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Theory-Driven Design for the Development of a Student-Centered Error-Correction Online Learning System

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Abstract: Many benefits are associated with error-correction, but currently, the task is mostly done by teachers. Although student self-correction should help activate generative behavior and promote learning, most students are not accustomed to self-correction nor equipped with the needed knowledge and skills. Hence, the main goal of this work is to create a theory-driven student-centered error-correction learning system. In this paper, literature on error-correction to serve as the basis for the development of a generic error-correction framework is briefly reviewed. Additionally, four design principles to guide its development are described.

Keywords: Customizability, error-correction, online learning system design and development, pro deep learning, scaffolding, student-centered approach

1. Introduction

While 'practice makes perfect' is commonly preached, unless students can correct and learn from their own mistakes, the anticipated gains from practice cannot be warranted. Numerous benefits of error-correction have been reported. They include reduction of errors, better retention and understanding of the tested concepts (Almuhimedi & Alshumaimeri, 2015), solid consolidation of knowledge (Sompong, 2013), and elevated learning performance (Galeano et al., 2020).

Despite its pedagogical value, error-correction is frequently and mostly directed by the teacher, with students mainly responsible for jotting down what is being transmitted during the process (Bargiel & Bargiel, 2009). With educational paradigm shifting away from the teacher-centered model (Dmitrenko et al., 2021), student-centered error-correction would be the anticipated alternative (Luo & Liao, 2015). From theoretical perspectives, the work involved in student-centered error-correction should help activate higher-order thinking and generative learning from the learner (Rushton, 2018).

Currently, empirical studies generally support the student-centered error-correction approach for learning (e.g., Jamalinesari et al., 2015; Rushton, 2018). Nevertheless, most students are not accustomed to self-correction, nor equipped with the essential knowledge and skills for its beneficial effects to fully manifest (Suarez, 2013). Teachers also need an explicit set of guidelines and framework to engage students at a sufficient level for error-correction (Teba, 2018). Hence, in this paper, theory-based design for the development of a student-centered error-correction learning system addressing these areas is presented.

2. Areas of Importance Guided by Literature on Error-Correction and Theories

Researchers have provided suggestions on focal areas of attention during error-correction so as to harvest maximal learning gains. For instance, Arias (2004) pointed out that besides informing students of the correct form, teachers should highlight the reasons for student errors, summarize common errors, and explain the correct usage of rules if the error involved

incorrect/inappropriate use of rules. Iseni (2011) stressed the importance of having students explain their errors and attend to the types and frequency of errors made when making corrections. In light of existent literature on error-correction and theories, including self-explanation and generative learning, a generic error-correction framework consisting of seven core elements is proposed (see Figure 1).

1. Write out the answer key to the mis-answered question
2. Identify the main idea(s) tested in the question
3. Pinpoint the keyword/phrase that points to the correct answer (or eliminates unlikely solutions/options)
4. Explain why the correct answer is correct
5. Explain why the previously given response (or other options in the multiple-choice question) is incorrect
6. Analyze the reason(s) for your mis-answering the question:
   - Misunderstood or not understanding the question
   - Not mastering the key concept/rule/principle tested in the question
   - Lack (or forgot) sufficient, related knowledge and/or skills
   - Carelessness (e.g., mis-calculation, misread, using wrong formula)
   - Not enough time
   - Other reasons_____
7. Add other relevant and important knowledge pieces (e.g., vocabulary, phrases, grammatical rules, concepts/rule/principle)

Figure 1. The generic error-correction framework

3. Design Principles for The Development of Error-Correction Learning System

Four design principles were set up to guide the development of a student-centered error-correction learning system: scaffolding, pro deep learning, versatility, and customizability.

3.1 Scaffolding

Our derived generic error-correction framework is provided in the system first for the teacher's reference to devise one for his/her class use. The devised framework is then shown in a step-by-step fashion to guide students through the error-correction process (see Figure 2).

