Using Toulmin's Argument Pattern in the evaluation of argumentation in school science.

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Abstract

Toulmin's definition of argument has been used by researchers as a theoretical perspective on argument and as a methodological tool for analysing episodes of oral argumentation. An adaptation of Toulmin's framework used by researchers has informed a professional development programme for teachers. Research on the impact of the programme on pedagogic practice shows that Toulmin-based materials are advantageous in helping teachers to conceptualise argument and model it for students. However focus on the process of argumentation limits any consideration of the content and quality of evidence. Toulmin's framework can also be used to evaluate student outcomes when using argumentation software.

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Introduction

In recent years several studies in science education have focused on the analysis of argumentation discourse in classroom contexts (e.g. Driver, Newton and Osborne 2000; Jiménez-Aleixandre, Rodríguez, and Duschl 2000; Osborne, Erduran, and Simon 2004a), and the importance of argumentation in the development of scientific knowledge and understanding (Pontecorvo 1987; Schwarz et al. 2003; von Aufschneider et al. 2008). One implication that can be drawn from these and other studies, particularly the research of Kuhn (1991), is that argumentation is a form of discourse that needs to be appropriated by children and explicitly taught through suitable instruction, task structuring and modeling (Osborne, Erduran, and Simon 2004a). To this end, frameworks for conceptualising argument and communicating its meaning become important research tools and pedagogical devices. The aim of this paper is to show how such tools, developed by researchers, have subsequently informed the pedagogic practice of argumentation, implemented by teachers.

Research on argumentation in science education has been underpinned by philosophical and cognitive perspectives on the role of argument (Duschl and Osborne 2002). From a philosophical perspective, science involves the construction of theories that provide explanations for phenomena that are open to challenge and refutation; science proceeds through dispute, conflict and argumentation (Latour and Woolgar 1986). Arguments about the interpretation of evidence and the validity of knowledge claims are central to science and scientific discourse. From a cognitive perspective, argument is an important feature of reasoning and thinking (Billig 1987); as students

engage in argumentation they learn to appreciate the connection between evidence and claim and the importance of justification in scientific argument. From these different perspectives, researchers studying the quality of argumentation have developed theoretical and methodological frameworks for the conception and analysis of argumentation in science (e.g. Jiménez-Aleixandre, Rodríguez, and Duschl 2000; Zohar and Nemet, 2002; Osborne, Erduran, and Simon 2004a). Included amongst these is a framework derived from a model developed by Toulmin (1958) which offers the basis for a theoretical perspective on argument. Toulmin's Argument Pattern (TAP) illustrates an interconnection between argument components that facilitates a conceptualisation of the meaning of argument.

This paper draws on methodological approaches involving the application of Toulmin's Argument Pattern (TAP) to the analysis of science discourse that were developed by the author and colleagues as part of a research project on enhancing the quality of argument in school science (Osborne, Erduran, and Simon, 2004a; Erduran, Simon, and Osborne, 2004; Simon, Erduran, and Osborne, 2006). The research carried out by these authors set out to determine the impact of interventions with both teachers and students on the quality of argumentation in scientific and socio-scientific contexts. The outcomes of this project have been disseminated in the science education community worldwide, and the use of TAP is forming a significant component of teacher professional development aimed at enhancing the pedagogy of argumentation in science. The first part of the paper describes how TAP was used to define the quality of argument and hence to quantify arguments generated in whole-class discussions between teachers and students. The account also shows how TAP was used to identify students' use of

rebuttals, that is statements that counter the grounds for claims in an argument, and how the quality of argument was evaluated by the presence and nature of rebuttals voiced among students.

In more recent projects, the author has drawn on Toulmin's work to research teachers' developing understanding of argument and to evaluate students' argumentation using digital technology. The second part of this paper discusses issues arising from results of two projects. The aim of the first project was to evaluate the impact of a teachers' professional development programme using TAP based materials, from recorded discussions between teachers and analysis of teachers' written portfolios. The second study focused on the use of TAP in evaluating the outcomes of students' collaborative argumentation generated through using argumentation software in science classrooms. Reflection on these two projects reveals the limitations of the use of TAP, but also the possible advantages of using TAP in developing an understanding of argument for both teachers and students.

In conclusion, the paper discusses how Toulmin's work has been influential in developing a theoretical perspective on argument, a methodological tool for analysis, and a means of modelling argument for both teachers and students.

Toulmin's Argument Pattern

From a Toulmin perspective, arguments include a claim, data that support the claim, warrants that provide a link between the data and the claim, backings that strengthen the warrants, and rebuttals that indicate the circumstances under which the claim would not

be true (Figure 1). Toulmin also considered qualifiers as showing the degree of reliance that can be placed on conclusions arising from arguments.

