discursive rules

As outlined above, several theories consider domain-specific practices. Anna Sfard's work on learning metaphors and meta-discursive rules helps to tie together the various strands of sociocultural-inspired and disciplinary-based research. These meta-rules guide and shape forms of communication: "it is within the system of meta-rules that people's culturally specific norms, values, and beliefs are encoded" (Sfard, 2001, p. 30).[1] Sfard recognises the "invisible" nature of these tacit rules, and calls for close analysis to elicit tacit elements (2001, p. 31). The tacit nature of discipline-specific practices is emphasised in several of the theories discussed above. Tacit knowledge is conceptualised as a form of troublesome knowledge (Meyer & Land, 2003; Perkins, 2006). It is argued that by identifying the shared learning, knowledge and characteristics of a discipline, a CoP, or an episteme,[2] greater understanding of that community is encouraged (Bruner, 1973; Perkins, 2006; Schwab, 1978; Wenger-Traynor & Wenger-Traynor, 2014). Perkins suggests the constructivist approach of *surfacing and animating*:

> Get those tacit presumptions out on the table at least for a while…And not just as objects of discursive analysis but as systems of activity to engage. The idea is not simply to know about the game but to play the game knowingly (2006, p. 51).

It is argued that academic disciplines adopt their own key styles of reasoning. These styles draw upon a range of different evidence-types considered valuable and appropriate and are guided by disciplinary-based meta-rules. It is therefore important that these tacit styles (and rules) are identified for each academic discipline. This is particularly important for education. If students are to develop key reasoning practices necessary within domains, having a clear framework of these styles, and then explicitly addressing them in teaching should strengthen their reasoning capacities and support the process of learning to reason in different subjects of the curriculum.

The difficulties faced by teachers in promoting and teaching reasoning are discussed above. Given the need to surface and animate key meta-discursive rules within disciplines, the importance of dialogue and collaboration, supported by consideration of task design, should therefore be explored.

2. Research background

2.1. Dialogue

Language, communication and talk are central to sociocultural theory and to the development and practice of reasoning (Vygotsky, 1978; Wells, 1999; Wertsch, 1985, 1991). Wells describes language as "a semiotic tool" (1999, p. 19) enabling connection with and participation in a particular culture. Vygotsky (1978) considered language to be both a cultural and a psychological tool. It has been argued that language "has a central, integrated position in enabling human cognition to be both individual and social" (Mercer, 2013, p. 152). Frith and Singer (2008) refer to the creation of "common knowledge" (2008, p. 3876; Clark, 1996) following joint action and it

[1] Concepts similar to the notion of meta-rules include Wittgenstein's (1953) *language games*, Bourdieu's (1999) *dispositions* and Goffman's (1974) *interaction frames* (Sfard, 2001).

[2] "An episteme can be defined as a system of ideas or way of understanding that allows us to establish knowledge…epistemes are manners of justifying, explaining, solving problems, conducting enquiries, and designing and validating various kinds of products or outcomes" (Perkins, 2006, p. 52).

is suggested that the process for creating common knowledge is interactive and discursive (Edwards & Mercer, 1987/2012; Mercer, 2013).

Research suggests that particular forms of structured talk are beneficial to learning and understanding (Cazden, 2001; Michaels, Sohmer & O'Connor, 2004; Sohmer, Michaels, O'Connor & Resnick, 2009). *Exploratory talk* captures features of dialogue believed to be most productive to learning and understanding (Barnes, 1976, 2008; Mercer, 2013). It requires critical but constructive engagement with the ideas of other group members where ideas are considered jointly and are open to challenge and counterchallenge. Such challenges require justification and alternative suggestions. Exploratory talk emphasises the active participation of all group members where each member contributes to the formation of joint decisions (Mercer & Littleton, 2007). This form of dialogue has been described as representing "a social mode of reasoning" (Mercer, 2013, p. 158).[3]

2.2. Collaboration

Given the prominence of dialogue to the development of reasoning, collaborative learning is of great importance. The EEF Teaching and Learning Toolkit (https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit) defines *collaborative* (or *cooperative*) learning as "learning tasks or activities where students work together in a group small enough for everyone to participate on a collective task that has been clearly assigned" (EEF, 2018, p. 2). While recognising the importance of the teacher's role, group work shifts ownership and control of the task towards pupils (Blatchford, Kutnick, Baines & Galton, 2003). Howe and Abedin's (2013) systematic review considering four decades of research into classroom dialogue identified the richness in student contributions when collaborating in small groups which is not found in traditional, teacher-fronted Initiation-Response-Follow up/Feedback (IRF) contexts (Bleicher, Tobin & McRobbie, 2003; Danielewicz, Rogers & Noblit, 1996; Kim, Anderson, Nguyen-Jahiel & Archodidou, 2007; McIntyre, Kyle & Moore, 2006; Olitsky, 2007; Roychoudhury & Roth, 1996; Rymes, 2003). The Teaching and Learning Toolkit (EEF, 2018) identifies the consistently positive impact of collaborative approaches with an estimated average of five months' attainment gain (based on consideration of 212 research studies). According to the Toolkit, benefits are enhanced when structured approaches to collaboration are adopted, with well-designed tasks employed.

Despite the extensive evidence in support of collaborative approaches to teaching and learning, group work tends to be rare in UK classrooms and often of low quality (Bennett & Cass, 1989; Blatchford, Kutnick, Baines & Galton, 2003; Comber, Galton, Hargreaves, Wall & Pell, 1999; Galton, Simon & Croll, 1980; Howe, 2017; Mercer, 2013; Murphy, Wilkinson, Soter, Hennessey & Alexander, 2009; Wegerif & Scrimshaw, 1997). Research has illustrated the lack of talk within classrooms alongside a preference towards low-level tasks and questioning, which place limited cognitive demand on students (Edwards & Westgate, 1994; Howe & Abedin, 2013; Smith, Hardman, Wall & Mroz, 2004). Students are often seated *in* groups, but rarely work and interact *as* groups (Galton, Simon & Croll, 1980; Howe, 2017; Howe & Abedin, 2013). Several factors contribute to the lack of high-quality group work. For teachers, there may be concerns about behavioural implications of using collaborative approaches, such as disruption, off-task behaviour and loss of control (Cohen & Intilli, 1981; Gillies & Boyle, 2010). Challenges in terms of planning, organising and resourcing group work, while fulfilling curriculum demands and sustaining collaborative approaches over time are also recognised (Blatchford et al., 2003; Gillies & Boyle, 2010; Kohn, 1992). Usually, limited time and attention are given to planning for effective group work (Blatchford et al., 2003; Galton & Williamson, 1992). In Gillies and Boyle's study (2010), perceptions from ten middle-year teachers who had implemented a cooperative learning approach were reflected upon. Teachers identified factors necessary for successful group work including group composition; the task(s) to be used; training for students to support development of social skills; and assessment of learning within group work. The lack of teacher training to support the implementation of collaborative learning approaches and teachers' lack of understanding about how to use collaborative approaches have also been identified (Blatchford et al., 2003; Gillies & Boyle, 2010). This raises concerns about the possibility of teachers being able to implement the conditions required for 'successful' group work.

2.3. Task design

Compounding the difficulties of planning and implementing collaborative learning opportunities, research suggests that teachers often find selecting and designing appropriate tasks to promote collaborative work and dialogue challenging (Bennett & Dunne, 1992; Blatchford et al., 2003; Harwood, 1995). It has been argued that students only engage in dialogue of high-quality if they are specifically asked to provide reasons for and justify their conclusions (Chinn, O'Donnell & Jinks, 2000; Muhonen, Rasku-Puttonen, Pakarinen, Poikkeus & Lerkkanen, 2016). Several authors have focused specifically on task design, suggesting ways in which collaborative work and reasoning can be promoted. Leat and Higgins (2002) define and discuss the role of *powerful pedagogical cstrategies* (PPS) and Lotan (2014) provides conditions for *groupworthy* tasks. Both PPS and groupworthy tasks emphasise the importance of tasks being open-ended, or *ill-structured*, promoting problem solving and reasoning (see also Cohen, 1994). Tasks should also engage with subject content knowledge. Within PPS, reasoning is stimulated by the gap between prior knowledge and new scenarios or possibilities created by the task demands. The nature and structure of PPS or groupworthy tasks foreground the development of collaborative, dialogic learning which supports the process of learning to reason. Leat and Higgins' requirement that PPS "encourage talk" is particularly resonant to this project: "they present information in a way that demands interpretation, clarification, connecting, hypothesizing and evaluating, which are the kinds of talk that are prized for their role in helping pupils jointly construct understanding" (2002, p. 76).

[3] Other terms designed to capture productive forms of talk have also been used, such as *accountable talk* (Michaels, O'Connor, & Resnick, 2008) and *transactive dialogue* (Keefer, Zeitz & Resnick, 2000).

This draws obvious parallels to the importance of dialogue and to the promotion of reasoning in this project.

