

A comparison of epistemic features of student and teacher talk during argument-based instruction

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1. Introduction and Aims

Current perspectives in science learning and instruction emphasise that students should not only be aware of 'what we know' but also of 'how we know what we know and why we choose to believe it over alternatives' (Duschl, 2008). Thus, science educators need to address the epistemic nature of scientific practices and knowledge. This study argues that a way to foreground the epistemic aspects of science is to teach science as argument (Kuhn, 1993; Driver, Newton & Osborne, 2000). *Argumentation* is an integral part of the epistemic practices of science, which are 'specific ways members of a community propose, justify, evaluate, and legitimize knowledge claims' (Kelly, 2008). Accordingly, within science education, practices such as the epistemic justification for how we know what we know, how scientists use facts to construct knowledge, and the ability to evaluate claims and construct counter-arguments, should be presented to students. Through the use of argumentation to teach science, *epistemic discourse* can be developed; however, this way of talking science needs to be promoted and established by teachers, who have to be aware of ways to establish this type of talk in their classrooms. The aim of this study is to investigate teacher talk during argumentation instruction, and compare that to the students' talk during the same lessons, in order to determine the extent to which students and teachers engage in epistemic discourse, and the similarities and differences that this student and teacher discourse entails.

2. Study Design, Sample and Methods

- case study design to explore 'a contemporary phenomenon within its real-life context' where 'the boundaries between phenomenon and context are not clearly evident' (Yin, 2003).
- one experienced male teacher & a mixed-ability class of 27 Grade 8 students (11 girls, 16 boys) from which a representative group (gender, attainment, interest in science) of 4 students (2 boys, 2 girls) was selected by the teacher for observations
- 6 argumentation lessons across a school year
- Participant observation (field notes and video-recordings of teacher and students)

