

Facilitating Written Biology Assessment in Large-Enrollment Courses Using Machine Learning

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Abstract : Writing is an essential scientific practice, yet, in several countries, the increasing university science class-size limits the use of written assessments. Written assessments allow students to demonstrate their learning in their own words and permit the faculty to evaluate students' understanding. However, the time and resources required to grade written assessments prohibit their use in large-enrollment science courses. This study examined the use of machine learning algorithms to automatically analyze student writing and provide timely feedback to the faculty about students' writing in biology. Written responses to questions about matter and energy transformation were collected from large-enrollment undergraduate introductory biology classrooms. Responses were analyzed using the LightSide text mining and classification software. Cohen's Kappa was used to measure agreement between the LightSide models and human raters. Predictive models achieved agreement with human coding of 0.7 Cohen's Kappa or greater. Models captured that when writing about matter-energy transformation at the ecosystem level, students focused on primarily on the concepts of heat loss, recycling of matter, and conservation of matter and energy. Models were also produced to capture writing about processes such as decomposition and biochemical cycling. The models created in this study can be used to provide automatic feedback about students understanding of these concepts to biology faculty who desire to use formative written assessments in larger enrollment biology classes, but do not have the time or personnel for manual grading.

Keywords : machine learning, written assessment, biology education, text mining

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