Further areas of investigation related to task design include Kagan's *structures,* designed to promote cooperative learning (Kagan, 1989). The structural approach to cooperative learning is "based on the creation, analysis, and systematic application of structures, or content-free ways of organising social interaction in the classroom" (Davidson & Major, 2014, p. 13). These structures are typically sequential, with different steps prompting different behaviours or actions and organising patterns of communication within the group. As implied in Leat and Higgins' (2002) *PPS* and Lotan's (2014) *groupworthy* tasks, structures are distinguished from activities, the latter of which combine open-ended, broadly applicable and adaptable structures with specific academic content. This also relates to work on thinking routines (Ritchhart, Church & Morrison, 2011, 2006; Ritchhart & Perkins, 2008; Salmon, 2010). Ritchhart, Church and Morrison conceptualise thinking routines in three ways: as tools, as structures and as patterns of behaviour (2011). It is argued that teachers who successfully promote students' thinking tend to scaffold and support this thinking by developing, adapting and using specific routines (Ritchhart, 2002). Ritchart, Church and Morrison (2011) suggest that thinking routines support the learner to develop growing awareness of their own thinking and are therefore valuable for students and teachers. The thinking routines identified also represent structures. The stages involved within the routines act as natural scaffolds supporting higher levels of thinking. Rather than representing individual items to complete, sequential steps within thinking routines build on and extend the thinking involved in the previous stage. It is argued that once students become familiar with the stages involved in the thinking routines, this awareness helps them to structure small group discussions (Ritchard, Church & Morrison, 2011). Thinking routines therefore represent "socially shared, scripted slices of behaviour" (Ritchhart, Church & Morrison, 2011, p. 48; Leinhardt & Steele, 2005; Yinger, 1979) which students use with increasing independence. They can be viewed as patterns of behaviour which contribute to the development of classroom culture (Leinhardt, Weidman, & Hammond, 1987; Ritchhart, Palmer, Church & Tishman, 2006, 2002). This bears clear resonance to concepts of discipline-specific practices and meta-discursive rules which guide and regulate expected behaviours and practices within particular contexts (or disciplines).

Given the benefits of dialogue and collaboration to the development of reasoning, and the potential role that task design may play in supporting this endeavour, this paper asks: how can domain-specific reasoning styles be promoted in English teaching in primary schools? Empirical evidence from a broader reasoning styles project (HIDDEN) will be shared to address this research question.

3. The reasoning styles project

The 'reasoning styles project' was an ESRC-funded study which aimed to address the difficulties many teachers face in promoting reasoning and in developing collaborative, dialogic group tasks. The project aimed to promote explicit teaching of reasoning in the primary English curriculum subject (HIDDEN). To achieve this, a framework of reasoning styles required in, and appropriate to, the primary English curriculum was constructed (see also Appendix A). This framework was used to develop tasks which foreground collaboration and dialogue, and promote reasoning styles identified. Tasks were formally investigated in classrooms to explore their potential to promote specific reasoning styles. Four main task structures were used to explore the feasibility of targeting three reasoning styles in English lessons: genre-based reasoning (GRE), analogy-based reasoning (ARE) and language-based reasoning (LRE). Exploratory activities were used with KS2 students (in groups of 2–4) from five classes across two schools (approximately 150 students were involved). Teachers worked with the researcher to develop tasks collaboratively. Class teachers introduced the task and made links with targeted reasoning styles explicit. Targeted reasoning styles were modelled by class teachers at the start of lessons and examples from students were shared during plenaries. This project adhered to ethical guidelines for educational research as required by the School of Education at Durham University and based on the British Educational Research Association's *Ethical Guidelines for Educational Research* (BERA, 2018). Ethical approval was granted in two stages (02.11.2017 and 05.01.2018).

25 audio recordings from 11 tasks were made. As a minimum, one group (of 2–4 students) working with the researcher and one group working independently were recorded for each of the tasks. Staff constraints limited the option for a teacher-supported group for each task and so this condition was removed from formal analysis. Nevertheless, engaging teachers in scaffolding tasks with a small group represents an area for future research. Tasks lasted approximately 20 min. Detailed notes were taken by the researcher in the researcher-supported group. These focused on visual aspects not obvious in the audio recording (such as movement of items in a diamond ranking task). Copies of completed tasks (e.g. completed diamond ranking grids) were taken for each recorded group. Future research will explore the possibility of video recording to enhance the audio data. Transcripts of recordings were coded using an adapted version of the Cambridge Dialogue Analysis Scheme (CDAS) (Vrikki et al., 2019). CDAS represents an instrument able to capture major dialogue moves, particularly those considered productive to learning. Developed by the Cambridge Educational Dialogue Research Group (CEDiR), CDAS has been used across multiple large-scale projects (e.g. Howe, Hennessy, Mercer, Vrikki & Wheatley, 2019) and was borne from a particular focus on identifying educationally productive forms of dialogue (including reasoning). Comparison of coding instruments and further discussion about the CDAS instrument and its use in this project is offered in HIDDEN (HIDDEN). CDAS includes a general reasoning code but for the purpose of this project, additional codes were developed to operationalise domain-specific reasoning styles in English. To create additional codes, descriptions and definitions of the reasoning styles identified for primary English were critically considered and operationalised using a format similar to other codes in CDAS. Similar levels of description and detail accompany each additional code (Appendix B). The theoretical framework of reasoning styles and the accompanying coding instrument represent original contributions to existing research.

3.1. Selection of task structures

Given the project's requirements for collaborative work which promotes reasoning, criteria for selecting task structures focused on

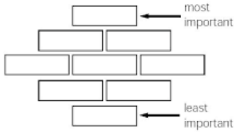
their capacity to promote extended discussion and reasoning. It was therefore necessary that task structures were:

- Adaptable: to more than one reasoning style and to a range of contexts (including topic, year group, ability range);
- Open-ended: to facilitate authentic exploration of ideas where there is not a single 'correct' answer or approach, which are supported by careful reasoning and are subject to debate;
- Accessible: readily understood by teachers and most or all students across KS2; limited demand in terms of resource and preparation time required.

A range of task structures were considered prior to the formal exploration phase of the study, including materials produced by the Thinking Skills research team at Newcastle University (Higgins, 2001; Leat & Higgins, 2002). After piloting, four task structures were selected for formal investigation: diamond ranking, odd one out, role on the wall and fortune lines. They were selected based on their capacity to scaffold and promote extended discussion, thinking and reasoning (Higgins, 2001). Although not the focus of this study, these task structures are also adaptable across curriculum subjects (e.g. see Higgins, 2001; Leat & Higgins, 2002). They are also adaptable to content and genre within primary English, and to age and ability of students. Moreover, piloting demonstrated their accessibility to students in KS2; with limited instruction and demonstration from a teacher, all students were able to participate in the tasks. Student confidence and competence were strengthened through repeated engagement with these structures, applied in various contexts and used to promote different reasoning styles.

Findings of the exploratory investigation showed that the three reasoning styles targeted are realisable in the primary classroom; they can be promoted, captured, operationalised, and measured. On average, students participating in collaborative activities spent approximately one fifth of the total discussion engaging in domain-specific reasoning. This is in addition to any general reasoning observed.[4] Notably for this discussion, proportions of domain-specific reasoning appeared to vary according to task structure used. On average, diamond ranking and odd one out saw higher proportions of domain-specific and general reasoning across all reasoning styles. An overview of these two task structures is provided below followed by data to exemplify these findings.

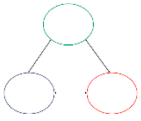
3.2. Diamond ranking



Diamond ranking, or *diamond 9's*, is used to facilitate ordering or ranking. Nine boxes are organised in a diamond layout. Items to rank are commonly statements, but may also be objects, images or photographs (e.g. Niemi, 2015). Students must sort and rank these items, in terms of importance or interest (Clark, 2012), or according to context/content-specific criteria. The middle rows allow for items considered of equivalent importance to be placed adjacently. The diamond therefore removes the need to rank in a linear fashion, instead requesting only most and least important aspects are identified. There is no 'correct' solution; the process of discussion, debate and reasoning is promoted and valued.

Diamond ranking has several benefits. First, it represents a useful stimulus for discussion and debate (Clark, 2012; Niemi, Kumpulainen & Lipponen, 2015; Rockett & Percival, 2002; Woolner et al., 2010) and has been identified as a thinking skills tool (Rockett & Percival, 2002). Students are required to explicitly consider the importance of items and are therefore prompted to explain and justify decisions made, particularly when the task is conducted in pairs or small groups. In addition, it is a novel, engaging and motivating task structure (Baumfield, Hall & Wall, 2013; Niemi et al., 2015). This task requires minimal preparation and can be readily understood by teachers and students. *Diamond ranking* is also suitable for a range of abilities and ages, particularly when it is modified. For example, younger children or struggling readers might be given pictures rather than written text; the rows may be extended or reduced to change the size of the diamond; the level of conceptual difficulty related to items or the task focus might be adapted; or the criteria for ranking might be omitted so that students decide on what grounds they will rank their items.

3.3. Odd one out



Odd one out supports students' ability to sort and classify (identified as thinking skills, e.g. Higgins, 2001). It requires consideration of similarities and differences between a given set of items with the goal of deciding which of a set are similar and can be grouped and which is the 'odd one out'. Commonly presented in a triangle format (Higgins, 2001), odd one out typically presents three 'items' (in English, these might be characters, texts, genres or settings). Students decide which of the three is 'odd' based on some distinguishing feature and the similarity linking the two remaining items must be articulated. The triangle template permits recording of similarities

[4] Dialogue was coded using an adapted version of the Cambridge Dialogue Analysis Scheme (CDAS) (Vrikki et al., 2019). This coding instrument identifies and codes major forms of dialogue considered to be educationally productive. Additional codes were developed in the project to operationalise domain-specific reasoning styles in English. This will be reported elsewhere.

through use of arrows between any two items in the triangle. Differences can be noted around the outside of a given point in the triangle, located beside the specific item which is distinguished in some way from the other two. This format should also support students' ability to identify alternative solutions to the *odd one out* problem. Explicitly considering similarities between two remaining items should support students to select carefully considered 'odd' items, hopefully developing stronger justifications for their task responses. Given that the task is open-ended,[5] students are encouraged to identify and reflect on alternative solutions, justifying the basis of these possibilities. To extend thinking within odd one out, students can identify additional items belonging to the 'similar' group. This encourages engagement with principles and structures underpinning their groupings.