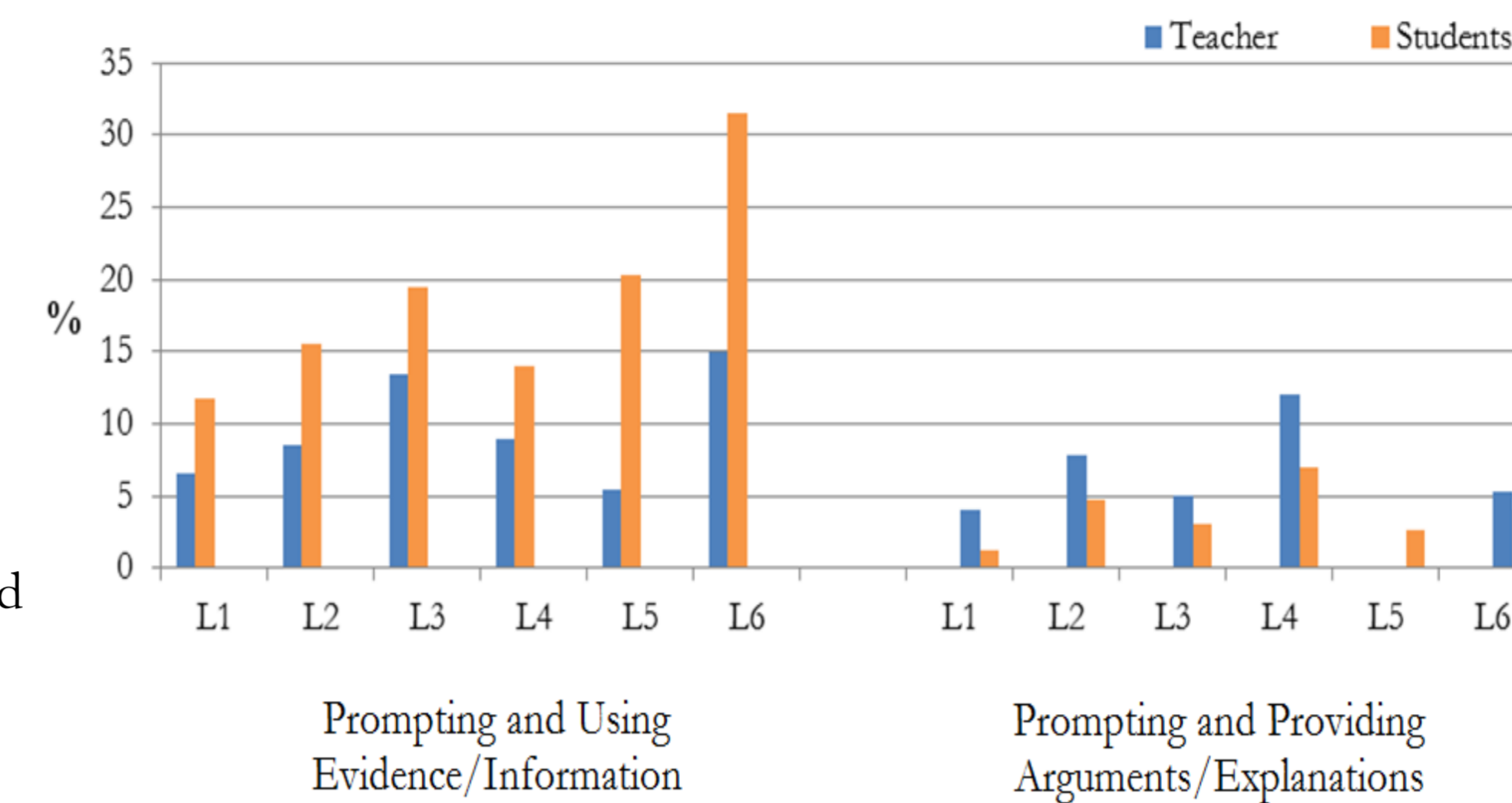
3. Analysis

- Thematic analysis based on a framework of **epistemic operations** such as describing, explaining, arguing, counter-arguing etc. (Jiménez-Aleixandre et al., 2008; Ohlsson, 1996). Epistemic operations are the *discursive and cognitive actions* undertaken by teachers or students, whose function is to promote the creation and development of knowledge and understanding.
- The teacher's classroom discourse was organised based on the epistemic operations he **performed** and the epistemic operations he **prompted** students to use.
- The students' talk was organised based on the epistemic operations they **performed** or **requested** from other students or their teacher (e.g. 'Requests Justification').

