Computer-Mediated Learner-Centered Error-Correction Activities: Opportunities and Challenges

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Abstract: This work aims to leverage technological affordances—specifically, adaptability, interactivity, choice, feedback, high processing speed, and immense storage space—to better support error-correction activities following drill-and-practice activities. An evaluative study adopting a within-subjects quasi-experimental design with seventh-grade students (*n*=57) was conducted. The major findings are as follows: First, all purposefully designed features and functionalities received strong affirmation for their respective learning supportiveness. Second, with the provision of (a) instant feedback on student performance, which is critical for initiating error-correction activities, and (b) a customizable correction steps along with an additional layer of hints for challenging steps—ranked the highest and second highest in terms of perceived supportiveness—the results further underscore the advantages of computer-mediated arrangements for error-correction activities over traditional paper-based formats. Students' explanatory comments illuminate the opportunities offered by a computer-mediated, learner-centered error-correction approach, while also noting challenges associated with different error-correction modes.

Keywords: Drill-and-practice activities, error-correction modes, learners' perceived usefulness, learning from errors, online learning system design, technological affordances

1. Introduction

The pedagogical value of error correction for promoting deep learning and improved performance is well recognized (Álvarez-Herrero, 2019; Galeano et al., 202). Consequently, it is frequently assigned alongside drill-and-practice activities in classrooms (Angrum et al., 2020). However, research has found that students often engage in shallow error-correction behaviors when prompted by the teacher (Xu, 2017), and many lack the knowledge, skills, and strategies required for constructive error correction (Suarez, 2013). To address these challenges, and drawing on related literature (e.g., learning from errors, failure-based learning, and feedback), my research team has compiled a generic error-correction framework incorporating an error-analysis scheme. A classroom-based empirical study further substantiated its educational efficacy (Zhang & Yu, 2023).

As a logical next step, my team has been developing a learner-centered error-correction system that incorporates the established framework while leveraging technological affordances (Yu, 2024)—specifically adaptability, interactivity, choice, feedback, high processing speed, and immense storage capacity (The National Academies of Sciences, Engineering, and Medicine, 2018; Thompson & Hite, 2021). Briefly, to provide dynamic support for students in completing tasks across different learning contexts, *adaptability* is emphasized, enabling a customized procedure and a second-tier scaffold for challenging steps as found needed in prior studies (Zhang & Yu, 2023). Additionally, recognizing that students often encounter difficulties and seek teacher support even in computer-supported learning environments (Mercer & Fisher, 1992), *interactivity* is emphasized to allow personalized assistance from the teacher. Furthermore, acknowledging 'control' as a key factor of an activity's intrinsic motivational value (Malone, & Lepper, 1987), and drawing on the theory of mind (ToM), which suggests potential additional cognitive gains (Schaafsma et al., 2015), *choice* is incorporated by allowing students to correct not only their own incorrect responses but also questions commonly answered incorrectly by their classmates. Finally, leveraging technology's *high processing speed* and *immense storage space* capability, the system (a) provides instant, automatic 'feedback' on student performance, (b) allows permanent access to individual performance records, and (c) eliminates the need for handwriting during error correction.

This study aims to evaluate the educational efficacy of each of the intentionally incorporated features and functionalities, based on the perceptions of the target audience.

2. Method

Two classes of seventh-grade students (n=57) participated in the study over eight weeks. The online error-correction activities were integrated into the classes' weekly drill-and-practice exercises to support Chinese language learning. In the first session, the teacher trained students on how to use the system and then, following online drill-and-practice activities, guided the whole class in correcting the most commonly misanswered questions, using the step-by-step procedures outlined in the system. In the second week, while keeping all other elements constant, students individually corrected their own misanswered questions from the online practice activity, following the same structured steps. From the third week onwards, students corrected both their own misanswered questions and the questions most frequently missed by their classmates. Data on students' perceptions of the incorporated functionalities were collected during the final session. Q#1: *Overall, which of the designed features of this error-correction system do you find 'very helpful' for supporting your learning of the course content and completion of the correction task?* (Check all that apply) (see Table 1). Q#2: *Which of the following error-correction approaches do you find most helpful for your learning of the course content*—(a) teacher-led correction with the whole class, (b) self-correction of one's own misanswered questions, or (c) self-correction of one's own misanswered questions plus the most commonly missed questions of the whole class? *Explain your selection*.

3. Results and Discussion

For the result of Q#1, all designed features and functionalities leveraging technological affordances received strong affirmations for their learning supportiveness—ranging from about two-thirds to more than three-fourths of participants (see Table 1). Among these, providing instant feedback on student performance ranked the highest. Conceptually and technically, this feature is critical for initiating error-correction activities and would not be easily achievable without a computer-mediated arrangement. Furthermore, the provision of an explicitly listed step-by-step correction process, along with an additional layer of hints for challenging steps, ranked second. These supports, again, can be readily implemented with technological *adaptability* affordance.

For the result of Q#2, students' choices were split among the three modes, with n=17, 22, and 18, for mode (a), (b), and (c), respectively. A chi-square test found no significant difference, $X^2 = 0.74$, $p = 0.69$. The provided explanations shed light on the benefits and limitations of the three modes. For the **teacher-led** mode, the most salient theme was that '*elaborated explanations can be obtained easily and efficiently to promote better understanding*.' For the **self-correction** mode, supporters most often emphasized that '*personally investing time and effort in locating and organizing pertinent content leads to an enduring impression and better learning*.' Supporters of the **self-correction plus commonly missed class questions** mode echoed the benefits noted by self-correction supporters but identified an additional advantage: '*attending to peer work creates a lasting impression, thus helping learning*.' This view, essentially, reflects the concept of ToM—by noticing frequently missed questions and inferring possible misconceptions of peers, students may enhance their social-cognitive development (Schaafsma et al., 2015). However, supporters of this mode also cited ‘time pressure’ as a challenge.

Table 1. *Results on Q#1*

	Technological affordances[a]	%
The clearly listed step-by-step correction process	A	75.86
The hints provided for challenging steps	A	75.86
Sending a request-for-help to the teacher in real time when needed	B	63.79
The permanent storage of my record for future reference	F	68.97
Display of accuracy rates for each question	E	67.24
Display of the number of students selecting each option of each question	E	65.52
Typing rather than writing by hand	E	68.97
Can immediately know my performance after completing the practice activity	D & E	77.59

[a] A: adaptability, B: interactivity, C: choice, D: feedback, E: high processing speed, F: immense storage space

To align with today’s constructivist educational paradigm, teachers and students are encouraged to move away from the traditional teacher-directed error-correction mode to a learner-centered one. However, as researchers have observed, students often engage in shallow error-correction behaviors (Xu, 2017) and lack associated knowledge, skills, and strategies (Suarez, 2013). Therefore, finding ways to better support students with (a) timely feedback on performance, (b) adaptable scaffolding devices, (c) real-time interaction with the teacher, and (e) choice is an important pedagogical issue that should not be overlooked. As affirmed in this work, by leveraging technological affordances, the error-correction process can not only be supported in a customizable and easily executable way, but learners’ needs for various error-correction modes can also be effectively accommodated through a computer-mediated arrangement.

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