A variation of *odd one out* presents items in a grid with a range of items within grid cells. Students form groups from the items, based on some identified similarity which distinguishes the group from other items or groups. Again, this focuses on classification and requires students to compare and contrast items before arriving at a decision. It can be used to extend consideration from three items, of which only one can be odd, to requiring the formation of several groups, which must be distinguishable from others, or to selecting one odd item or group from a larger set of items.

Like diamond ranking, *odd one out* has many advantages. Although considered in relation to English here, it can be used across the curriculum (see examples of its use in mathematics, science and geography in Higgins (2001)). It also requires minimal preparation and is easy to explain to both teachers and students. It is suitable across the school age range and is an engaging activity which does not require extensive written work (although its potential in this endeavour is explored by HIDDEN (HIDDEN)). *Odd one out* encourages development of a key mode of thinking, classification, and facilitates group discussion by giving a real purpose for classroom talk. The activity encourages students to develop a more precise vocabulary in English. It requires careful thinking and reasoning, both from students and teachers, and while it is open-ended, it can be approached systematically.

3.4. Findings

In this project, diamond ranking and odd one out tasks saw larger proportions of domain-specific reasoning across the three targeted reasoning styles in this project (at least 24% for diamond ranking when the four cross-cutting CDAS codes are removed; at least 18% for odd one out when overlapping codes are removed from analysis) .[6] Fig. 1 exemplifies this data. Data are presented below for each lesson recorded using a diamond ranking or odd one out task design. On average, tasks lasted approximately 20 min. Extracts from student dialogue will then be shared to exemplify the reasoning styles identified.

3.4.1. Diamond ranking

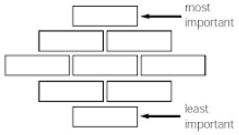


Table 1 and Fig. 1 summarise evidence for diamond ranking and its capacity to promote discipline-specific reasoning in English.

Diamond ranking was used to target genre-based reasoning (GRE) in two schools (School A: 'SA' and School B: 'SB') and language-based reasoning (LRE) in one. A high proportion of domain-specific reasoning (24% or more of all dialogue including that which was 'uncoded') was observed in all three lessons using diamond ranking. Evidence suggests that this task structure is promising in terms of its capacity to promote reasoning styles in English. While diamond ranking was initially deemed least applicable to the promotion of analogy-based reasoning (ARE) (in comparison with the other three task structures) and was not subject to formal exploration here, future efforts should explore the potential that this task structure holds to promote ARE given its promising findings for the other two reasoning styles.

3.4.2. Odd one out

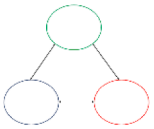


Table 2 and Fig. 2 summarise evidence for odd one out and its capacity to promote domain-specific reasoning in English.

Odd one out was used to target all three reasoning styles subject to formal exploration (GRE, ARE and LRE). A high proportion of domain-specific reasoning (18% or more of all dialogue including that which was 'uncoded') was observed in all three lessons using odd one out. The lesson targeting GRE observed the highest proportion of domain-specific reasoning (40%). While comparatively smaller, 18% of all dialogue was coded using the domain-specific reasoning code in the LRE lesson. Overall, evidence from odd one out tasks suggests its promise for promoting domain-specific reasoning in English.

[5] It is the open-ended nature of odd one out, as it is used in this study, which departs from the way in which odd one out problems are typically used in Intelligence Quotient (IQ) tests and similar (see e.g. Sinapov & Stoytchev, 2010).

[6] Within the CDAS coding instrument, there are four overlapping CDAS codes which can be used alongside other dialogue codes (agreement, querying, reference back and reference to wider context). In this paper, these are removed from analysis. This prevents a skewed representation which might arise when instances of the cross-cutting codes were high and used alongside other codes. These overlapping codes may mask instances of other forms of dialogue (including reasoning). For a full report which includes details of proportions with these codes included, see Oliver, 2020a).

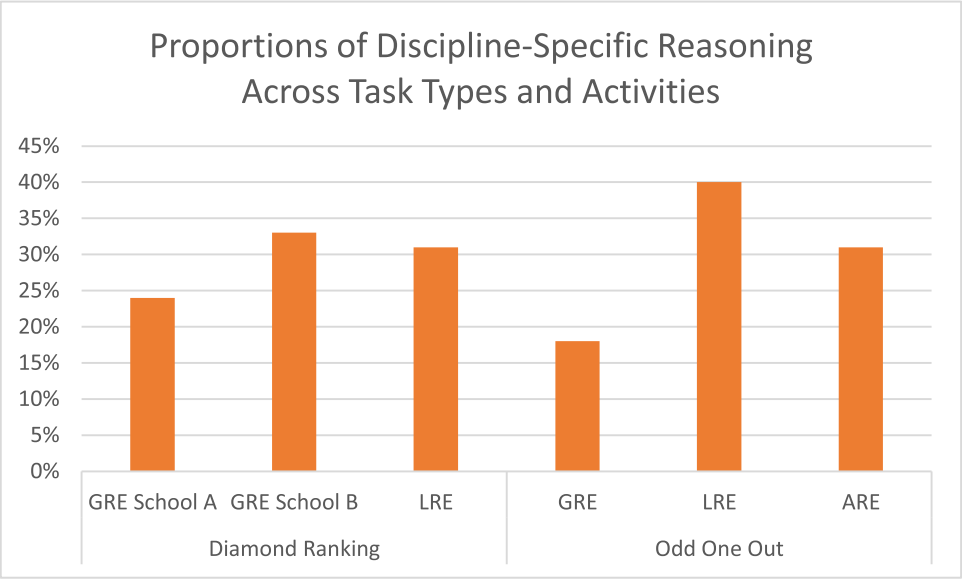


Fig. 1. Proportions of Discipline-Specific Reasoning Across Task Types and Activities.

Table 1
Frequency of Utterances Coded with Discipline-Specific Code for Each Activity Using Diamond Ranking Structure.

Activity and Reasoning Style Promoted	Frequency of Utterances	Total Utterances in Activity	Proportion of Discipline-Specific Reasoning
GRE School A	24	101	24%
GRE School B	65	196	33%
LRE	46	148	31%

Table 2
Frequency of Utterances Coded with Discipline-Specific Code for Each Activity Using Odd One Out Structure.

Activity and Reasoning Style Promoted	Frequency of Utterances	Total Utterances in Activity	Proportion of Discipline-Specific Reasoning
LRE	49	276	18%
GRE	37	93	40%
ARE	56	178	31%

3.4.3. Exemplification

Extracts of student dialogue from one odd one out and one diamond ranking task will be shared to exemplify domain-specific reasoning styles in English.

The diamond ranking task represented in Fig. 3 was designed to promote genre-based reasoning (GRE) with a Year 5 class (9–10 years of age). The odd one out task represented in Fig. 4 was designed to promote analogy-based reasoning (ARE) with a Year 6 class (10–11 years of age). The quotations from student dialogue included in the illustrations are taken from one group recording for each of these activities (i.e. dialogue from one group for the diamond ranking task and dialogue from one group for the odd one out task meaning that two of twenty-five recordings are represented in these two diagrams). These illustrations support exploration of the affordances of these task structures. Using two different targeted reasoning styles also helps to demonstrate some differences between the two reasoning styles. This is further exemplified in Appendix A where the framework of reasoning styles identified for English is shared alongside examples of student dialogue exemplifying individual styles.

Fig. 4 illustrates some of the specific affordances of the diamond ranking format. Items are considered in relation to each other which is supported by the multimodality benefits that this task structure brings. The capacity to rank items alongside one another within the middle portions of the diamond also enables consideration of links and relationships (e.g. “the hero is in the same line [as the villain] because if you didn’t have them in the story, it would be too evil and you wouldn’t have anything to stop the evil”). These benefits are explored further in Section 4 of this paper. Fig. 4 also exemplifies GRE. Students explicitly consider genre conventions when justifying their task-based decisions (e.g. the message or moral is considered most important because “the only reason why you really have a fairy tale is to teach you a message or moral”). Students demonstrate recognition of the importance of particular conventions within the fairy tale genre and thus use features to justify their inferences.

Fig. 5 illustrates some of the specific affordances of the odd one out task structure. Individual items represented by three circles are

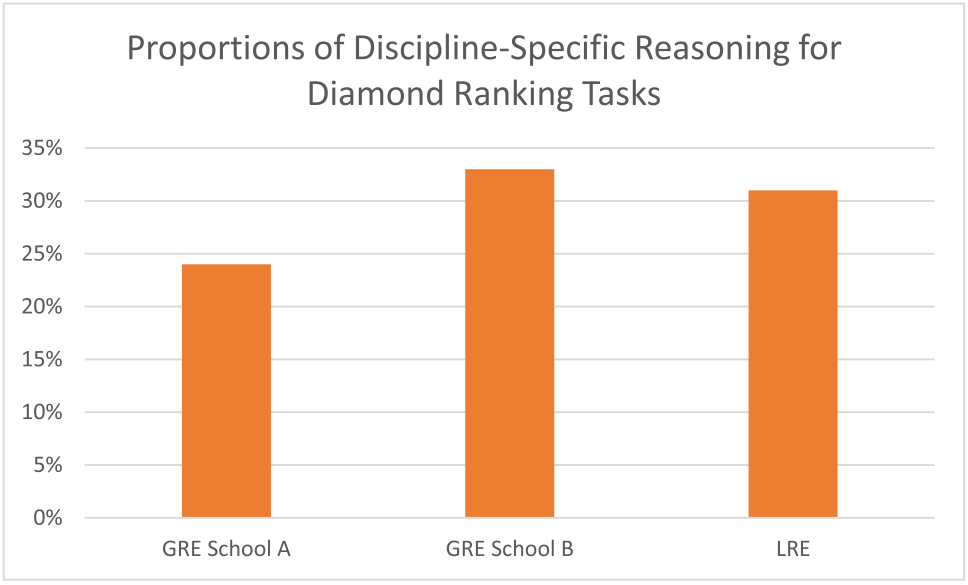


Fig. 2. Proportions of Discipline-Specific Reasoning for Diamond Ranking Activity.