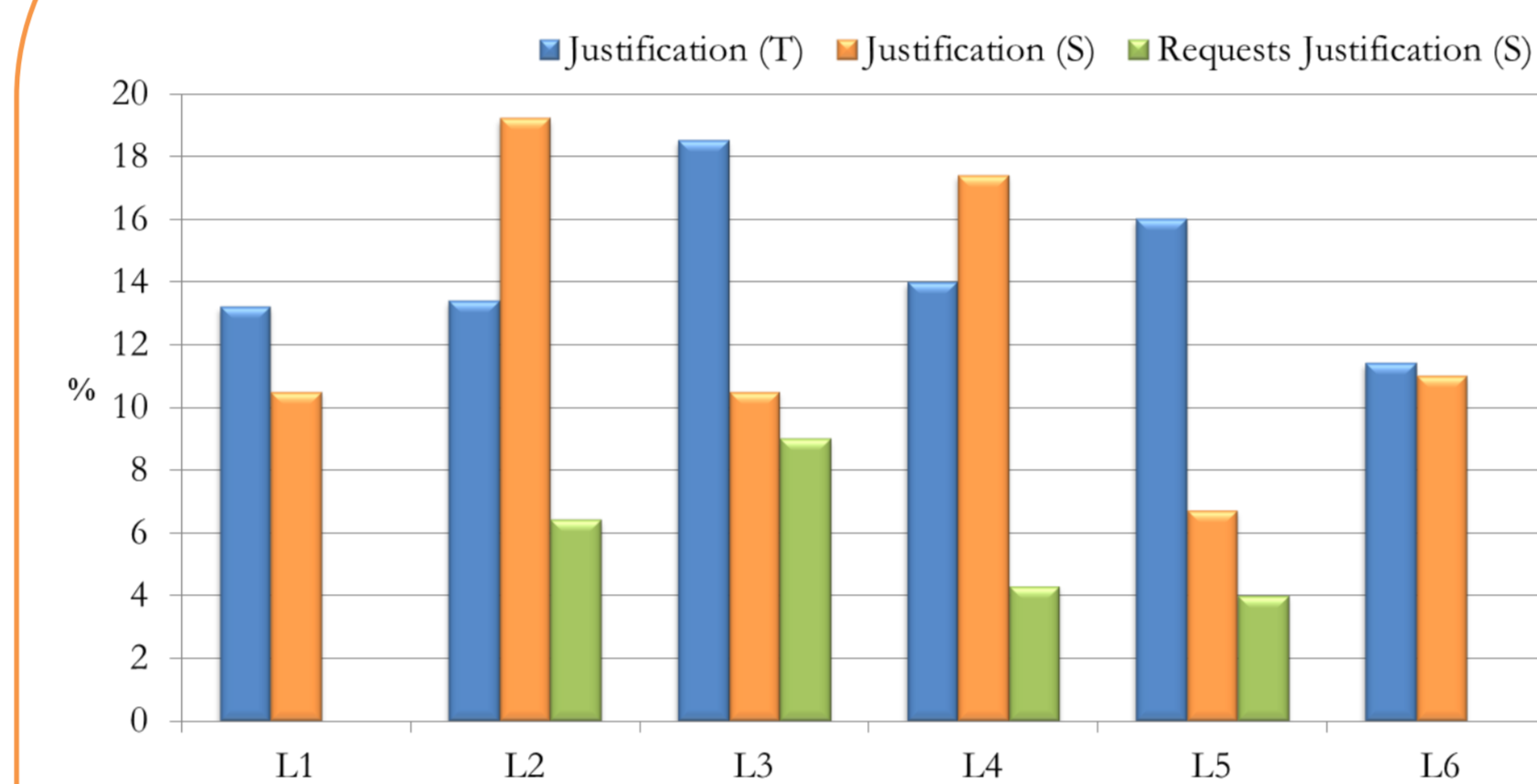
4. Findings

Constructing knowledge claims

- The teacher's increased focus on prompting for specific epistemic operations was reflected in the students' use of these epistemic operations (Providing Evidence, Argument, Explanation).
- 'Prompts for Argument' was not a prevalent epistemic action in all lessons; accordingly, students would 'Take or Propose Positions' but would not always engage in 'Argument'.