[insert Figure 1 here]

Toulmin's definition was used in research undertaken by Osborne, Erduran and Simon as a framework for analysing the components of arguments occurring in classroom discourse and hence the quality of argumentation (Erduran, Simon, and Osborne 2004, Osborne, Erduran and Simon 2004a, Simon, Erduran, and Osborne 2006). The application of TAP was underpinned by the assumption that the more elements of TAP that were present in the dialogue, the better the quality of argumentation. Claims supported by grounds including data, warrants and backings were deemed to represent more complex hence more sophisticated arguments. Moreover, argumentation including rebuttals, where the data or warrants were opposed, was seen to foster the process of justification and elaboration of evidence. These researchers did not focus on the nature of data, warrants etc, as their concern was to use TAP as a means of analysing the argumentation process rather than evaluating its content; their aim was to enhance the skill of constructing arguments using evidence. However, to leave unexplored the nature of evidence used to support claims sets a limitation on their definition of quality.

Using TAP to identify the components of argumentation, Simon et al. compared the quality of the argumentation generated in science lessons in 12 classrooms over the course of a year. Transcripts of teachers' interactions with students were analysed for components of argumentation identified by TAP, although the processes of interpretation

were not without difficulties similar to those experienced by previous researchers (Kelly, Druker, and Chen, 1998).

To code the transcripts, decisions needed to be taken with respect to the components of an argument – what counts as claim, warrant or data. However, there is considerable ambiguity as one example from Erduran et al.'s report (2004) suggests. In the following extract, which constitutes an episode of argumentation used as a unit for analysis, students are invited to consider alternative theories to explain the phases of the moon.

> T: [Statement]A, the moon spins around, so the part of the moon that gives out light is not always facing us. Julian, A?
>
> S1: The moon doesn't give out light.
>
> T: Right, so that's why A is wrong. That's true. How do you know that?
>
> S1: Because the light that comes from the moon is actually from the sun.
>
> T: He is saying the light that we see from the moon is actually a reflection from the sun. How do we know that? Andrew?
>
> S2: Because the moon is blocked by the . . . .
>
> In this example, one could consider the statement "The moon spins around" as a piece of data which supports the claim "So the part of the moon that gives out light is not always facing us." One could also argue, however, that the student's choice of "A" (the statement on the card) is the main claim. In other words, "A is right" can be considered an implicit claim which is challenged by the next claim "The moon doesn't give out light." Deciding which of the statements to take as a claim (i.e. "The moon spins around" or "A is right") can thus become problematic.
>
> (Erduran et al. p 920)

Such ambiguities can be resolved by examining the words ‘so’ and ‘because’ – which in this example show there is little doubt there is a claim and a justification (so…), plus a rebuttal and further elaboration that provides justification for the rebuttal (because…). The researchers needed to listen to recordings to judge the force of statements in order to determine the substantive claim and identify other TAP components that contributed to argumentation around that claim, hence the identification of an episode. The research conducted by these authors achieved 80% inter-reliability through pairs of researchers analysing transcripts using TAP and cross-checking identification of argument components and episodes.

The analysis reported by Simon, Erduran and Osborne (2006) facilitated quantitative results in terms of the frequency and complexity of arguments, i.e. the range of TAP components present in each episode of argumentation. The research team were able to compare teachers’ use of argument with each other and to establish any changes that occurred over the course of a year (Figure 2). The teacher represented in Figure 2 shows a shift to more complex argumentation in year 2, i.e. a higher frequency of argumentation involving more components.

[Insert Fig 2 here]

On comparing this profile with other teachers, Simon et al found that 5 out of the 12 teachers showed significant change in terms of this complexity of argumentation. Comparisons between teachers also revealed different combinations of TAP components hence different teacher profiles, suggesting that differences between teachers were greater than changes from one year to the next. This conclusion was important for a

subsequent professional development programme that would take into account the variation between teachers in their understanding and pedagogy of argumentation. Moreover, the use of TAP as a means of analysing arguments was introduced to teachers in the programme (see below).

Development of TAP: A framework of levels

In addition to this application of TAP, Erduran, Osborne and Simon generated a scheme where argumentation was assessed in terms of levels, which illustrated the quality of opposition or rebuttals in the students' small-group discussions (Erduran, Simon, and Osborne, 2004; Osborne, Erduran, and Simon 2004a). The presence of a rebuttal was a significant indicator of quality of argumentation as rebuttals force students to evaluate the validity and strength of arguments. The focus was on those episodes of student-student dialogue where there was a clear opposition between students, and the nature of this opposition was assessed in term of the strength of rebuttals offered. Low-level arguments included counter-arguments that were unrelated, higher level arguments included rebuttals. The framework of levels (Table 1) devised by these researchers was applied to opposition episodes identified in the data recorded from small group discussions.

