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EDUC795 Learning Analytics

PROBLEM

I aim to use Learning Analytics to improve the learning experience for learners using discussion boards in an LMS, though I use Canvas in my running example and annotations. Though I built examples specific to my asynchronous course on menstrual hygiene management education, the solutions can be adapted across age bands capable of engaging in discussion forums. Instructors often rely heavily on discussion boards as key, if not sole, platforms for collaborative learning. Yet, there are missed opportunities to optimize discussion board posts for productive reflection, especially without criteria that is both scaffolded and adaptive to learners' writing skills and goals.

PROBLEM RESPONSE & OVERARCHING IDEA

I suggest integrating a checklist feature for learners to use while writing their discussion board posts, and this checklist will be used as a diagnostic tool to help auto-scaffold an adaptive rubric. The checklist will serve as a tool to help first identify learners' foundation of forming a written argument using three criteria, starting with: 1) reference to another source, 2) opinion articulation, and 3) use of evidence. The adaptive rubric then targets learners' self-regulated learning skills by prompting goal-setting, and their goals help feed forward into future criteria. This cycle reinforces the process of task performance, self-reflection, monitoring and goal-setting (Zimmerman, 2010)

I consider the checklist a diagnostic tool that can also provide deeper understanding about self-efficacy. I ground this design in Panadero et al.'s (2017) meta-analytic review, which supports the role of self-assessment in improving not only learning performance but also self-regulated learning skills and self-efficacy. Moreover, their review of four studies reveals that gender interacts with self-assessment; girls show greater improvement in self-efficacy than boys after engaging in self-assessment interventions. Given the target audience of my course (though menstruators are not limited to girls and women), I use literature that intersects gender and these three interlinked domains to inform a gender-responsive design.

TASK

A 3-item checklist will prompt learners to self-assess if they have completed all three criteria related to their post content. Then, natural language processing (NLP) will be used to determine if the learner indeed met the criteria. Depending on alignment between learner self-assessment and the NLP assessment, learners will then be led to an adaptive "master list" of criteria to help improve their writing skills within the 3 criteria dimensions. Learners can drag and drop criteria (auto-populated based on the accuracy of their self-assessment) into categories of "Must Haves" and "Amazings," a framework I use from Bondie and Zusho (2018). "Must Haves" represent the criteria that will be used to generate criteria in the next checklist for the next

forum post. The “Amazing” prompts the learner to consider what they would like to include in the future, though this is not appear in the next checklist.

