OPPORTUNITIES AND CHALLENGES WITH STUDENT-FACING LEARNING ANALYTICS: A STUDY EXAMINING WHETHER META-COGNITIVE STRATEGIES CAN BE SUPPORTED BY MACHINE-LEARNING

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ABSTRACT
Metacognitive strategies help students reflect on their own learning and develop capacity for higher level skills. To become lifelong learner, it is important to manage your own learning instead of passively absorb information. An emergent technology in K12 education is to use student-facing learning analytics, but the use of algorithmic decision-making can be imprecise since these datasets often lack contextual input from authentic school settings. The Swedish National Agency for Education (2020) reviewed the trend on AIpowered tools since rule-based decision support systems now are shifting to algorithmbased. Machine-learning is a sub-set of artificial intelligence that allows machines to learn from data without being programmed explicitly and *supervised learning* use labelled datasets that train algorithms to classify data or predict outcomes accurately. One of the authors behind the review, Martin Tallvid is co-investigator in the research project *"The Missing Teacher In AI: Involving Teachers in Metadesign of AI to Ensure FAIRness"* (University of Gothenburg, 2021). These sources highlight that learning processes and values in schools should guide the construction of datasets in order to increase relevance, build trust and prevent structural biases.

Universal Design for Learning (UDL) developed by Center for Applied Special Technology, is a curriculum design framework incorporating cognitive neuroscience. The learning process executive function has been linked to the prefrontal cortex region of the brain, that is used to set long-term goals, develop metacognitive strategies, and monitor progress to make decisions. The UDL framework approach *capacity for executive function* in two ways: 1) by scaffolding lower-level skills so that students require less executive processing; and 2) by scaffolding higher-level executive skills and strategies so that students are more effective and autonomous during learning (CAST, 2008). This is an instructional design theory with a cognitive constructivist perspective that focus on how our brain process generic concepts as mental data structures called "schemas"(Smith & Ragan, 2004).

This introduction has presented the problem that algorithmic decision-making in AIpowered tools lack contextual input from school settings. The Universal Design for Learning framework promote a student-centred approach with guidelines for how

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metacognitive strategies develop capacity for higher level executive skills. The main objective of this study is to understand how classroom activities are used to develop these metacognitive strategies with focus on self-reflection. The hypothesis is that further understanding of the teachers' implicit decisions for classroom activities create International Symposium on Digital Transformation, Feb 15-16, 2022 opportunities and challenges for student-facing learning analytics. Following research questions will be analysed using repertory grid technique (Kelly, 1955):

RQ1: What emergent constructs show commonality and what elements show relations in classroom activities involving self-reflection?

RQ2: Can the elicitated constructs be used for an ontology-based knowledge representation that enable supervised machine-learning?

Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources (Hlynka and Jacobsen, 2009). This is a cross-disciplinary study between Applied Educational Science and Data Science, which are branches of the research area *Educational Technology*. The purpose of this study is to create structured educational data sources from semantic tagging and annotation from authentic classroom activities involving self-reflection. The article "*Big data comes to school: Implications for learning, assessment, and research*" (Cope and Kalantzis, 2016) confirms that context-dependent machine annotation can add precision and also claim that semantic tagging can specify precise meanings against domain-specific taxonomies and ontologies.

The repertory grid is a structured interview technique that extracts internalised 'personal constructs', i.e., what people think about a given topic (Gkatzidou, Giacomin and Skrypchuk, 2021). During the initial planning of the study, it was concluded that semantic annotation and tagging of classroom activities is hard to elicitate in half an hour. To develop an objective understanding teachers' individual meaning-making, similar to individual grounded theory, the repertory grid technique was chosen as methodology. The data collection from participating teachers was done by snowball sampling with invitation of nominated recipients over e-mail with a link to a registration form. The prerequisite was that participants are working as K12 teachers in the Swedish school system and has experience of Universal Design for Learning. Due to COVID-19 regulation the interview was performed as a videoconference with access to a shared whiteboard. The interview had three steps that each were allocated ten minutes and the collected data was verified and approved by the respondent. During the element elicitation the participant selected a series of classroom activities (i.e., *elements*) that were representative for metacognitive strategies with focus on self-reflection (i.e., topic). The next step is to elicit their personal perception, where the properties of three elements (i.e., triad) are described as shared by two of them but not the third element. Then, the participant was asked to state the opposite of this property, which became a bi-polar scale called a construct. These are identified as rating attributes that are emergent (marked with 0) as preferred or contrasting (marked with X) as not preferred, to be

used for *rating* of the classroom activities in the final step of the interview. After the interview participants were also asked to comment on the patterns that appeared in their answers.

The preliminary results indicate that the repertory grid technique can be used to understand teachers' individual meaning-making related to classroom activities involving self-reflection. The practise interview show that constructs can show commonality and elements can show relations. This interview also display that the participant preferred the element "reflective question" and was least fond of "reflective journal" (fig. 1).

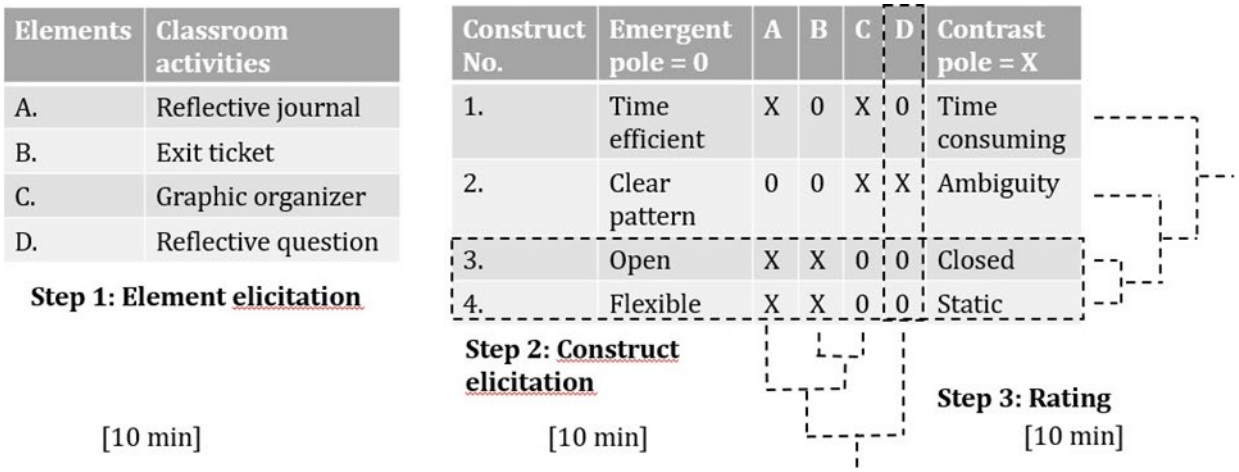

Fig. 1: Results from practice interview with repertory grid technique

The eyeball inspection can be extended with cluster analysis and sematic analysis to statistically study commonalities between constructs or relations between elements. Also, tree diagrams can visualise these relationships and communalities which could be used in decision support systems. There are several implications when the collected data comes from a small group of in-service teachers expressing their own personal constructs. The contribution to the research in educational technology is hopefully to emphasise user- centred design for AI-powered tools (i.e., co-design with practitioners). The results will be used in a research project with a design thinking approach that is part of my participation in the master's programme in educational technology with specialisation in pedagogy at Linnaeus University (2019).

Keywords: metacognitive strategies, self-reflection, repertory grid, student-facing learning analytics, supervised machine-learning

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