[Insert Table 1 here]

For example, the extract cited earlier where students were given alternative theories to explain the phases of the moon, was coded as level 4. The first student advances the claim that it is explanation A, appealing to a datum that 'the part of the moon that gives out light in not always facing us.' There is then a rebuttal supplied with supporting data that the 'light that comes from the moon is actually from the sun' and a warrant that is unfinished.

The method of analysis using this level system enabled the researchers to perform comparisons pre and post intervention, and for different contexts (see Osborne, Erduran, and Simon 2004a). In this way TAP was used both qualitatively to identify levels, and quantitatively in making such comparisons. Though the level system enabled researchers to make these comparisons based on assumptions of quality as defined by TAP, the nature of grounds and rebuttals remained unexplored. Thus the definition of quality is confined to argument structure rather than content and strength of evidence. The level system has since been used by teachers in their evaluation of students' argumentation both in oral discussion activities and in argumentative writing. Teachers concerned as much with the nature of evidence as well as its existence, would find using the level system alone has limitations.

Toulmin's Argument Pattern: further applications

The research on the quality of argumentation in science reported above was centred on classroom discourse where there was interactive conversation with alternative points of view. In these classrooms teachers actively promoted argumentative discussion

through tasks, such as consideration of competing theories, where students engaged in such discussion, and the use of rebuttals was encouraged through questioning by the teacher. More recent studies undertaken by the author have incorporated Toulmin-based analytical frameworks for promoting the teaching and evaluation of argumentation in science contexts through professional development programmes, and through the use of argumentation software.

Professional development in science teaching

A professional development programme focusing on collaborative reflective practice (Hoban 2002) was designed for the teaching of argumentation. Three groups of four teachers were involved over a three-year period; the first group were teachers experienced in the use of argumentation (Year 1), who co-designed the programme with researchers using in-service training materials arising from the project described above (Osborne, Erduran, and Simon 2004b). The two subsequent groups included teachers who were inexperienced in using argumentation (Years 2 and 3), and refinements were made to the programme in the light of each group's experience. The programme included five workshops of three hours spread out over the course of each year. The workshops incorporated inputs by researchers on the pedagogy of argumentation, including teaching activities, strategies for small group discussion, lesson planning, and evaluation of student outcomes. The programme was designed so that these inputs would be interspersed with periods where teachers could implement new ideas and reflect on

practice, with a view of sharing these experiences in subsequent workshops (Simon and Johnson 2008).

The aim of the research was to evaluate the impact of the programme on teachers' professional learning, as evidenced by their oral and documented accounts of practice. Data sources included audio-recordings of workshops, which were analysed by listening to teachers' reflections, questions and discussion to ascertain their interpretations of argumentation and implementation of ideas in practice. Documentary evidence was collected in the form of a personal portfolio, which included lesson plans, lesson observations, evaluations and reflective commentaries. It is beyond the scope of this paper to give a full account of this research, but extracts bearing on the discussion of Toulmin are presented.

One deliberation that occurred in working with teachers was how they might respond to the introduction of Toulmin's definition of argument. Having used TAP as an analytical tool for research purposes, it was envisaged that teachers' understanding of argument might be enhanced if they too used TAP as an analytical tool. In one session they were presented with a series of arguments such as *'Manchester United are a better football team than Arsenal. They have won more football matches at home and away because their players have superior skills.*' They were asked to identify components of the argument using Toulmin's model. The researchers' analysis would be (from Osborne, Erduran, and Simon 2004b):

- Manchester United are a better football team – claim
- They have won more football matches - data

- Their players have superior skills - warrant

Audio-recordings showed that teachers were unsure of the distinction between data, warrants and backings, a response that reflected the ambiguities identified in using TAP as an analytical tool in research. However, using TAP presented the teachers with a perspective on argument of claims being supported by grounds (data, warrants, backings). In later discussions teachers reported using the Toulmin perspective on argument to inform their pedagogical strategies. For example, one teacher introduced the meaning of argument by presenting students with two arguments, one involving a simple claim, the other a claim supported by evidence in the form of data and warrant. She asked students to judge which of the two arguments was the stronger and why. The students focused on the existence of reasons and the teacher used their responses to highlight the importance of evidence in argument. The analytical process had helped her to conceptualise argumentation in a way that informed her practice.