RUNNING EXAMPLE & TASK ANNOTATION

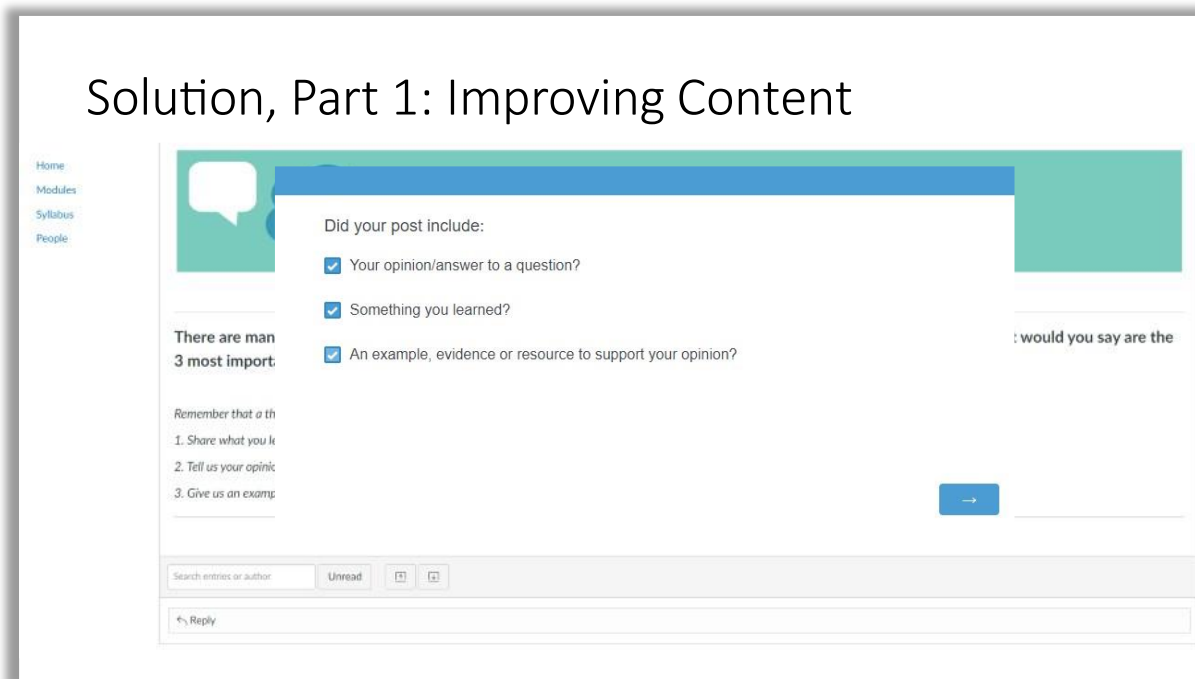


Figure 1 An example of a checklist, the learner’s first environment within the product. This is shared as a link below the discussion forum prompt. Data tracing occurs upon the learner opening the link.

Drag and drop the criteria you would like to include in your next checklist for Discussion Post 2.

Items	Must Haves (at least 3)
Mention a new fact or idea you learned in the video.	
Mention something you read from last week's reading.	
Reference a classmate's opinion or something they have mentioned.	
Describe an example from your personal experience to support your opinion.	
Use the phrase, "For example..."	
Describe an example from the video to support your opinion.	
Start your response with, "Seeing this question reminds me of..."	
	Amazings (at least 1)

Figure 2 An example of an adaptive rubric, the learner's second environment within the product. Items on the left are generated based on data traced from the learner engagement with the checklist, which is cross-checked with the NLP autograder. The items provide specific feedback that the learner can implement as the next checklist's criteria.

Task Engagement In Figure 1, I provide an example checklist. This appears after a learner has opened it (provided through a link in the discussion forum prompt). The checklist serves to help the learner self-assess foundational skills in articulating and structuring an argument. Specifically, the learner has self-assessed that they meet all three criteria. In Figure 2, we see the adaptive rubric that appears after the learner has self-assessed using the checklist and after the NLP autograder has cross-checked the items. Specifically, we can see items corresponding to Criteria 1 ("Does your post include something you learned?") and Criteria 3 ("Does your post include an example, evidence or resource to support your opinion?"). This is because the autograder determined that the learner did not meet these criteria, thus provisioning more specific items that would help the learner toward achieving Criteria 1 and Criteria 3.

Learning Processes The checklist and adaptive rubric are designed to promote self-regulated learning phases. Specifically, the checklist aims to promote self-reflection as it prompts the learner to assess their performance after the discussion forum post task. The adaptive rubric is a tool to promote goal-setting and forethought by prompting the learner to select items from a

master list of criteria and hold them accountable to self-assessing in the future if they have met the criteria in the next post.

What can be traced Specific learner interactions that can be traced include opening the checklist, how many and which criteria were met in the checklist, if these criteria were met in the checklist, and what the items the learner drags and drops into their adaptive rubric. The data tracing within the adaptive rubric help unveil learners' SRL skills, particularly in self-monitoring and goal-setting. It is possible to track what items the learner chooses to improve upon, which can tell us about what feedback they gravitate toward. After goal-setting, we can see how self-monitoring behaviors might change as they may change their self-assessment behaviors, such as spending more time to reflect on their performance before checking off an item.

The data tracing also has the potential to tell us more about the relationships between learner self-assessment, self-regulated learning and self-efficacy. For example, the autograder cross-checking the self-assessment makes it possible to identify learners who overestimate or underestimate their meeting of the criteria. Learners who overestimate may have misconceptions or may benefit from prompting to reflect on what the criteria are asking of them. Trace data revealing that a learner routinely underestimates their meeting of the criteria may similarly be unsure of what is being asked; more deeply though, this learner (or even the class) may benefit from a self-efficacy intervention. In such a case, the autograder may play a significant role in screening for learners who are in fact meeting criteria and writing quality posts but hold the belief that they are unable to do so.