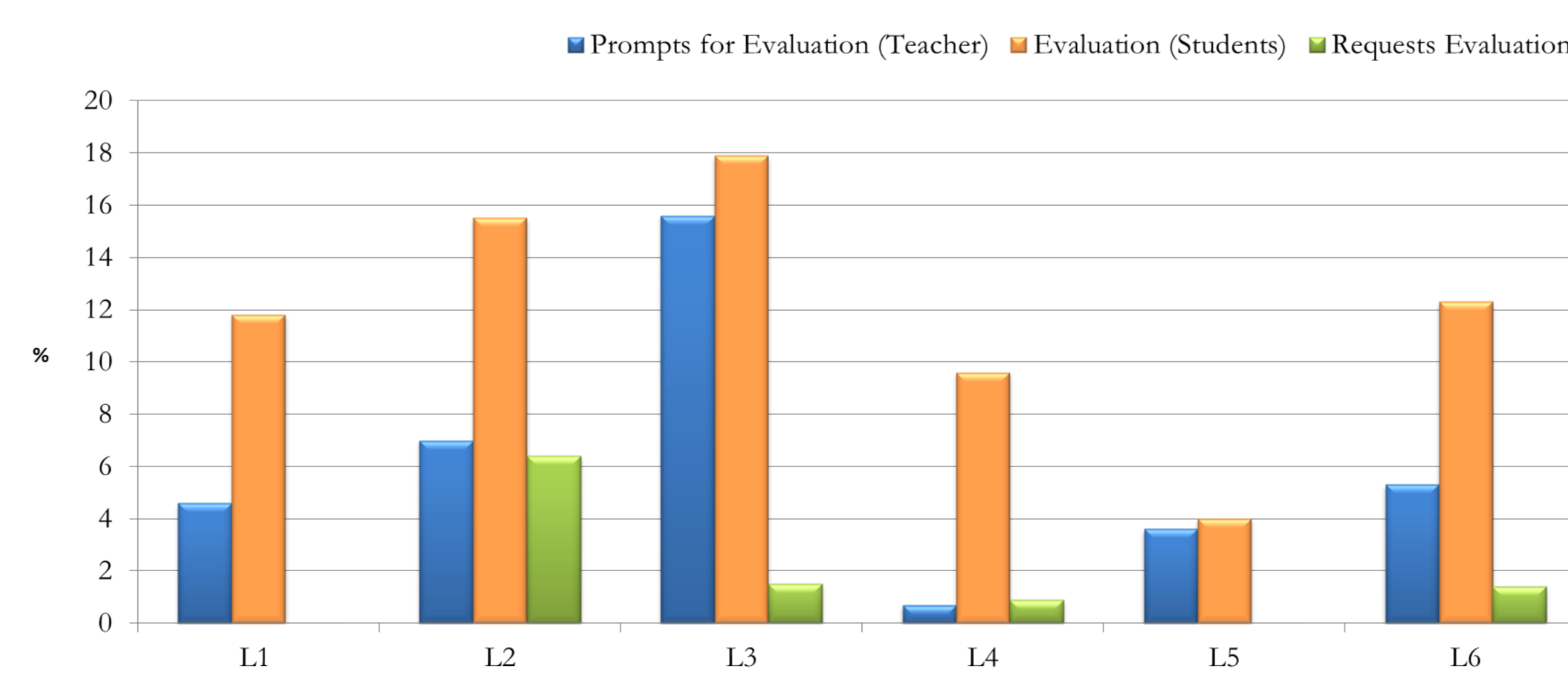
Justifying knowledge claims



- The teacher's use of justificatory talk was consistent in the lessons; students also used justification consistently in their discussions.
- 'Requests Justification' was present in lessons that the *design of activities and use of artefacts* also promoted justificatory talk.

S9: Basically pesticides are bad for you.
S10: Yeah they can kill you.
S6: And it takes longer,
S10: Yeah, but we have to have evidence.
S11: Why?
S9: Why? Because look, pesticides may cause brain and nerve damage,
S6: And it takes longer to digest.
S12: Yeah.
S11: Yeah but you have to expand on it, you can't just read off the statement.
S9: Yeah but still it's bad.
S6: And if [inaudible]
S11: So if you're pregnant and you eat pesticides then the baby will get them as well.
S9: Yeah because if you eat them you are giving them to the baby as well. If you had a cow and the cow ate the, and then you ate the cow you will have pesticides inside of you.

Evaluating knowledge claims



- During the lessons that the teacher used the most 'Prompts for Evaluation' the students also utilized the epistemic operations of 'Evaluation' and 'Requests Evaluation' in their group work (L2).
- 'Requests Evaluation' was also facilitated by the worksheet that students used, which asked them to make an evaluative judgment and then provide reasons to support it.

The net force is always in the same direction as the ball is moving:
true or false?

James: Did you ask me something?
S4: Yeah, will that be true?
James: Why do you think that's true?
S4: Cause the net force is in the same direction as the ball [inaudible]
James: Is it?
S4: I don't know.
S3: I said false.
James: So you don't agree. Why do you think it's not true?
S3: Because the overall force and that includes air resistance and all that, so when it's in the air, there is air resistance and air resistance isn't going to the way that the ball is moving'

5. Conclusions and Implications

- 'Requests Evaluation' and 'Requests Justification' are metacognitive and reflective in nature, and a sign of 'epistemic thinking' (Mason & Boldrin, 2008). Students in this study, were able to use this way of talking but this depended on their teachers' prompts and the design of the lesson.
- The students' classroom talk during the six argumentation lessons observed would suggest that:
 - (a) Students were able to engage in epistemic talk, as shown through their use of justificatory and evaluative comments.
 - (b) Students did not always justify their ideas, unless this action was facilitated by the teacher or a prompt such as a worksheet, and/or the students were secure about their content knowledge.
 - (c) The epistemic talk that took place during argument-based instruction was *context-specific*, as the aim of each lesson provided a focus for the types of talk that developed.
- Science teachers should focus on the use of specific talk moves such as prompting students for evaluation, justifications, comparisons and counter-arguments in order to assist their students engaging in epistemic discourse, which is argued as an essential element of the development of students' understanding of epistemic aspects of science (Sandoval & Morrison, 2003).
- The importance of the context for the facilitation of epistemic processes such as evaluation suggests that further research in developing in-service teacher's ability to design suitable materials for the teaching of science as argument, is required.

6. References

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