The researchers also introduced the 5-level system (Erduran, Simon, and Osborne, 2004; Osborne, Erduran, and Simon 2004a) for analysing argumentation discourse and exemplified its application to transcript data. To encourage counter-argument, where an opposing claim and grounds are presented, and the use of rebuttals, where the data and warrants of original claims are opposed, teachers were introduced to strategies that they could use to involve students in a conflict situation (e.g. a pair taking one position in an argument working with a pair taking an opposing position). Such activities resulted in teachers problematising a distinction between counter-argument and rebuttal. They were provided with a definition of counter-argument as a counter-claim with grounds (data,

warrant, backings), and a rebuttal as opposition to the data or warrants of an opposing claim. For example, with reference to the football team argument, a rebuttal of the data 'they have won more football matches', was 'not in the last month of this season', whereas a counter-argument was 'Chelsea are a better football team as they play in international competitions'. Here the data for the counter-argument are not related to the data or warrant of the original argument. Teachers were initially confused by this distinction, but the discussion led to some critical commentary on the value of identifying rebuttals as a measure of quality, as rebuttals help to sustain argumentation and stimulate further justification of claims.

Analysis: the example of Alice

Through analysis of the portfolios and listening to teachers' discussions based on their reflections, the researchers found that teachers used the Toulmin model of argument and the 5-level system to explore ways in which students' argumentation could be assessed. One of these teachers, Alice, adapted the level system to simplify it for her own use and to communicate her assessment criteria to students. The following analysis of her portfolio entry and oral contribution shows how she has interpreted argumentation from the Toulmin-based exercises.

Alice's portfolio extract shown in Figure 3 demonstrates how she was trying to use the level system to clarify her own thinking about the quality of argumentation. Alice focused on episodes that she believed illustrated how she had understood the five levels. In her oral account of her practice Alice described how she noted down 'snippets' of

students' spoken arguments as they discussed the use of genetically modified foods, and explained how she then applied the 5 levels of argumentation as she analysed the discourse. Her approach was to first 'get my head around the levels' by posing questions that could be addressed in her mind as she listened to students' discussions. Her questions included 'How are the arguments justified?' 'What sources of evidence have they used?', 'Is this evidence good for the claims made?' These questions show that she was as concerned about the nature of evidence as well as its existence, though she did not acknowledge that using the level system would not be addressing such questions.

[Insert Figure 3 here]

Alice considered her analysis of Level 1 argumentation as unproblematic, but she expressed her confusion when recounting the Level 2 example. She had identified Vincent's statement 'Well, I haven't died' as a warrant for his earlier implied claim that GM food is all right when he says 'I eat GM food' (data), but was unsure whether Vincent's statement really was a warrant. Moreover, the statement by Jake 'But you don't know if it's doing something inside' was not initially recognised as a rebuttal, but then Alice realised it raised questions about the weakness of the grounds used by Vincent, so eventually she decided that this argument was an example of Level 3.

Though Alice used Toulmin terms to show how she had interpreted Toulmin's definition, her use of these terms following Rima's contribution in her Level 5 example (Figure 3) shows ambiguity, as she identifies similar statements about effect on environment/food chain as being distinctly different TAP components, data and warrant.

Moreover, though Alice's final statement shows how she has defined a good argument in terms of using evidence, she has not extended this definition to the use of rebuttals, which raises questions about her interpretation of the importance of rebuttals, fundamental to the level system.

Alice's account of her portfolio entries stimulated a discussion on the value of the level system, after which Alice concluded that ' I am not too confident with levelling but by using it I have a better understanding of what a good argument looks like'. She was able to consider the complexity of argumentation by using the level system, which she claimed would help her to improve students' arguments in the future by communicating her evaluation criteria of quality. Even with its limitations, the research tool used for comparing the quality of students' discourse was used by Alice as a means of developing an understanding of the quality of argumentation.

An implication of this research is that the use of Toulmin as a methodological framework for analysing argumentation can provide an influence on classroom practice through professional development informed by research involving this methodology.

Extension of TAP based analysis to new media

A further development has occurred using a Toulmin perspective in the use of argumentation software in more recent study involving a group of four teachers over a period of 18 months. This study focused on the implementation of an ICT development, digalo, that was designed to enhance students' argumentation and assist teachers in their mediation of students' learning.

Digalo can be used on a computer by a small group of students engaged in argumentative activity based on a task or problem. The digalo screen consists of a pad on which discourse can be mapped as argumentation proceeds among the members of the group (see Figure 4). A series of text boxes on the screen represent structural elements of an argument (claim, argument, information, explanation, question); each of these elements is labelled on the tool bar and has a different shape. During a digalo session participants work collaboratively as they choose text boxes and make entries, they link their text boxes with arrows of support or opposition. By using shapes and arrows to build up the map a sequence or chain of reasoning emerges. The end product is an argumentative map with recognisable features of a structured argument, not unlike those of Toulmin's framework. The use of digalo to capture student contributions to argumentation enables the whole process to be visualised by the students, and also saved and analysed for evaluation purposes.