INFRASTRUCTURE

Logging Structure & Documentation ➔

Student ID	Date	Time Stamp	Duration (sec)	Learning Event	Input (checks)	Criteria1_student	Criteria1_autograder	Criteria1_agreement
123456	4/11/2022	1:08PM	0:09	Checklist opened	3	1	1	1
123456	4/18/2022	8:08PM	0:20	Checklist opened	3	1	1	1
123456	4/22/2022	11:56PM	0:19	Checklist opened	2	1	1	1
123456	4/26/2022	12:01AM	0:15	Checklist opened	3	1	1	1
123456	4/30/2022	12:10AM	0:24	Checklist opened	2	0	0	1
123456	5/4/2022	12:11AM	0:10	Checklist opened	3	1	0	0
123456	5/11/2022	12:13AM	0:11	Checklist opened	3	1	0	0
123456	5/18/2022	12:15AM	0:09	Checklist opened	1	1	1	1
123456	5/24/2022	12:20AM	0:13	Checklist opened	1	1	0	0

Figure 3.1 A table for collecting raw metadata about the task, inputs and context for learner engagement within the checklist. This structure continues for Criteria 2 and 3.

Criteria2_student	Criteria2_autograde	Criteria2_agreemen	Criteria3_student	Criteria3_autograder	Criteria3_agreement
0	1	0	1	0	0
0	1	0	1	1	1
1	0	0	0	0	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	1	1	1
1	1	1	0	0	1
0	0	1	0	0	1
0	0	1	1	1	1

Figure 3.2 The checklist infrastructure continues across all three criteria

Criteria3_agreement	Rubric MustHave	Rubric Amazing
0	1, 2, 3	4
1	1, 3, 6	2
1	2, 4	
1	3, 5, 7	2
1	1, 2, 4	3
1	1, 3, 6	5
1	1, 6, 7	2
1	1, 4, 5	
1	2, 5, 6	

Figure 3.3 The end of the table documents the learner selections from the adaptive rubric master items.

Plan to collect metadata about learner task, object, action, context, etc.

In Figure 3.1 and 3.2, I provide a logging structure and documentation for the learning processes that can be traced for one student. The learner's ID, date of learning action, duration, learning event (checklist opened) and number of inputted checkmarks can be traced. We can also trace across all three criteria whether the learner self-assessed if they met the criteria. The autograder's assessment of whether the student has met the criteria is listed next to this. I use a 0 and 1 system, where "0" indicates a criterion is unmet and "1" indicates a criterion has been met. Finally, after the student and autograder assessments are recorded, an agreement is determined using the "0" and "1" notation. A score of "1" indicates that the learner and autograder are aligned in their assessment.

Plan to engineer meaningful features from raw data

The raw data from each criterion's student score, autograder score and agreement score will help derive the adaptive rubric's master list of items. The learner will then use this master list and drag and drop them into the "Must Haves" and "Amazings" fields to track what criteria the learner would like to use to evaluate their next forum post. By using these scores to inform the

master list of criteria items from which the learner can choose, we reduce the degrees of freedom while supporting the learner's choice. This is also a form of hint provision, where the specificity of the master list items helps the learner identify specific phrases or sources to improve their writing.

In the Figure 3.1 annotations, the first row shows that the learner opened the checklist and checked all items on the checklist. This includes Criteria 1, which the autograder also assessed as met, amounting to an agreement score of "1." Moving forward, the adaptive rubric will not include items focusing on Criteria 1, as the learner has sufficient mastery. The last row, however, shows disagreement between the learner and autograder. As such, the agreement score is "0", which prompts the adaptive rubric to feed more items that can help scaffold the learner toward mastery of Criteria 1.

Finally, Figure 3.3 documents data collected from learner engagement with the adaptive rubric. In the first row, the learner chose to use items 1, 2, and 3 in their next checklist. Item 4 was selected to be an "exemplary" goal. This will not be featured in the next checklist, but notes that the learner is thinking about clear, actionable ways to accomplish exemplary work. Where we see that the learner is not selecting a sufficient number of items for the checklist or does not identify "Amazings," this might prompt the instructor to check-in with the learner.