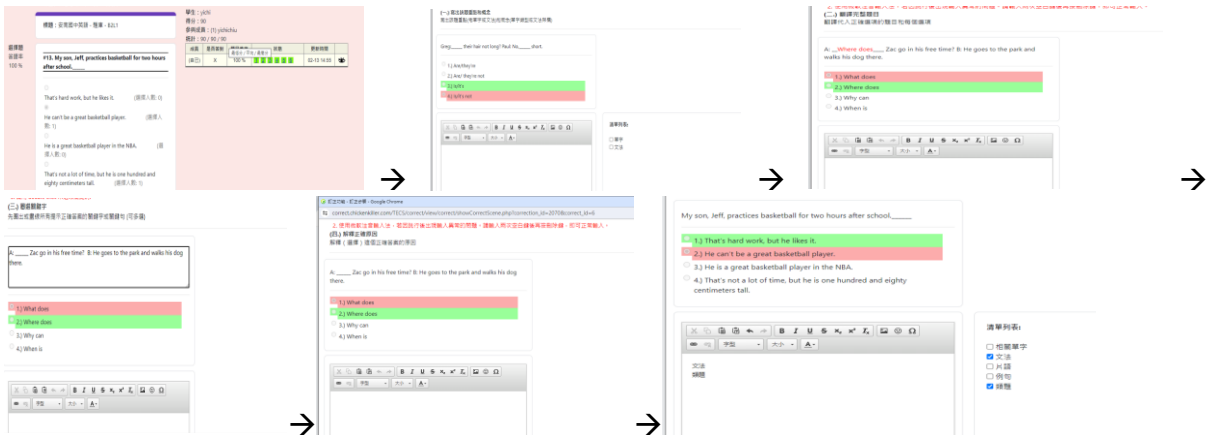

Figure 2. The customizable step-by-step scaffolding for error-correction

3.2 Pro Deep Learning

The derived framework aimed not so much at having students correct errors at the surface level (e.g., provide the correct answer), but more at directing them to deep thinking (e.g., note the main ideas tested and inter-connect related knowledge pieces; Steps 2~7, Figure 1).

3.3 Versatility

In addition to the error-correction framework acting as support for self-correction, our system includes peers as social scaffold. We added a collaborative peer-assisted correction mode, where students can see how their peers progress along the error-correction task (see Figure 3), access to peer completed work, and ask for help from peers when needed.

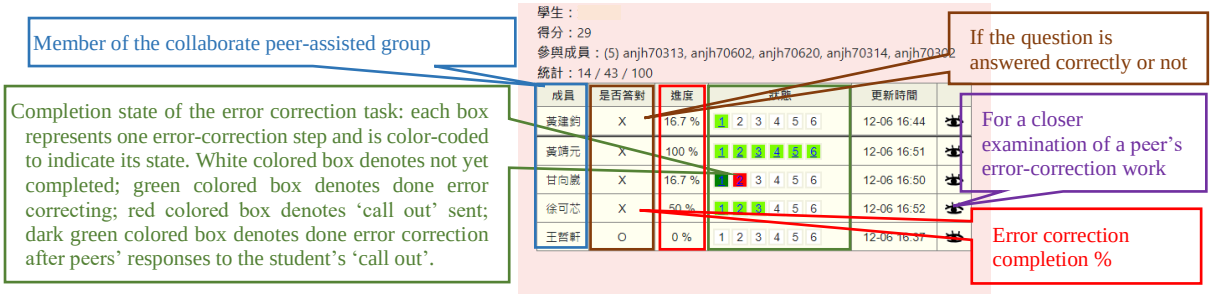

Figure 3. The collaborative peer-assisted error-correction space

3.4 Customizability

To accommodate individual teachers' instructional plans in different subject areas and ensure the provision of context-appropriate support, our system allows the teacher to modify not only the steps and content of the error-correction framework, but also designs and functionalities, for instance, adding context-dependent examples, activating a specific error-correction mode (i.e., self or collaborative error-correction), call-out (to the teacher or peers), among others.

4. Conclusion

This work aims at developing a supportive learning space to guide students through the error-correction process. Based on literature on error-correction and theories, a generic error-correction framework was devised. Four design principles were set up to guide the development of a scaffolded, pro deep learning, versatile, and customizable student-centered error-correction system. This work has technological and pedagogical significance. First, the developed system is the first of its kind. Second, the devised error-correction framework should help teachers in creating and students in engaging in scaffolded pro deep learning.

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