Figure 4 shows a simple map of the argumentation that ensued as two students were asked to debate whether the Atkins diet is safe. In this example the numbered contributions begin at 7, indicating that the users deleted earlier contributions. User Stephanie (diamond) presents a claim that 'The Atkins diet is not safe. It says that you should not eat carbohydrates'. She supports this claim with information box number 8 'Carbohydrates are needed to provide energy for the body', using a solid support arrow. User Chantal (circle) then opposes the claim with an argument 'some carbohydrates are higher in sugar and fat'. Her information to support this argument (box number 11) is 'some people find it harder to burn off the fat from carbohydrates making them fatter', which is also used to oppose box number 8. Further additions to the map show Stephanie

extending her argument with extra information (13), which Chantal then opposes (16), though Stephanie has the last word with her final argument (17).

[Insert Figure 4 here]

The researchers' evaluation of this and other maps generated by students involved the application of the 5-level system derived from Toulmin (Erduran, Simon, and Osborne, 2004; Osborne, Erduran, and Simon 2004a). The shapes that are available to use in argumentative maps are similar to Toulmin's argument components, allowing for cross-referencing between the maps and framework to take place, with some adaptations. Using this level system, the example in Figure 4 would most certainly be level 5, as there are extended arguments and more than one rebuttal (e.g. boxes 10 and 11). Researchers found, however, that digalo argumentation outcomes from other tasks were more frequently at levels 2 and 3, in common with the findings of Osborne et al. (2004a) from their analysis of oral discussion. Students of all ages were good at substantiating their own arguments and asking questions, but sequences involving rebuttals were less apparent. Applying TAP to the digalo maps appeared to be more straightforward than to oral discussion because students have already identified argument components in digalo and lines of support or opposition. However, the analysis has to take into account students' interpretation of digalo icons, which was not consistent between students.

To help teachers incorporate the use of digalo in their science teaching and to develop a pedagogy of argument using digalo, a series of workshops took place based on similar lines to those described above from Simon & Johnson (2008). Teaching scenarios were

co-constructed by researchers and teachers, each scenario using the digalo tool to enhance argumentation practices.

In a large class where students are engaged in oral discussion, it is difficult for teachers to be aware of the quality of argumentation in each group. The visualisation provided by digalo enables teachers to see how students are contributing to discussion, as well as enabling them to revisit and refine arguments in the light of further evaluation. The research reported here was limited in terms of such follow-through but future research could incorporate more evaluative work, and explore the possibility of using Toulmin's framework in teachers' evaluation and modelling of argument using digalo. Digalo enables the researcher or teacher to see how the use of rebuttals is incorporated, and thus how students might be encouraged, through task modeling, to enrich their argumentation.

Discussion

Toulmin's framework has provided researchers with a theoretical perspective on argument that involves conceptualising argument in terms of linked components. The advantage to researchers of adopting this framework is that it can be used to assess the quality of argumentation in terms of identifying the number of components, hence the complexity of the arguments used. In this way TAP can be applied to written argument and transcripts of oral discussion. Limitations of the framework are that claims are sometimes implicit in argumentation discourse and have to de deduced, plus identifying data, warrants and backings can be ambiguous. Moreover, by focusing on the structure of

arguments, researchers do not explore the content of argumentation, so this perspective has limitations for evaluating the quality of evidence.

Such limitations become more apparent in developing teachers' practice in the use of argument as they are concerned with examining the nature of evidence in students' arguments. However, for teachers who are inexperienced in teaching argument, Toulmin's framework provides a means of modelling argument for students, by focusing on components and links they can emphasise the use of evidence.

The introduction of Toulmin's framework to teachers needs to be carefully considered by researchers. Early introduction of such a framework, without contextual preparation in terms of developing a rationale for teaching argument, strategies for using discussion activities and organisation of small groups, was found to be inappropriate. Teachers do not see the point of the framework until they have practised and reflected on using argument in their teaching. Once there is a perceived need to assess student outcomes of argumentation activities and provide model arguments to help students evaluate their own arguments, then Toulmin's framework is a useful basis for communicating the meaning of argument and evaluating student outcomes.