PRODUCT

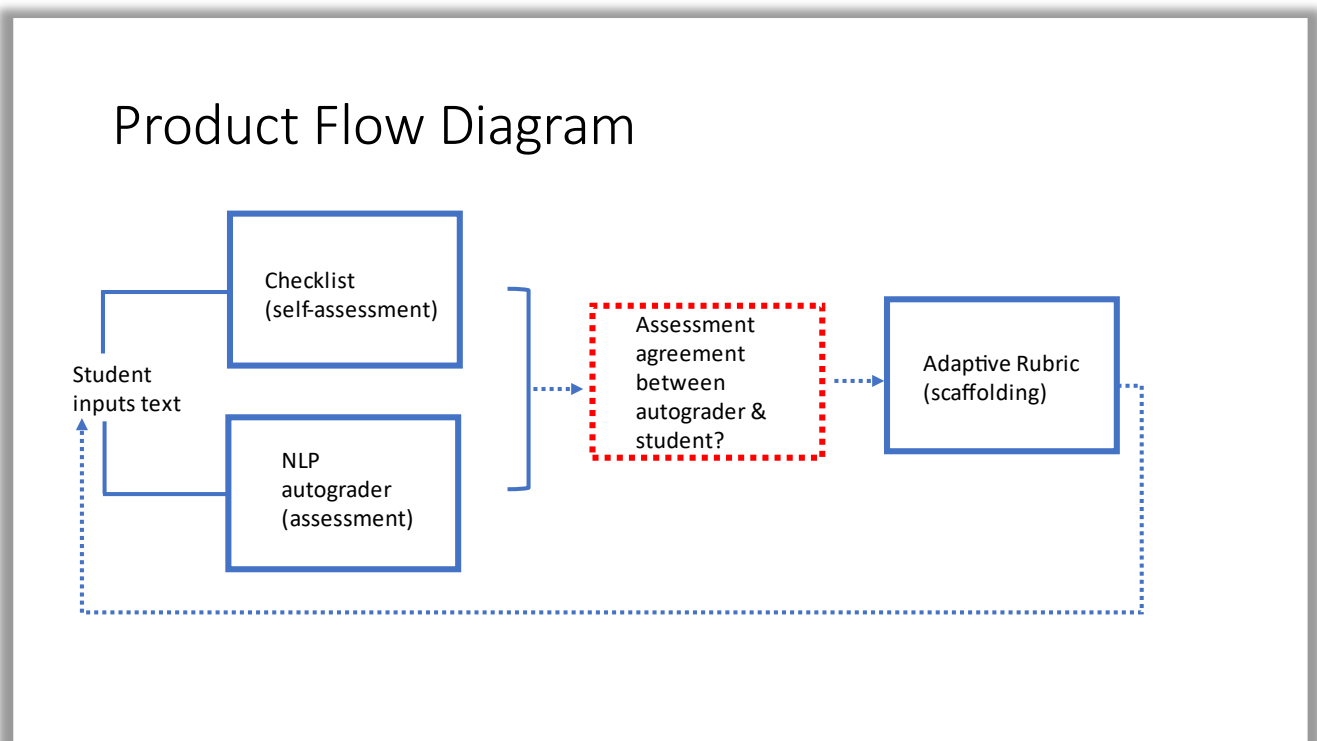


Figure 4

Figure 4 provides a decision tree diagram to explicate the high-level flow of learning events that lead to the provision of the future learning activity (i.e. the next checklist to appear in the next discussion forum post exercise). The flow of events starts from the left and continues to the right, starting with the learner inputting text for the discussion forum post. The learner can then open the checklist, while the NLP autograder is also conducting an assessment to determine if the learner has met each criterion. An agreement score is then calculated to discern if the learner and autograder are in agreement. Where there is disagreement, the adaptive rubric will generate items specific to fulfilling the criterion that the learner erroneously marked as “met” and the autograder marked as “unmet.” Within the adaptive rubric, the learner selects the next criteria that will be used to assess moving forward with the next discussion post input. These criteria are used in the next checklist, which is documented in the same logging structure as shown in Figure 3, creating a feedback loop.

Figure 5 details the if-then logic that delivers the adaptive rubric solution (essentially deconstructing the decision-making that occurs in the red dashed box in Figure 4).

