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Research Article

Teacher supports and technology needs to develop students' self-regulated learning at U.S. K-12 online schools

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ABSTRACT

Studies have indicated that self-regulated learning is critical for 21st century learners and lifelong learners, and it can also explain students' learning outcomes. In the current learner-centered instruction, especially in online learning environments, self-regulated learning has become a more critical element for students' success. Given the previous findings that self-regulated learning is teachable, this study attempted to examine what kinds of supports teachers at U.S. K-12 online schools provided to their students to develop self-regulated learning skills and how teachers provided those supports. The roles of technology in such teachers' practices were also examined. The results showed that teachers provided students with more direct guidance instead of helping them understand and develop self-regulated learning by themselves. Implications for practices to support the development of students' self-regulated learning, such as personalization, learning community, and balance between teacher-regulated learning and self-regulated learning were discussed.

Keywords: K-12 online, self-regulated learning, teacher support

INTRODUCTION

Self-regulated learning (SRL) has received constant attention in education due to its positive relationship with academic performance (Artino, 2007; Dent & Koenka, 2016; Sitzmann & Ely, 2011; Sung, 2006; Zimmerman, 2001, 2002), and during and after the pandemic era, SRL has become a major interest among educators and researchers due to its critical role for successful online learning experience (Hudaifah, 2020; Klimova et al., 2022; Sutarni et al., 2021; Ulfatun et al., 2021). Generally, learner's high level of SRL is associated with higher learning outcomes (Dignath & Büttner, 2008). Given this importance of SRL, researchers have investigated how to teach SRL skills or how to support learners in developing SRL skills (Cigdem & Oncu, 2024; Paris & Paris, 2001). However, most of the studies have been conducted in traditional face-to-face classroom environments, hardly in fully online contexts. Moreover, SRL research in online learning environments has been conducted in higher education (Klimova et al., 2022; Theobald, 2021) and corporate settings, not in the K-12 online environment. Thus, there is a deficiency in the literature on developing students' SRL skills in online K-12 environments. This study aims to examine what types of support teachers provide for their students and how they provide the support to develop students' SRL skills in fully online K-12 contexts and investigates what features teachers want to see from technology to support their practice.

LITERATURE REVIEW

SRL, Academic Achievement, and Online Learning Environments

High achieving learners are characterized as having high levels of SRL (Ablard & Lipschultz, 1998; Nota et al., 2004; Purdie et al., 1996), indicating more use of SRL strategies (Dent & Koenka, 2016; Zimmerman & Martinez-Pons, 1986).

In the SRL literature, students' SRL is often characterized by how much they utilize SRL strategies in their learning. A line of research has focused on examining students' self-regulatory strategy use and its relationship with academic performance. For example, in earlier days, Zimmerman and Martinez-Pons (1990) noted that students from 5th, 8th, and 11th grades showed a high positive correlation between their use of self-regulatory strategies and their academic mathematical efficacy and verbal efficacy. Dent and Koenka (2016) also identified a significant correlation between cognitive strategy uses and academic performance in their meta-analysis study on students in elementary and secondary school. And most recently, the use of SRL strategies and its positive relationship with reading ability during post-pandemic era was examined at the university context (Omari & Arssi, 2024). In sum, students' use of SRL strategies has been a critical factor for academic success regardless of content areas or grade levels.

Another line of research examined the relationship between the elements of SRL and academic outcomes. The elements of SRL include constructs such as motivation, goal orientation, self-efficacy, and self-reflection. College students' regulation of motivation was found to have a positive relationship with their SRL and academic outcomes (Wolters, 1998), and their goal orientation was also shown to have positive relationships with motivational belief, SRL, and academic outcomes (Wolters et al., 1996). Similarly, the motivation of college students was highly correlated with their SRL in online learning contexts (Samruayruen et al., 2013). A correlational study with 7th graders also showed that self-efficacy and intrinsic value were positively related to their SRL and performance (Pintrich & De Groot, 1990). Furthermore, historically self-efficacy has been related to academic performance in numerous research studies in education (Harrison et al., 1997; Schunk, 1984, 1990; Schunk & Ertmer, 1999, 2000; Schunk & Zimmerman, 2007; Ulfatun et al., 2021; Williams & Williams, 2010). Overall, the studies have shown that major elements of SRL have close relationships with learners' overall SRL and academic performance. In addition, a meta-analysis study on SRL in work-related training and educational attainment showed that SRL constructs, such as goals and self-efficacy, had the strongest effect on learning outcomes for adult learners who were 18 or older (Sitzmann & Ely, 2011).