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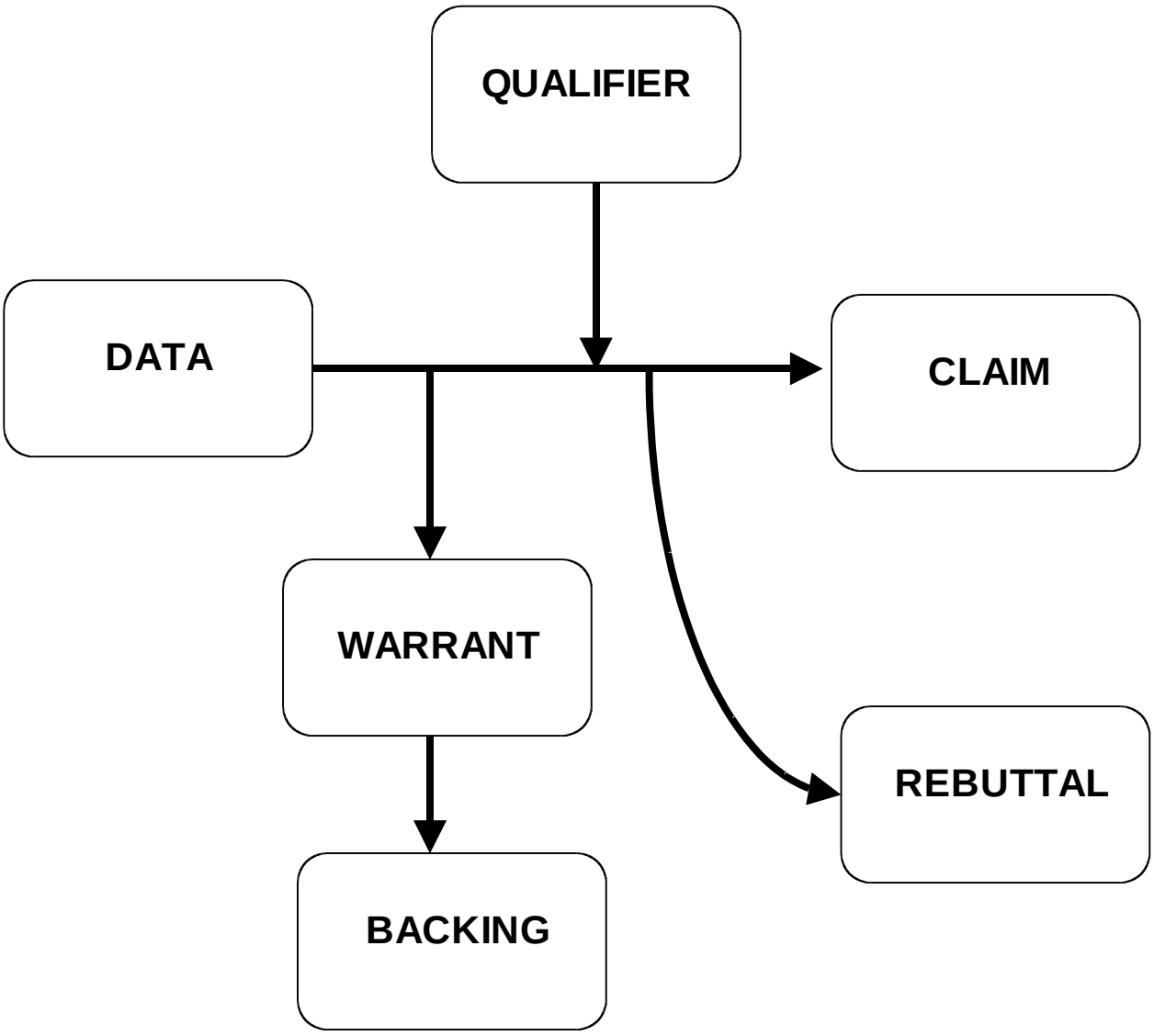
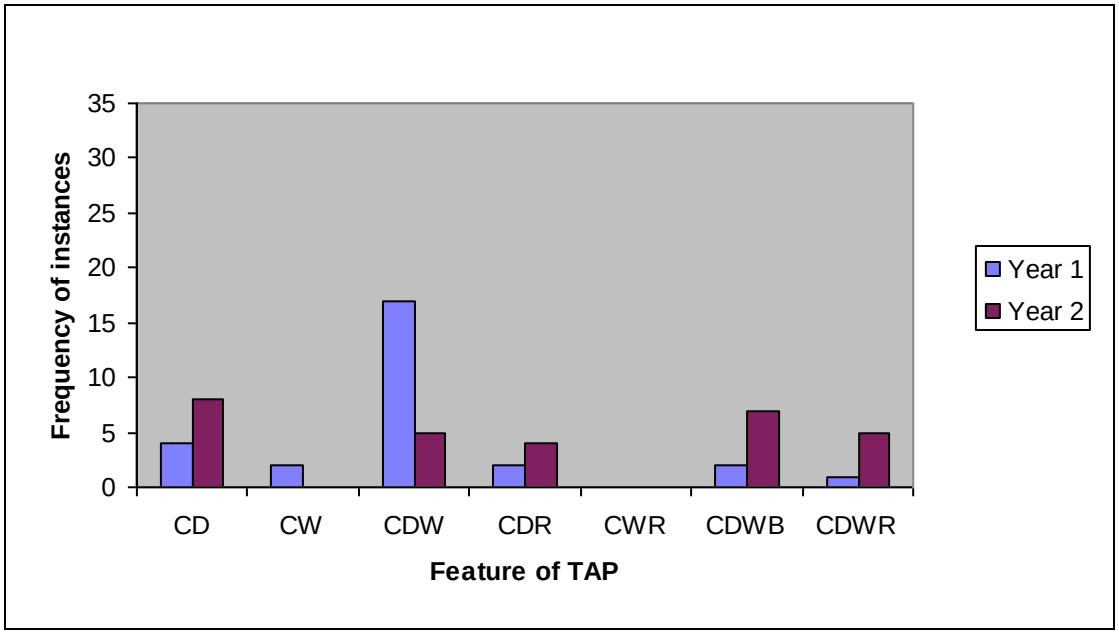