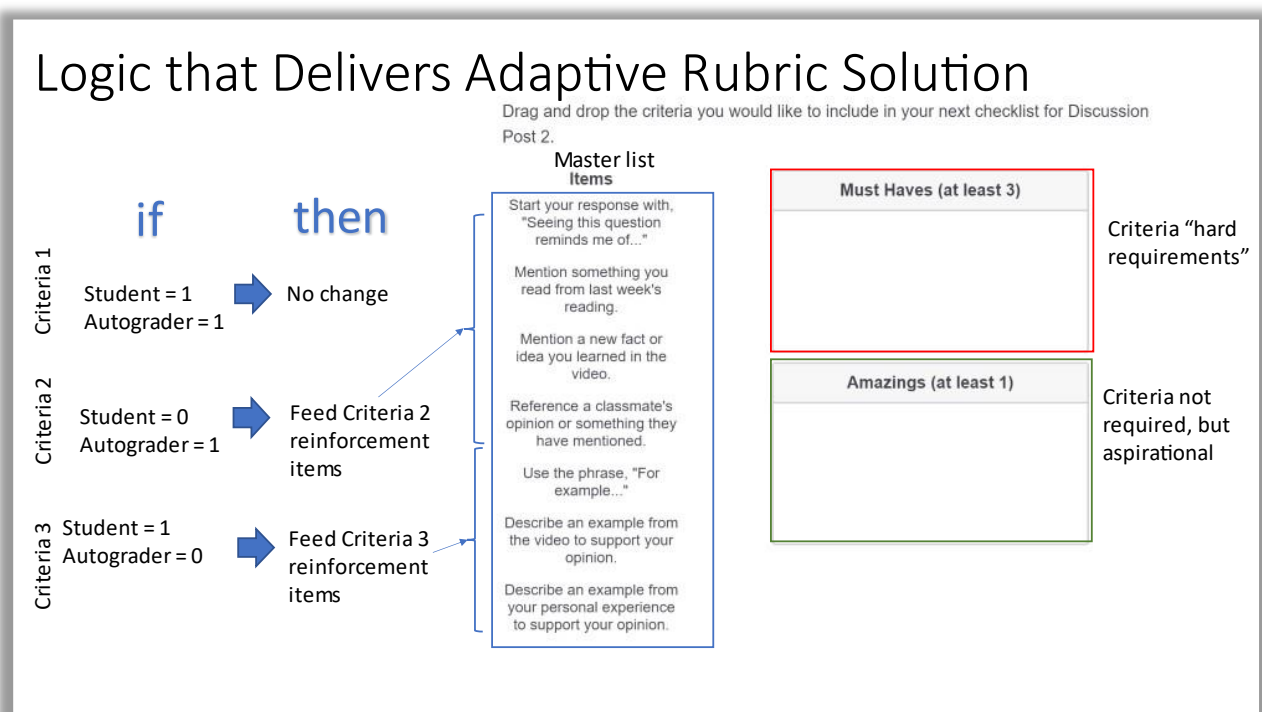


Figure 5

GAPS & FUTURE WORK

Natural Language Processing (NLP) An area still in development is determining a platform to house the checklist, NLP autograder and the adaptive rubric in one place. The product's current prototyping is in Qualtrics, and while the current design could simply include a link that leads

the learner to an NLP platform, the NLP platform would still need to be customized to include dictionaries specific to the criteria included in the checklist “curriculum.”

Checklist Curriculum The lifespan of a checklist to feed forward is not infinite. For example, the three foundational criteria in the running example above can help provision rubric items, but the rubric items that are in the next checklist would be challenging to further break down into meaningful directives in the next iteration of the adaptive rubric. Recognizing this, I propose that instructors use a checklist over the course of two or three discussion forum post rounds, and then identify a different domain of learning goals to create a checklist. For example, where an instructor sees low self-efficacy across a class, the checklist can double as a curricular tool as well as an intervention, including criteria that might target strategies to boost self-efficacy.

References

- Chapter 8: Natural Language Processing and Learning Analytics - PDF Free Download.* (n.d.). Retrieved May 2, 2022, from <https://docplayer.net/48472408-Chapter-8-natural-language-processing-and-learning-analytics.html>
- Panadero, Ernesto, Anders Jonsson, Juan Botella. Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses. (2017). *Educational Research Review*, 22, 74–98. <https://doi.org/10.1016/j.edurev.2017.08.004>
- Rhonda, B., & Akane, Z. (2018). Step 1: Identify OSCAR. In *Differentiated Instruction Made Practical*. Routledge.
- Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Link to PowerPoint Presentation slides:
[EDUC795_FINAL_presentation_Yeeva Cheng.pptx](#)