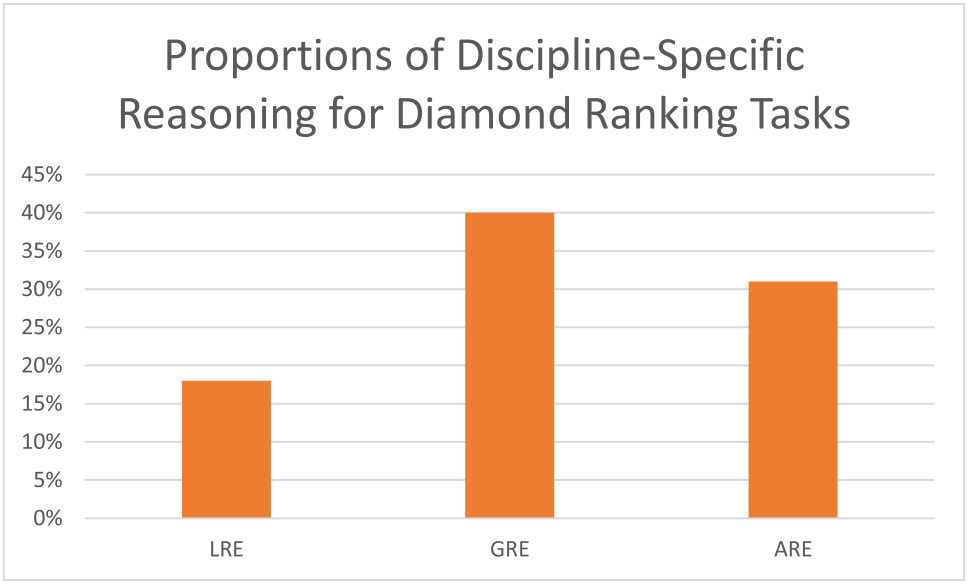


Fig. 3. Proportions of Discipline-Specific Reasoning for Odd One Out Activity.

used to record odd one out decisions. Arrows connecting two items are used to record corresponding similarities. The middle portion can be used to record similarities shared by all three items. These benefits are explored further in Section 4 of this paper. Fig. 5 also exemplifies ARE. Students explicitly compare items to arrive at a decision about which character is considered 'odd'.

4. Discussion

4.1. Meta-discursive rules

Reasoning styles represent discipline-specific practices which are expected, and prevalent, in forms of communication and dialogue within that disciplinary culture. When conclusions are formed, and arguments justified, reasoning styles are drawn upon since they represent valid ways of justifying, concluding and arguing in a given discipline. Reasoning styles can therefore be considered in terms of participation practices. Guiding participation within a discipline, and the forms or communication adopted, are meta-discursive

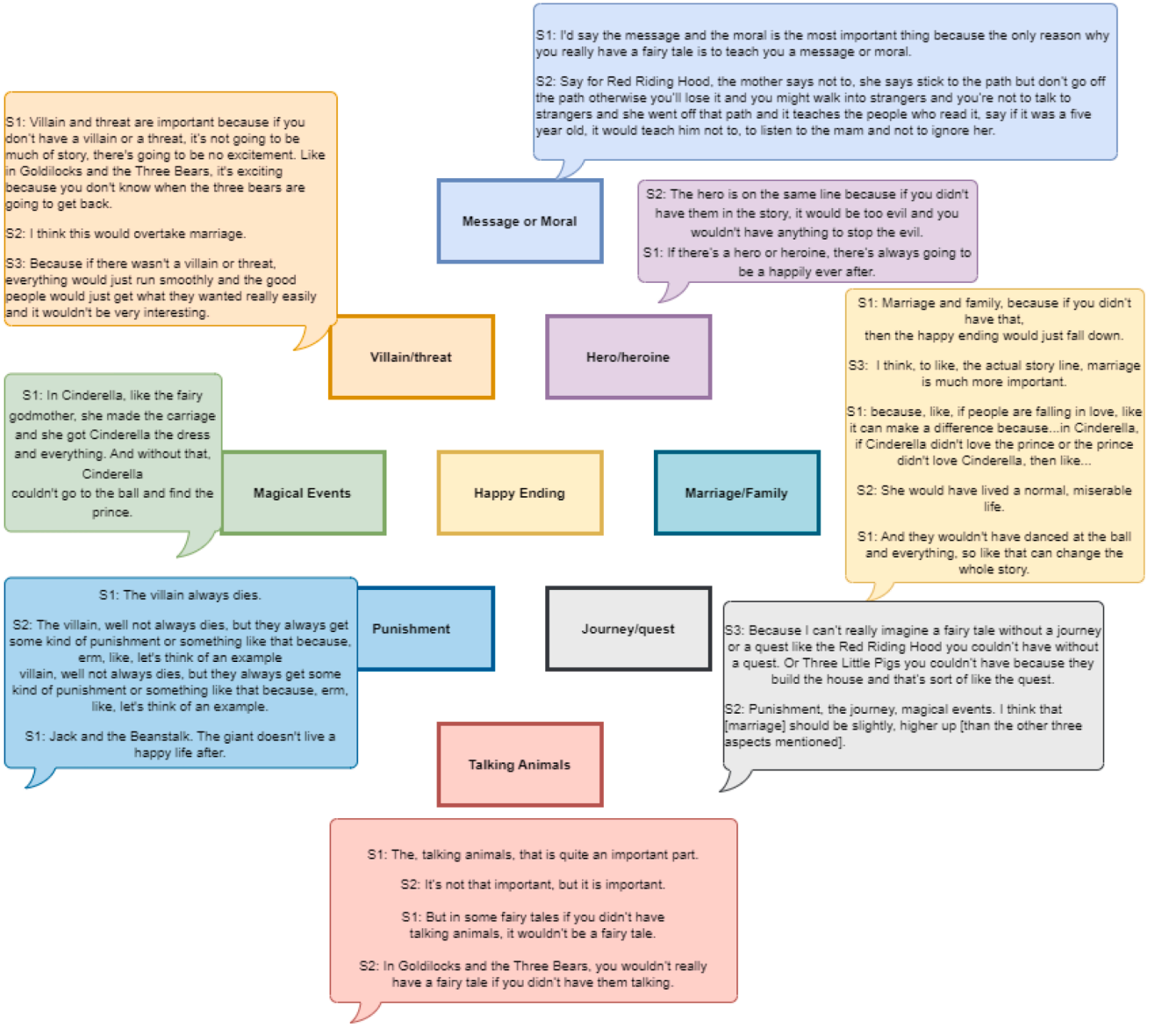


Fig. 4. Diamond ranking task to promote genre-based reasoning (GRE).