Claims:	Assertions about what exists or values that people hold.
Data:	Statements that are used as evidence to support the claim.
Warrants:	Statements that explain the relationship of the data to the claim.
Qualifiers:	Special conditions under which the claim holds true.
Backings:	Underlying assumptions that are often not made explicit.
Rebuttals:	Statements that contradict either the data, warrant, backing or qualifier of an argument.

Figure 1. Toulmin's Argument Pattern (Toulmin, 1958).



Key: C = Claim; D = Data; W = Warrant; B = Backing; R = Rebuttal

Figure 2. Year 1 versus Year 2 for one teacher: From Simon et al 2006, p 245

In this lesson the focus has been 'Evaluating argument'. I am looking at how argument can be assessed. I have chosen to focus on spoken argument during class discussions. The 'Level of argument' sheet was used to identify claim, data, warrants and rebuttals in pupils' conversations. What follows is an attempt to analyse particular parts of the lesson that I recorded in writing.

Level 1	*Fateha*	*I agree with it*
	John	*No it's bad*
	Fahmida	*I don't know*
	John	*It's bad, I know*

This shows a claim from Fateha. John just disagrees - a counter claim. Fahmida doesn't help. John repeats what he had said before, but still doesn't explain why.

Vincent	*I eat GM food and you do too*
Sabena	*Don't say that, it's not true. Anyway how do you know what I eat?*
Vincent	*……said it's in loads of food, like veg.*
Sabena	*I don't like veg.*

Vincent seems interested in discussing a social implication of the presence of GM but Sabena took offence and defended herself. This is another example of a low level argument as it is simply claim versus claim.

Level 2	Jake responded to Vincent	
	Jake	*So this means it is bad for health because we are eating it*
	Vincent	*Well, I haven't died*
	Jake	*But you don't know if it's doing something inside.*

This conversation shows a claim by Jake followed by Vincent backing his claim with 'weak' data – 'Well, I haven't died'.

Level 3	*Fateha*	*We can have more food and people need it.*
	John	*But it's bad because it's not natural*
	Fatena	*What, plants or genes?*
	John	*No changing it like that*
	Fatena	*And it grows quicker*
	John	*Because you can't change it back*

John has included a rebuttal – 'changing genes' is not 'natural' and implies danger when he adds the data 'because you can't change it back'. However, it doesn't carry much

weight. John does not explain fully how his evidence related to his argument, so I assume it to be a Level 3.

Level 4 Luke steps into the conversation between Fateha and John, in support of John.

Luke *Yeh, its like sometimes the changes can do a bad thing, like getting it to be bad for the soil, or it makes it dangerous and if that happens it spreads and you can't stop it.*

Luke reiterates what John said but makes a stronger rebuttal this time.

Level 5

John *GM food is not good*

Fateha *I don't think so*

Fahmida *It affects wildlife like insects so it has to be bad because of the food chain, so it will have an effect on the environment like more or less animals. It depends .*

Fateha talks to Rima to get her on side –

Rima *Look, it says that more people can eat because it grows better, I don't know, so then the land will be less damaged because you have to grow less. And this is done so it doesn't get diseases and that.*

The discussion starts with a simple claim 'it's not good' vs counter claim by Fateha. Fahmida offers data – it affects the environment, and also a warrant – because it affects the food chain causing an imbalance. Rima supports Fateha with a rebuttal – it will affect the land less because you have to grow less and there is less chance of the plant being diseased.

