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# PRE-SERVICE SCIENCE TEACHERS' USE AND REFLECTIONS ON A MODEL FOR ASSESSING SOCIOSCIENTIFIC ARGUMENTATION

*Teaching socioscientific argumentation (SSA) is a challenging task. One difficulty is the assessment of students' performances. Based on an earlier framework for teachers' assessment of SSA (TAF), we developed a model called Practical Assessment of Socioscientific argumentation Model (PASM). The aim of this study is to present PASM and explore how pre-service science teachers (PSTs) develop their skills in assessing SSA by using PASM. Ten science PSTs were asked to prepare arguments for and against the use of nuclear power and GMO. PASM comprised several rounds where the PSTs (divided into small groups) argued in favour of, or against, the topic discussed, or acted as examiner assessing the argumentation. After the PSTs had tried all roles, including regular discussions where the examiner gave feedback to those arguing, the SSI shifted from nuclear power to GMO and the whole cycle was repeated. Data were collected as audio-recordings of the group discussions, field notes taken by both authors during joint discussions and PSTs individual written reflections, and were analysed using thematic analysis. Six main themes and several subthemes were identified in the data analysis: focus in the assessment, the tools in PASM such as the matrix and TAF, the nature of PASM, such as the roles and iterative cycles, and coping strategies. The exercise made PSTs aware of the quality criteria that should be included in assessment of SSA. The nature of PASM, with its iterative cycles and repeated reflections, expanded PSTs view of SSA assessment, which showed a progression through the different stages of data collection. We conclude that it is of great importance to include training assessment of SSA in teacher education and that using the PASM model could be one way of doing this.*

*Keywords*: SSI, argumentation, assessment

## INTRODUCTION

Argumentation is at the core of the production of scientific knowledge (Jiménez-Aleixandre & Erduran, 2008) and including argumentation in science education can promote students' understanding of nature of science (NOS) and scientific literacy (Zeidler, 2014). Teaching socioscientific argumentation (SSA) is a challenging task and one of the most noted difficulties include the assessment of students' performance (Christenson et al, 2017). Several challenges have been identified, e.g. teachers epistemic view of SSI teaching as instrumental, leading to a predominant focus on content knowledge, excluding other important aspects such as values and argument structure (Tideman & Nielsen, 2017). However, research on teachers' assessment of SSA is limited and called for (e.g. Evagorou & Nielsen, 2019). Based on TAF, which is a hierarchically framework showing components corresponding to quality criteria in SSA (Christenson & Chang Rundgren, 2014) we developed a model (including an assessment matrix) for teachers to train assessment of SSA, called Practical Assessment of Socio-scientific argumentation Model (PASM) and allowed pre-service teachers (PSTs) to test and reflect on using the model.

### *Key objectives*

The aim of this study is to present a model, Practicing Assessment of Socioscientific argumentation Model (PASM) developed for teachers to train assessment on SSA and explore if and how PSTs develop their skills in assessing SSA.

The research questions are:

1. What are the characteristics of a model (PASM) designed to promote the skill of assessing SSA in science education?
2. How does PASM affect pre-service teachers' competences in assessing SSA?

## METHOD

Ten PSTs volunteered to participate in this study and took part in the assessment training. PASM comprises five phases A-E (Table 1). After a preparatory phase (A) PSTs engaged in an assessment session (B) where the they were given roles to argue in favour of, or against, the first SSI (nuclear power usage), or the role as examiner providing feedback to the other roles. After the PSTs had tried all roles, an evaluation including a joint discussion took place (C). Thereafter, the SSI shifted to GMO and the process wasrepeated (D), followed by a meta-evaluation including all participants writing individual reflections (E).

**Table 1.** PASM. *Data collection.

| **Phase** | **Activities** |
|---|---|
| A Preparation. | 1. PSTs watch video-recorded lecture.<br>2. PSTs read provided literature.<br>3. PSTs prepare arguments (pros and cons) about SSI.<br>4. Lecture on how to conduct the assessment and argumentation practice and use of the matrix. |
| B. Assessment of SSA. | 5. Iterative cycles with assessment of short debates (5 minutes). PSTs are divided into groups of 3-4. First theme discussed: nuclear power. All PSTs try all roles (pro, con and assessing). After each round, PSTs acting as examiner provide short formative feedback to the others. |
| C. Evaluation. | 6. When all PSTs have tried all roles a group discussion* is conducted evaluating the experience.<br>7. Joint discussion* with all PSTs about the experience. |
| D. Repetition. | 8. Steps 5-7 are repeated with new SSI being discussed. |
| E Meta evaluation. | 9. A few days after the workshop, PSTs write individual reflections* about the whole process, evaluating the PASM. |

Data were collected as audio-recordings of the group discussions, field notes taken by both authors during joint discussions with PSTs, and PSTs individual written reflections. A thematic analysis (Braun and Clarke, 2006) was conducted, searching for themes related to the issues identified as especially challenging in assessing SSA. We were also interested in PSTs reflections on whether the exercise using PASM helped them to practice assessing SSA and if so, how.

## RESULTS

Six main themes and several sub-themes were identified in the data analysis: **focus in the assessment**, the tools in PASM such as **the matrix** and **TAF**, the nature of PASM such as the **roles** and **iterative cycles,** and

**coping strategies.** Regarding focus in the assessment and the challenges with assessing both structure and content of the SSA, the PSTsreported that they mainly focused on content (in line with earlier findings e.g. Christenson, et al, 2017) and noted the importance of being knowledgeable about the SSI. PSTs reported a difference in focus between the two cycles, in the first they solely focused on content knowledge. In the second, following the joint discussion, they also included additional aspects such as values and argument structure in their assessment. Overall, they appreciated that the cycles were repeated and felt more comfortable assessing the second round. In particular, the change of roles, as well as the short feedback sessions in every cycle were identified as important. Several PSTs wanted to develop the matrix further, constructing their own version. They suggested that the matrix could be prepared with important concepts that were expected to be used by students during their argumentation. Regarding content and structure of SSA, the PSTs recognised that the choice of SSI could be more spontaneous and based on students' interests when focusing on structure alone, since the structure of arguments is context free regarding quality.

## DISCUCCION AND CONCLUSIONS

PASM presented PSTs with a strategy and a tool for how to assess the learning objectives related to SSA, something that has been found as lacking among teachers (Evangorou et al. 2011; Tideman & Nielsen, 2017). The exercise made PSTs aware of the quality criteria that should be included in assessing SSA. Furthermore, the nature of PASM with its iterative cycles and repeated reflections expanded PSTs' view of the SSA assessment. This was shown as progression in the PSTs' reflections through the different stages of data collection. However, although presenting coping strategies for their future assessment practices as teachers, PSTs' discussions indicated that they do not fully understand the full potential of including SSI in the science classroom and pursuing a SSI driven curricula. We conclude that it is of great importance to include training in assessment of SSA in teacher education and that the PASM model could be one way of doing this. The PASM could also be developed and used in formative assessment practices regarding SSA in the science classroom.

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