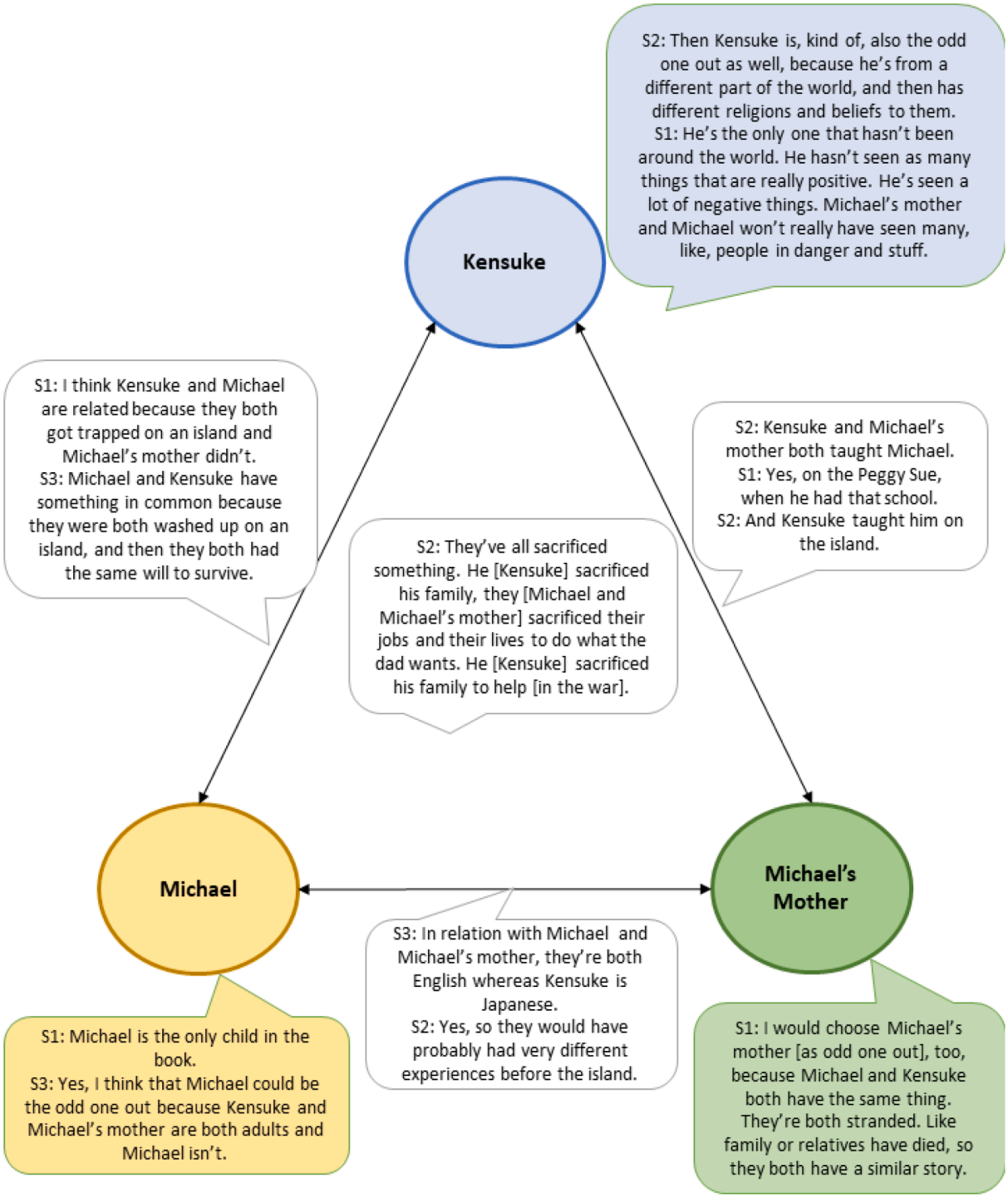


Fig. 5. Odd one out task to promote analogy-based reasoning (ARE).

rules (Sfard, 2001). These rules ensure that appropriate and expected forms of communication and dialogue are enacted. This paper explores ways in which task design can support the promotion of domain-specific reasoning styles in primary school English lessons. It is argued that the task structures foreground engagement with meta-discursive rules and require participation practices which emphasise articulation of (discipline-specific) reasoning. Two key aspects of the diamond ranking and odd one out task structures are important in guiding key meta-discursive rules: the forced prioritisation they demand, and the visual and spatial aspect guiding the direction of dialogue.

4.2. 'Forced prioritisation'

Both diamond ranking and odd one out require elicitation of constructs and demand an explicit decision. Students engaging with these tasks must articulate over-arching relationships supporting their organisation of ideas (in terms of ranking or categorisation decisions) (Clark, 2012). Since there is no 'correct' solution in diamond ranking or odd one out tasks, and given that activities are often tackled in pairs or small groups, students must discuss, negotiate, debate, reason, argue, accommodate, reflect, compromise and seek consensus to varying degrees. By providing reasons and justifications for decisions about where to place items in a diamond or which to label as 'odd', students' understandings become available for scrutiny, evaluation and comparison (Clark, 2012). These tasks therefore require that justification and reasoning be sound enough to 'pass' judgements made within the group. Hopkins describes the diamond as "forc[ing] sacrifices and prioritisation"(2010, p. 48). In both diamond ranking and odd one out, clear and explicit reasoning is encouraged so that all decisions are justified and agreed upon by group members. Constraints of the two task structures (in terms of requiring explicit decision-making) may therefore be beneficial to the promotion of reasoning. The need to make explicit, polarised decisions because of constraints within diamond ranking and odd one out formats requires an increased level of justification and reasoning from students. This meets the requirement articulated by Chinn, O'Donnell and Jinks (2000) that students will only participate in high-quality dialogue when they are specifically requested to provide reasons and justifications for their decisions/conclusions.

4.3. Visual/spatial/multimodal aspect

Also beneficial to the promotion of collaborative working and participation is the guidance provided by the visual, spatial and often multimodal nature of the task structures. This visual and spatial aspect prompts engagement with meta-discursive rules, shaping the direction of dialogue and requiring explicit articulation of (discipline-specific) reasoning. The visual, spatial and inclusive nature of the tasks enhance their accessibility and may support students in their thinking and organisation of ideas. It is suggested that use of visual activities supports participation and is particularly encouraging to those who might be challenged by tasks requiring high levels of proficiency in reading and writing (Clark, Laing, Tiplady & Woolner, 2013; Moss, Deppeler, Astley & Pattison, 2007; Niemi, Kumpulainen & Lipponen, 2015). Both odd one out and diamond ranking incorporate a highly visual component. Diamond ranking involves a diamond-shaped structure with spaces to place ranked items and odd one out can be presented in a triangle format or as a target board. Clark (2012) suggests that the process of arranging items (in her study, photographs) within the diamond assisted individual participants in their thinking. She also argues that arranging items while discussing the content of individual items was an important part in the process of reaching agreement. The visual and multimodal aspect of diamond ranking may therefore scaffold cognitive task requirements. Once students have established some (even implicit) rules of collaboration, the act of touching and moving a data item requires them to justify that action by explaining what they are doing. This represents a valuable diagnostic clue to how students are collaborating. Multimodal benefits might also apply to the odd one out task structure, where students can move the three items within the triangle so that two are grouped, and one is 'odd'.

Scaffolding support provided by the visual structure of tasks seems to have been beneficial in the study discussed here, illustrated in the following exchange from a GRE-focused diamond ranking activity:

> Student 2: I think ['marriage'] should be slightly, like higher up… because, if people are falling in love, like it can make a difference because… in Cinderella, if Cinderella didn't love the prince or the prince didn't love Cinderella, then like…
>
> Student 1: She would have lived a normal, miserable life.
>
> Student 2: And they wouldn't have danced at the ball and everything, so that can be like, it can change the whole story.

The requirement to physically arrange features of the fairy tale genre in the diamond ranking task seemed to prompt explicit reasoning from students.

Clark (2012) discusses the middle portion of the diamond, likening it to a "neutral", "undecided" or "middle-value", similar to that used in the Likert (1932) psychometric scale. It is suggested that justifications about choices around the middle portion of the diamond may be weaker than those for items placed at the top or bottom. However, in this study, the middle portions, where several items are ranked 'equally', prompted some careful discipline-specific reasoning from students. For example, in a diamond ranking task designed to promote GRE, features of fairy tales were ranked according to their importance to the genre. One group of students placed 'hero' and 'villain' alongside one another arguing: "if there wasn't a hero…the villain wouldn't be stopped". This example suggests potential affordances of the diamond structure where equivalent positions may be beneficial to the reasoning process. Unique requirements of the diamond may therefore help to explain why it seemed to promote discipline-specific reasoning most readily and flexibly across the three styles in this project.

In addition to scaffolding thinking, the visual nature of diamond ranking and odd one out also promotes inclusivity (Clark, 2012). Barriers which tasks relying on high levels of reading and writing proficiency might impose are removed and responses from a greater variety of participants might be encouraged. It was hoped in Clark's diamond ranking study that use of a visual tool would "enable the inclusive participation of a diverse group of teachers, students, support staff and community members" (2012, p. 231). While used only with students in the present study, both diamond ranking and odd one out were used across KS2 (ages 7–11), with students of varying abilities (including those identified as having special educational needs and disabilities). Therefore, the 'success' of these task structures at promoting discipline-specific reasoning might also be partially explained by their accessibility to a range of students, with limited reliance on written skills.

Despite limited writing demands, it is suggested that annotating can consolidate use of diamond ranking as a discussion tool (Clark, 2012; Niemi et al., 2015; Woolner et al., 2010). Written annotations can articulate justifications made for decisions about where to place items in the diamond. In this project, diamond ranking tasks did not typically require students to annotate their diamonds, yet odd one out tasks presented in the triangle format usually encouraged student annotation. Noting shared similarities along the line of the triangle connecting the two grouped items helps to make clear the basis on which these two have been classified as 'similar'. Recording distinctive element(s) of the item regarded as 'odd' adds to this justification. There is also opportunity to consider alternative solutions to odd one out tasks, with space to record numerous similarities and differences. This can help students to decide which of their justifications is strongest. Annotations might be useful in a classroom context where dialogue cannot usually be audio-recorded or transcribed. It might support students to make the bridge from verbal disciplinary-based reasoning, to written disciplinary-based reasoning. Although annotations were not always required from students in this project and were not subject to analysis, use of annotation might represent a profitable focus of future research into the utility of pedagogical tools/structures.

4.4. Meta-discursive rules and collaborative learning

Leat and Higgins (2002) suggest that PPS can support metacognitive awareness by requiring cognitive and social processes which can be discussed in class. This links to Lotan's requirement that tasks "include clear criteria for the evaluation of the group's product and of the individual report" (2014, p. 85). Because these task structures accommodate a variety of responses and approaches, they provide opportunities to engage in whole-class discussion, guided largely by the teacher. Such styles can be modelled, discussed, and compared, with support from task structures and through a process of skilled questioning and exemplification established by the teacher. Use of reasoning styles also provides the evaluation criteria Lotan mentions; by engaging in talk about cognitive and social processes involved in reasoning according to different styles in primary English, students develop metacognitive awareness and can learn to evaluate their use of particular styles. Again, the role of the teacher in this mediation process is key. The open-ended, flexible structure of tasks used in this study, which engage with subject content, are therefore important to creating optimum conditions for engagement with disciplinary-based reasoning. They require students to *participate* in disciplinary-based practices. Tasks therefore support students to learn the meta-discursive rules of disciplines (Sfard, 2001). In other words, tasks provide conditions for students to develop and enact the meta-discursive rules required (or appropriate) in different contexts.