The challenge presented in an argumentation lesson is to make an effective argument – where all its components are present. It is important for pupils to offer reasons – data – to support their claim and, if they do not agree with the counter claim they should be able to work through the other's thinking to find out exactly why it is they don't agree with it. A good argument is valid and connects the claim and conclusion by using evidence. To evaluate argument I have focused on pupils' conversations during a class discussion.

Figure 3. Alice's analysis of students' transcribed spoken arguments. From Simon & Johnson, 2008, p 679

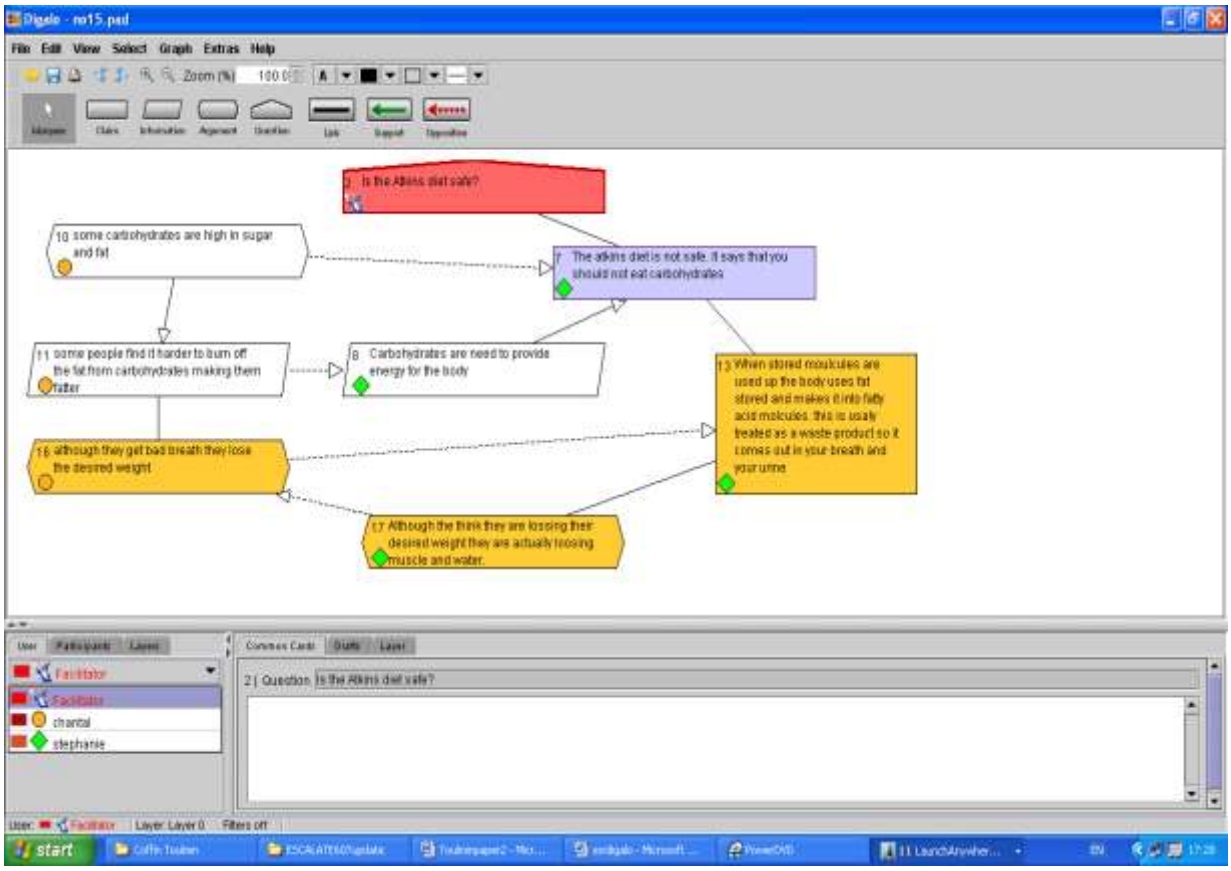


Figure 4 Digalo map for a debate about the safety of the Atkins diet

Table 1 Analytical framework used for assessing the quality of argumentation (From Erduran et al. p 928)

Level 1	Argumentation consists of arguments that are a simple claim versus a counter-claim or a claim versus a claim.
Level 2	Argumentation has arguments consisting of a claim versus a claim with either data, warrants, or backings but do not contain any rebuttals.
Level 3	Argumentation has arguments with a series of claims or counterclaims with either data, warrants, or backings with the occasional weak rebuttal.
Level 4	Argumentation shows arguments with a claim with a clearly identifiable rebuttal. Such an argument may have several claims and counterclaims as well.
Level 5	Argumentation displays an extended argument with more than one rebuttal.