The importance of learners' SRL in an online learning environment has been much emphasized due to the autonomous nature of online learning and the lack of ongoing and interactive support that instructors in face-to-face learning environments can easily provide (Azevedo et al., 2008; Dabbagh & Kitsantas, 2004). Along with the notion that online learning environments require learners to be more self-regulated in order to be successful, it is noted that the nature of the online learning environment encourages learners to utilize more exploration, elaboration, and activation of prior knowledge because of its inherent non-linear design (Azevedo & Cromley, 2004; Dabbagh & Kitsantas, 2004; Kramarski & Michalsky, 2009; Narciss et al., 2007). However, learners in online learning environments often feel difficulties in managing and regulating their learning, albeit that they have more opportunities to do so (Artino & Stephens, 2009; Lee et al., 2008). In addition, it is hardly possible to find research studies on promoting students' SRL in completely K-12 online learning contexts.

Developing Learner's SRL

Researchers have indicated that SRL is a teachable skill (Boekaerts, 1997; Zimmerman, 2002), and historically they have attempted to teach SRL skills to learners using different instructional strategies and approaches such as direct instruction (Bjork et al., 2013), modeling (Kistner et al., 2010; Page-Voth & Graham, 1999), reciprocal teaching (Dabbagh & Kitsantas, 2012), reflective learning diaries (Ahmad, 2024), and project-based learning with modeling and scaffolding (Cheng & Chau, 2013).

As noted in Paris and Paris (2001), promoting students' SRL can be done in three ways: (a) indirectly through experience; (b) directly through instruction; or (c) through elicited practice either indirectly or directly. One of the popular ways of promoting SRL that researchers have examined is the second option, directly

through instruction as a form of an intervention study. For example, Jansen et al. (2020) utilized videos to teach SRL and study suggestions to Massive Open Online Courses (MOOC) participants and identified that the intervention positively affected course completion as well as the use of SRL strategies. Moreover, SRL strategies were also examined to support remote learning context for online or blended learning during the pandemic era (Carter Jr et al., 2020).

In general, intervention studies showed that training in SRL skills was effective in promoting learners' SRL and academic performance; however, studies also found that teachers generally spent little time on explicit strategy instruction (Hamman et al., 2000; Jansen et al., 2020; Kistner et al., 2010; Moely et al., 1992). Another study examined teachers' explicit and implicit instruction of various SRL strategies to students and its effect on students' performance (Kistner et al., 2010). The study showed that most of the teachers' SRL strategy teaching took place in an implicit way, while explicit instruction and providing learning environments where students can learn SRL strategies were rare. Moreover, according to a meta-analysis study in the context of primary and secondary school levels, the interventions by teachers were less effective than the ones by researchers in promoting learners' SRL (Dignath & Büttner, 2008). They explained why interventions by teachers were less effective than ones by researchers, attributing it to teachers' insufficient knowledge of the SRL concept as well as inadequate or insufficient teacher training (Spruce & Bol, 2015). Nevertheless, they emphasized the role and importance of teachers in promoting students' SRL because teachers stay with students for a longer period and provide them with sustained intervention and support.

In the past, efforts have been made to teach SRL skills or help students develop SRL in a web-based learning environment (Kauffman, 2004) and in a computer-based learning environment (CBLE) (Winters et al., 2008). Both Web-based learning environments and CBLE need to be differentiated from online learning environments, where learners are generally remote, and all the learning activities and interactions take place completely online. The concept of an online learning environment is broader than those of Web-based learning environments or CBLE in that online learning environments entail more than instruction, including non-instructional interactions among stakeholders such as teachers, students, administrators, and parents, while both Web-based learning environments and CBLE focus on instructional elements. Online learning environments can be realized using Web-based learning environments and CBLE. This online environment, however, is different from that of K-12 online schools because students interact not only with computers but also with teachers and other students, fully online throughout semesters or academic years, instead of taking one-time online instruction. Thus, further examination is needed on teachers' practices of supporting students to develop SRL skills in a fully online learning context.

Although research studies have been conducted on SRL in online, computer-based, or Web-based learning environments, insufficient attention has been paid to how to better promote students' SRL in online learning (Kauffman, 2004). In addition, it is hardly possible to find research studies on promoting students' SRL in completely online learning contexts, especially in K-12 online environments.

Based on the abovementioned literature, in this study, the following research questions were examined.

1. What types of supports are teachers utilizing to develop their students' SRL skills, and how are teachers implementing those supports in online K-12 schools in the U.S.?
2. What features or functions do teachers want to see from technology in order to improve their practices of supporting students' SRL?