4.5. Coding tool

The CDAS coding instrument and the modifications made in this project to capture discipline-specific reasoning supports exploration of the role of task structures in promoting educationally productive forms of dialogue. Ten of the CDAS codes are termed "dialogic move codes" (Vrikki et al., 2019, p. 6) since they represent current views about productive forms of dialogue. Two additional codes (*agreement* (A) and *other invitations* (OI)) do not map so readily onto existing views about productive dialogue although when combined with other codes, they are able to reflect valuable dialogue. Despite focusing primarily on reasoning (and discipline-specific reasoning codes developed during the project), coding and analysis retained and used all other CDAS codes. This ensured recognition of the importance of other dialogic functions. While the primary objective of the project was to investigate whether reasoning styles in primary English can be elicited in student dialogue, by permitting consideration of broader dialogic functions, comments about whether dialogue observed was educationally productive overall were possible.

Modifications made to the CDAS coding instrument operationalise ideas developed in the reasoning styles framework (Appendix B). Operationalisation can then be tested to ensure reliability in coding. Ensuring that styles can be reliably identified and coded will support future research investigating the concept of discipline-specific reasoning styles. Reliably establishing styles identified for English demonstrates their distinctness and the possibility of realising them in the primary classroom.

5. Conclusion

This paper asks: how can domain-specific reasoning styles be promoted in primary English? The roles of dialogue, collaboration and task design in the promotion of reasoning have been considered, with empirical evidence illustrating examples of domain-specific reasoning in student dialogue. These examples exemplify reasoning styles identified for primary English, and demonstrate the value of the two task designs explored here to the realisation of such styles. The successful elicitation of high proportions of domain-specific reasoning from these task structures (diamond ranking and odd one out) can be considered based on their requirement for dialogue and collaboration. Sfard's (2001) participation metaphor and the concept of meta-discursive rules can also be considered in relation to these task structures. Domain-specific reasoning styles represent some of the English discipline's meta-discursive rules. To promote engagement with these rules (or reasoning styles), students require structures which foreground and require participation in dialogue, collaboration and reasoning. The tasks used in this study require students to consider and enact the meta-discursive rules of a discipline. Both diamond ranking and odd one out ask students to elicit the constructs underpinning their decisions. The tasks enact a form of forced prioritisation by requiring explicit decision-making. Diamond ranking and odd one out represent inclusive ways of encouraging a broad range of student participation. Significantly, these tasks also offer visual and spatial components which scaffold student thinking.

Acknowledgement of domain-specific practices and their meta-discursive rules requires consideration of ways in which these can be *surfaced and animated*. Once such practices, rules or reasoning styles are made explicit, efforts to promote participation and engagement with them must be made. This paper suggests that engagement in domain-specific reasoning can be promoted through

carefully selected and designed tasks, which foreground collaboration and dialogue. The features of diamond ranking and odd one out have been explored. Of particular value is their demand for explicit decision making, and the way in which their visual aspects scaffold student thinking. Future research should explore the value of other such broad task structures in the promotion of discipline-specific reasoning.

CRediT authorship contribution statement

Michaela Oliver: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration, Funding acquisition. **Steve Higgins:** Validation, Resources, Writing – review & editing.

Declaration of Competing Interest

The authors have no financial interest (or other potential benefit) which will follow from the direct applications of the research. This manuscript is an original work, has not been published before and is not being considered for publication elsewhere.

Data Availability

Data will be made available on request.

Acknowledgements

The PhD that this paper is based upon was funded by the Economic and Social Research Council (ESRC), awarded through the Northern Ireland and North East Doctoral Training Partnership (NINEDTP). Grant number: ES/J500082/1

Appendix

Appendix A: Framework of reasoning styles for primary English

Reasoning Style	Description of Style	Examples of, or reflections on, primary student engagement in style
Genre-based Reasoning (GRE)	Consideration of *genre*(s) drawn upon within a text, including associated conventions, how these are employed, and to what effect.	[Y5 student discussing the importance of a moral lesson in the fairy tale genre]: "*Say for Red Riding Hood, the mother says stick to the path but don't go off the path otherwise you'll lose it and you might walk into strangers and you're not to talk to strangers and she went off that path and it teaches the people who read it…to listen to their mum and not to ignore her.*" [Y6 *student discussing the* Robinsonade (*or desert island*) *genre*]: "*The people are usually quite determined and quite friendly, because, in Kensuke's Kingdom, Kensuke and Michael are helping each other to survive. In Robinson Crusoe, Robinson helps Friday and they save some more people and in Swiss Family Robinson they work together to help each other to survive.*" Both students recognise the importance of particular conventions within different genres. They apply this understanding to individual texts and justify inferences based on genre features.
Language-based Reasoning (LRE)	Consideration of the impact or effect of linguistic devices and *language* choices.	[Y5 students completing diamond ranking task with cards containing different emotion words for a character]: "*No, because 'confused' and 'unsure', they basically mean the same thing, but if you're going to change one of them you have to change the other* [so they remain aligned in the same row of the diamond structure indicating their equal importance]." *"Yes* [Michael was 'determined'] *because he said it felt more than an expedition. An expedition is very long and hard, so you would have to have determination for it, and you're climbing a mountain, so that would take a while. So, you would be determined throughout the whole thing."* These examples demonstrate explicit engagement with vocabulary and its meanings (an element of LRE). Nuances between synonyms are explored and used to justify task decisions and to make inferences about a text.
Analogy-based Reasoning (ARE)	Consideration of comparison and analogies to other sources which create, explore and contrast images, characters and themes within and between literary texts.	[Y5 students completing odd one out task with three characters from Morpurgo's *Kensuke's Kingdom* (1999)]: *"I would choose Michael's mother* [as odd one out] *because Michael and Kensuke both have the*

(*continued on next page*)

(*continued*)

Reasoning Style	Description of Style	Examples of, or reflections on, primary student engagement in style
		same thing. They're both stranded. Like family or relatives have died, so they both have a similar story." *"Kensuke could also be the odd one out because Michael and Michael's mother, well, they both went on a ship journey, whereas Kensuke didn't go on the ship journey and fall off. He just- Well, there was a storm, wasn't there?"* Students therefore engage in ARE to make task decisions and explicitly compare characters to decide who might be considered 'odd'.
Contextual Reasoning (CRE)	Reflection upon *contexts* (e.g. historical, social, religious, biographical) in which a text is set and/or was created.	Students might recount and describe contextual factors in which a literary text was produced (e.g. historical, biographical, social, cultural, political, religious, moral or economic circumstances/ situations). They might use observations of contextual details to explain and justify interpretations of a text. For example, when reading Nina Bawden's *Carrie's War* (1974), students might draw upon historical knowledge of the events of World War Two to support their interpretations (of characters and/or events). Contextual detail might be used to justify the manner and behaviour of particular characters.
Structural Reasoning (SRE)	Reflection upon organisational devices and *structural* features used within a text to achieve a sense of unity.	Students might recount and describe structural features employed by an author to achieve unity (e.g. the use of repetition within a text). They might use observations of structural features to explain and justify their interpretations. Students might reflect on narrative and non-fiction text structures when interpreting texts. They might consider effects of various sentence structures (including repeated refrains). Other structural considerations applicable to the primary stage include a focus on chronology and coherence. Students might consider cause and effect (what prompts particular events/behaviours/actions).

Appendix B: Coding framework for discipline-specific reasoning styles in primary English

Codes	KeyWords
Reasoning (RE) CDAS	Provides an explanation or justification of own or another's contribution, or speculates, predicts, hypothesizes with grounds given. E.g. (After 'He came back') 'because he made a promise' (Vrikki et al., 2019).
Genre-based Reasoning (GRE)	Provides an explanation or justification of own or another's contribution **based on specific genre features identified.** Refers to/ draws upon conventions of genre and uses these categories to support the process of forming and justifying conclusions. Considers, compares and contrasts texts in relation to others within or outside of a given genre. Includes some or all of the general reasoning features described in RE but **must also contain a genre-based focus/element**.
Analogy-based Reasoning (ARE)	Provides an explanation or justification of own or another's contribution **by drawing analogies to other sources/images/ characters/themes.** May make use of allusion, allegory, simile, metaphor. Identifies similarities and differences between two or more aspects during the process of comparison or contrasting. Such comparison is made explicit and is used to facilitate interpretation. Use of analogy needs to be central to the reasoning process and to the formation/justification of conclusions (otherwise RW (reference to wider context) should be used instead). Includes some or all of the general reasoning features described in RE but **must also make explicit use of analogy/comparison/contrast.**
Language-based Reasoning (LRE)	Provides an explanation or justification of own or another's contribution **by drawing on specific language and linguistic devices identified**. Consideration can be at word-level (e.g. vocabulary, word class features, repetition, onomatopoeia, alliteration); sentence-level (e.g. analysis of syntactical structure, use of rhetorical questions, pun, hyperbole, oxymoron, simile or figures of speech); or text-level (e.g. emotive language, personification, pathetic fallacy, metaphor, imagery, symbolism or irony). Features may operate at different levels (e.g. sentence and text-level) with different effects. Most likely includes close reference to the text, perhaps in the form of direct quotation. Includes some or all of the general reasoning features described in RE but **must also explicitly consider language/ linguistic devices when forming/justifying conclusions.**

References

Asterhan, C. S. C., & Schwarz, B. B. (2016). Argumentation for learning: Well-trodden paths and unexplored territories. *Educational Psychologist, 51*(2), 164–187. https://doi.org/10.1080/00461520.2016.1155458

Barnes, D. (1976). *From communication to curriculum*. Harmondsworth: Penguin Education.

Barnes, D. (2008). Exploratory talk for learning. In N. Mercer, & S. Hodgkinson (Eds.), *Exploring talk in school: Inspired by the work of Douglas Barnes* (pp. 1–16). London: SAGE Publications Inc. https://doi.org/10.4135/9781446279526.n1.

Baumfield, V., Hall, E., & Wall, K. (2013). *Action research in education: Learning through practitioner enquiry* (2nd ed.). London: Sage Publications.

Bennett, N., & Cass, A. (1989). The effects of group composition on group interactive processes and pupil understanding. *British Educational Research Journal, 15*(1), 19–32. https://doi.org/10.1080/0141192890150102

Bennett, N., & Dunne, E. (1992). *Managing classroom groups*. Hemel Hempstead: Simon & Schuster Education.

Blatchford, P., Kutnick, P., Baines, E., & Galton, M. (2003). Toward a social pedagogy of classroom group work. *International Journal of Educational Research, 39*(1–2), 153–172. https://doi.org/10.1016/S0883-0355(03)00078-8
Bleicher, R. E., Tobin, K. G., & McRobbie, C. J. (2003). Opportunities to talk science in a high school chemistry classroom. *Research in Science Education, 33*(3), 319–339. https://doi.org/10.1023/A:1025480311414
Bourdieu, P. (1999). Structures, *Habitus*, practices. In A. Elliot (Ed.), *The Blackwell reader in contemporary social theory*, pp. 107–118). Oxford: Blackwell.
British Educational Research Association (BERA). (2018). *Ethical guidelines for educational research* (4th ed.). London: British Educational Research Association.
Bruner, J. (1973). The growth of mind. In J. Anglin (Ed.), *Beyond the information given* (pp. 437–451). New York: Norton.
Bueno, O. (2012). Styles of reasoning: A pluralist view. *Studies in History and Philosophy of Science, 43*, 657–665. https://doi.org/10.1016/j.shpsa.2012.07.008
Cazden, C. B. (2001). Variations in lesson structure. *Classroom discourse: The language of teaching and learning* (2nd ed.). Portsmouth, NH: Heinemann. Retrieved from http://www.wou.edu/~girodm/library/cazden.pdf.
Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction, 11*(3), 1–16. https://doi.org/10.12973/iji.2018.1131a
Chinn, C. A., O'Donnell, A. M., & Jinks, T. S (2000). The structure of discourse in collaborative learning. *Journal of Experimental Education, 69*(1), 77–97. https://doi.org/10.1080/00220970009600650
Clark, H. H. (1996). *Using language*. Cambridge: Cambridge University Press.
Clark, J. (2012). Using diamond ranking as visual cues to engage young people in the research process. *Qualitative Research Journal, 12*(2), 222–237. https://doi.org/10.1108/14439881211248365
Clark, J., Laing, K., Tiplady, L., & Woolner, P. (2013). *Making connections: Theory and practice of using visual methods to aid participation in research*. Newcastle University: Research Centre for Learning and Teaching. Retrieved from http://www.ncl.ac.uk/cflat/.
Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64*(1), 1–35. https://doi.org/10.3102/00346543064001001
Cohen, E. G., & Intilli, J. K. (1981). *Interdependence and management in bilingual classrooms: Final report (No. NIE-G-80-0217)*. Stanford University: California Centre for Educational Research at Stanford.
Comber, C., Galton, M., Hargreaves, L., Wall, D., & Pell, A. (1999). *Inside the primary classroom: Twenty years on* (1st ed.). London: Routledge.
Crombie, A. C. (1995). Commitments and styles of European scientific thinking. *History of Science*, 225–238.
Danielewicz, J. M., Rogers, D. L., & Noblit, G. (1996). Children's discourse patterns and power relations in teacher-led and child-led sharing time. *International Journal of Qualitative Studies in Education, 9*(3), 311–331. https://doi.org/10.1080/0951839960090306
Davidson, N., & Major, C. H. (2014). Boundary crossings: Cooperative learning, collaborative learning, and problem-based learning. *Journal of Excellence in College Teaching, 25*(3&4), 7–55.
DfE. (2014). *The national curriculum in England: Framework document*. Retrieved March 3, 2022, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381344/Master_final_national_curriculum_28_Nov.pdf.
Education Endowment Foundation (EEF). (2018). *Teaching and learning toolkit*. Retrieved March 28, 2022, from https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/.
Education Endowment Foundation. (2019, July). *Improving literacy in secondary schools*. Retrieved March 28, 2022, from https://educationendowmentfoundation.org.uk/tools/guidance-reports/improving-literacy-in-secondary-schools/.
Edwards, D., & Mercer, N. (1987). *Common knowledge: The development of understanding in the classroom*. /2012. New York. London: Methuen/Routledge.
Edwards, A. D., & Westgate, D. P. G. (1994). *Investigating classroom talk*. London: Falmer Press.
Fang, Z. (2012). Language correlates of disciplinary literacy. *Topics in Language Disorders, 32*(1), 19–34. https://doi.org/10.1097/tld.0b013e31824501de
Fernández, M., Wegerif, R., Mercer, N., & Rojas-Drummond, S. (2001). *Re*-conceptualizing scaffolding and the zone of proximal development in the context of symmetrical collaborative learning. *The Journal of Classroom Interaction, 36*, 40–54. https://doi.org/10.2307/23869224
Frith, C. D., & Singer, T. (2008). The role of social cognition in decision making. *Philosophical Transactions of the Royal Society, 363*, 3875–3886. https://doi.org/10.1098/rstb.2008.0156
Galton, M. J., Simon, B., & Croll, P. (1980). *Inside the primary classroom*. London: Routledge & K. Paul.
Galton, M. J., & Williamson, J. (1992). *Group work in the primary classroom*. London: Routledge.
Gillies, R. M., & Boyle, M. (2010). Teachers' reflections on cooperative learning: Issues of implementation. *Teaching and Teacher Education, 26*(4), 933–940. https://doi.org/10.1016/J.TATE.2009.10.034
Goffman, E. (1974). *Frame analysis: An essay on organization of experience*. Boston, MA: Northeastern University Press.
Hacking, I. (1992). 'Style' for historians and philosophers. *Studies in History and Philosophy of Science Part A, 23*(1), 1–20. https://doi.org/10.1016/0039-3681(92)90024-Z
Hacking, I. (2012). Language, Truth and Reason" 30 years later. *Studies in History and Philosophy of Science, 43*, 599–609. https://doi.org/10.1016/j.shpsa.2012.07.002
Hakkarainen, K., & Paavola, S. (2009). Toward a trialogical approach to learning. In B. Schwarz, T. Dreyfus, & R. Hershkowitz (Eds.), *Transformation of knowledge through classroom interaction* (pp. 65–80). London; New York: Routledge.
Harwood, D. (1995). The pedagogy of the world studies 8-13 project: The influence of the presence/absence of the teacher upon primary children's collaborative group work. *British Educational Research Journal, 21*(5), 587–611. https://doi.org/10.1080/0141192950210504
Higgins, S. (2001). *Thinking through primary teaching*. Cambridge: Chris Kington Publishing.
Howe, C. (2010). *Peer groups and children's development*. Oxford: Wiley-Blackwell.
Howe, C. (2017). *Group work in primary classrooms: No longer a waste of time.* Retrieved October 1, 2019, from https://www.bera.ac.uk/blog/group-work-in-primary-classrooms-no-longer-a-waste-of-time.
Howe, C., & Abedin, M. (2013). Classroom dialogue: A systematic review across four decades of research. *Cambridge Journal of Education, 43*(3), 325–356. https://doi.org/10.1080/0305764X.2013.786024
Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–student dialogue during classroom teaching: Does it really impact on student outcomes? *Journal of the Learning Sciences, 28*(4–5), 462–512.
Joynes, C., Rossignoli, S., & Fenyiwa Amonoo-Kuofi, E. (2019). *21st century skills: Evidence of issues in definition, demand and delivery for development contexts (K4D helpdesk report)*. Brighton, UK: Institute of Development Studies.
Kagan, S. (1989). The structural approach to cooperative learning. *Educational Leadership, 47*(4), 12–15.
Keefer, M. W., Zeitz, C. M., & Resnick, L. B. (2000). Judging the quality of peer-led student dialogues. *Cognition and Instruction, 18*(1), 53–81. https://doi.org/10.1207/S1532690XCI1801_03
Kim, I. H., Anderson, R. C., Nguyen-Jahiel, K., & Archodidou, A. (2007). Discourse patterns during children's collaborative online discussions. *Journal of the Learning Sciences, 16*(3), 333–370. https://doi.org/10.1080/10508400701413419
Kohn, A. (1992). Resistance to cooperative learning: making sense of its deletion and dilution. *Journal of Education, 174*(2), 38–56.
Lave, J. (1988). *Cognition in practice*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511609268
Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
Leat, D., & Higgins, S. (2002). The role of powerful pedagogical strategies in curriculum development. *Curriculum Journal, 13*(1), 71–85. https://doi.org/10.1080/09585170110115286
Leinhardt, G., & Steele, M. D. (2005). Seeing the complexity of standing to the side: Instructional dialogues. *Cognition and Instruction, 23*(1), 87–163. https://doi.org/10.1207/s1532690xci2301_4
Lotan, R. A. (2014). Crafting groupworthy learning tasks. In E. G. Cohen, & R. A. Lotan (Eds.), *Designing groupwork: Strategies for the heterogeneous classroom* (3rd ed., pp. 85–97). New York; London: Teachers College Press.

McIntyre, E., Kyle, D. W., & Moore, G. H. (2006). A primary-grade teacher's guidance toward small-group dialogue. *Reading Research Quarterly, 41*(1), 36–66. https://doi.org/10.1598/rrq.41.1.2
McPeck, J. E. (1981). *Critical thinking and education*. Oxford: Martin Robertson.
Mercer, N. (2000). *Words and minds: How we use language to think together*. London: Routledge. https://doi.org/10.4324/9780203464984
Mercer, N. (2013). The social brain, language, and goal-directed collective thinking: A social conception of cognition and its implications for understanding how we think, teach, and learn. *Educational Psychologist, 48*(3), 148–168. https://doi.org/10.1080/00461520.2013.804394
Mercer, N., & Howe, C. (2012). Explaining the dialogic processes of teaching and learning: The value and potential of sociocultural theory. *Learning. Culture and Social Interaction, 1*(1), 12–21.
Mercer, N., & Littleton, K. (2007). *Dialogue and the development of children's thinking: A sociocultural approach*. London: Routledge.
Meyer, J. H. F., & Land, R. (2003). Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising. In C. Rust (Ed.), *Improving student learning - Theory and practice ten years on* (pp. 412–424). Oxford: Oxford Centre for Staff and Learning Development (OCSLD).
Michaels, S., O'Connor, C., & Resnick, L. (2008). Deliberative discourse idealized and realized: Accountable talk in the classroom and in civic life. *Studies in Philosophy and Education, 27*(4), 283–297. https://doi.org/10.1007/s11217-007-9071-1
Michaels, S., Sohmer, R., & O'Connor, M. C (2004). Classroom discourse. In H. Ammon, N. Dittmar, K. Mattheier, & P. Trudgill (Eds.), *Sociolinguistics: An international handbook of the science of language and society* (2nd ed., pp. 2351–2366). New York: Walter de Gruyter.
Moss, J., Deppeler, J., Astley, L., & Pattison, K. (2007). Student researchers in the middle: Using visual images to make sense of inclusive education. *Journal of Research in Special Educational Needs, 7*(1), 46–54. https://doi.org/10.1111/j.1471-3802.2007.00080.x
Muhonen, H., Rasku-Puttonen, H., Pakarinen, E., Poikkeus, A.-. M., & Lerkkanen, M. K. (2016). Scaffolding through dialogic teaching in early school classrooms. *Teaching and Teacher Education, 55*, 143–154. https://doi.org/10.1016/j.tate.2016.01.007
Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N., & Alexander, J. F. (2009). Examining the effects of classroom discussion on students' comprehension of text: A meta-analysis. *Journal of Educational Psychology, 101*(3), 740–764. https://doi.org/10.1037/a0015576
Nickerson, R. S., Perkins, D. N., & Smith, E. E. (2013). *The teaching of thinking*. New York; London: Psychology Press.
Niemi, R., Kumpulainen, K., & Lipponen, L. (2015). Pupils as active participants: Diamond ranking as a tool to investigate pupils' experiences of classroom practices. *European Educational Research Journal, 14*(2), 138–150. https://doi.org/10.1177/1474904115571797
O'Brien, D. G., Moje, E. B., & Stewart, R. A (2001). Exploring the context of secondary literacy: Literacy in people's everyday school lives. In E. B. Moje, & D. G. O'Brien (Eds.), *Constructions of literacy: Studies of teaching and learning in and out of secondary classrooms* (pp. 27–48). Mahwah, NJ: Erlbaum.
Olitsky, S. (2007). Promoting student engagement in science: Interaction rituals and the pursuit of a community of practice. *Journal of Research in Science Teaching, 44*(1), 33–56. https://doi.org/10.1002/tea.20128
Perkins, D. (2006). Constructivism and troublesome knowledge. *Overcoming barriers to student understanding: Threshold concepts and troublesome knowledge* (pp. 33–47). London; New York: Routledge.
Ritchhart, R. (2002). *Intellectual character: What it is, why it matters, and how to get it*. San Francisco, CA: Jossey-Bass.
Ritchhart, R., Church, M., & Morrison, K. (2011). *Making thinking visible: How to promote engagement, understanding and independence for all learners*. San Francisco, CA: Jossey-Bass.
Ritchhart, R., Palmer, P., Church, M., & Tishman, S. (2006). Thinking routines: Establishing patterns of thinking in the classroom. In *Paper presented at the annual meeting of the American Educational Research Association*.
Ritchhart, R., & Perkins, D. (2008). Making thinking visible. *Educational Leadership, 65*(5), 57–61.
Rockett, M., & Percival, S. (2002). *Thinking for learning*. Stafford: Network Educational Press.
Roychoudhury, A., & Roth, W. M. (1996). Interactions in an open-inquiry physics laboratory. *International Journal of Science Education, 18*(4), 423–445. https://doi.org/10.1080/0950069960180403
Rymes, B. (2003). Eliciting narratives: Drawing attention to the margins of classroom talk. *Research in the Teaching of English, 37*, 380–407. https://doi.org/10.2307/40171631
Salmon, A. (2010). Engaging young children in thinking routines. *Childhood Education, 86*(3), 132–137. https://doi.org/10.1080/00094056.2010.10523133
Schwab, J. J. (1978). Education and the structure of the disciplines. In I. Westbury, & N. J. Wilkof (Eds.), *Science, curriculum and liberal education: Selected essays* (pp. 229–272). Chicago: University of Chicago Press.
Sinapov, J., & Stoytchev, A. (2010). The odd one out task: Toward an intelligence test for robots. In *2010 IEEE 9th International Conference on Development and Learning* (pp. 126–131). *2010 IEEE 9th International Conference on Development and Learning*.
Sohmer, R., Michaels, S., O'Connor, M. C., & Resnick, L. (2009). Guided construction of knowledge in the classroom: The troika of talk, tasks and tools. In B. Schwarz, T. Dreyfus, & R. Hershkowitz (Eds.), *Transformation of knowledge through classroom interaction* (pp. 113–137). Abingdon, Oxon: Routledge. https://doi.org/10.4324/9780203879276-13.
Scott, C.L. (2015, November). *The futures of learning 2: What kind of learning for the 21st century?* (UNESCO Education, Research and Forsight; ERF Working Papers Series, No. 14). Retrieved from https://pdfs.semanticscholar.org/fdf6/502f635dc8408dcc4f9c6122b4398b2a758c.pdf.
Sfard, A. (2001). There is more to discourse than meets the ears: Looking at thinking as communicating to learn more about mathematical learning. *Educational Studies in Mathematics, 46*(1/3), 13–57. http://www.jstor.org/stable/3483239.
Shanahan, T., & Shanahan, C. (2012). What is disciplinary literacy and why does it matter? *Topics in Language Disorders, 32*(1), 7–18. https://doi.org/10.1097/TLD.0b013e318244557a
Smith, F., Hardman, F., Wall, K., & Mroz, M. (2004). Interactive whole class teaching in the National Literacy and Numercy Strategies. *British Educational Research Journal, 30*(3), 395–411. https://doi.org/10.1080/0141192041000168970 6
Trilling, B., & Fadel, C. (2009). *21st Century skills: Learning for life in our times*. San Francisco, Calif: Jossey-Bass/John Wiley & Sons, Inc.
van Drie, J., & van Boxtel, C. (2008). Historical reasoning: Towards a framework for analyzing students' reasoning about the past. *Educational Psychology Review, 20*(2), 87–110. https://doi.org/10.1007/s10648-007-9056-1
Vrikki, M., Wheatley, L., Howe, C., Hennessy, S., & Mercer, N. (2019). Dialogic practices in primary school classrooms. *Language and Education, 33*(1), 85–100. https://doi.org/10.1080/09500782.2018.1509988
Vygotsky, L. S. (1962). *Thought and language*. Cambridge, Massachusetts: MIT Press.
Vygotsky, L. S. (1978). *Mind in society : The development of higher psychological processes*. Cambridge, Massachusetts; London: Harvard University Press.
Wegerif, R. (2010). *Mindexpanding: Teaching for thinking and creativity in primary education*. Buckingham: Open University Press.
Wegerif, R., & Scrimshaw, P. (Eds.). (1997). *Computers and talk in the primary classroom*. Clevedon: Multilingual Matters.
Wells, C. G. (1999). *Dialogic inquiry: Towards a sociocultural practice and theory of education*. Cambridge: Cambridge University Press.
Wenger-Trayner, E., Fenton-O'Creevy, M., Hutchinson, S., Kubiak, C., & Wenger-Trayner, B (2014). *Learning in landscapes of practice: Boundaries, identity, and knowledgeability in practice-based learning*. Routledge.
Wertsch, J. V. (1985). *Vygotsky and the social formation of mind*. Harvard University Press.
Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, Massachusetts: Harvard University Press.
Wittgenstein, L. (1953). *Philosophical investigations*, G.E.M. Anscombe, Trans. Oxford, UK: Blackwell ((Original work published 1953)).
Woolner, P., Clark, J., Hall, E., Tiplady, L., Thomas, U., & Wall, K. (2010). Pictures are necessary but not sufficient: Using a range of visual methods to engage users about school design. *Learning Environments Research, 13*(1), 1–22. https://doi.org/10.1007/s10984-009-9067-6