METHODS

This study is a follow-up of the survey research conducted with teachers of K-12 online schools in the U.S. who were the member of the Aurora Institute, previously known as International Association for K-12 Online Learning (iNACOL), the leading organization of K-12 online learning (Huh & Reigeluth, 2018). This study utilized a mixed-method approach utilizing a survey research design (Babbie, 1990) where synchronous virtual interviews were conducted as well as content analysis to triangulate the data and to identify any missing data from the interview (Creswell, 2009; Gilmore, 2006; Neuendorf, 2002).

Table 1. Interview participants

Pseudonym	Grade Level	Subject	Online Teaching	F2F Teaching
Marie	Middle	English Language Art	2 years	0 year
Tammy	High	Math	3 years	2 years
Evan	High	Social Studies	12 years	4 years
Stella	High	Electives	1 year	23 years
Sara	High	Social Studies	8 years	3 years
Pam	High	Social Studies	18 years	4 years

Table 2. Documentation received for content analysis

Pseudonym	Documentation
Tammy	2 live lesson recordings
Evan	Introduction letter for students and parents, 5 instructional websites
Sara	Sample pace chart, sample assessment tracker for portfolio, 6 class announcements
Pam	Questions that students need to answer at the beginning of the course, self-reflection questions, pre-assessment questions, goal setting assignment, 2 pacing guides, course introduction, course introduction quiz, pacing guide quiz, academic integrity information, YouTube channels, webinars, study guides

Participants

The sample for the interviews was a subset of who participated in the survey from the initial study (Huh & Reigeluth, 2018). The criteria for identifying the interviewees were those who volunteered, who are actively and frequently developing students' SRL skills. A total of six teachers agreed to participate in the interviews (see **Table 1**).

Interviews

The interviews sought to gather in-depth information about each teacher's practice: what types of support they were providing to their students to develop SRL skills and how they were implementing. The interviews also attempted to identify whether there were any additional features of the technology they needed. An interview protocol was developed based on the conceptual framework of Pintrich (2004) as the initial survey questions (Huh & Reigeluth, 2018).

The interview data were analyzed based on transcripts, coding, and thematic analysis and pattern matching. First, interview recordings were transcribed verbatim right after each interview, and the transcripts were sent back to the participants for a member check to ensure the transcripts were what they meant. For the purpose of coding transcripts, a coding book with codes, definitions of codes, and examples of each code was developed. An emergent coding approach was utilized (Stemler, 2001). As recommended by Haney et al. (1998), two researchers independently reviewed the same transcript and came up with a set of codes. Then, the researchers compared their codes and reconciled any differences in their initial code categories. One researcher then used the consolidated categories to code the rest of the transcripts, and the other researcher examined the transcripts code by code to determine if she agreed. The researchers discussed any discrepancies until they reached an agreement. For the data gathered from open-ended questions, a thematic analysis was conducted (Creswell, 2013). The data were coded, and the researchers looked for emerging themes, then examined how the themes were patterned or fit together to tell a story about the data.

Content Analysis

The content analysis coincided with the member check process. In the member-checking email, the interview participants were also asked to provide any documentation to evidence their practice of supporting SRL. Four out of six teachers replied to the request for the content analysis. Two teachers provided the researchers with some forms of their virtual classrooms, such as (a) a recording of a live class session where no student identifiers were showing and (b) a website containing the content of the classroom lessons. Other materials included announcements, pace charts, worksheets, class introduction, and so on. The documents were collected to triangulate the teachers' answers from the interviews, as well as to see whether there were any unique practices they forgot to mention in their interviews. **Table 2** shows the types of documentation received from the participants.

Table 3. Frequency count based on types of teachers' supports in developing students' SRL

		Pam	Evan	Marie	Stella	Tammy	Sara	Total	%
Teachers' instructional support	Direct guidance	10	24	14	14	24	14	100	31%
	Prompting	12	15	8	5	7	11	58	18%
	Peer teaching and learning		2			5	1	8	3%
	Demonstration	2	1	1	1		1	6	2%
	Modeling	1	2	1		1	1	6	2%
	Elicited practice		6	1		6	2	15	5%
	Instruction piece	5	4	2	4	10		25	8%
Teachers' non-instructional support	Incentives	1			1	2		4	1%
	Mentoring conversation	6	6	7	4	3	1	27	8%
Non-teacher support	Technology system support	1	1	7	1	2	2	14	4%
	Parental involvement	6	1	2	3	5	3	20	6%
	Institutional support	9	4	5	2	14	2	36	11%
Total		53	66	48	35	79	38	319	100%

A coding form was also developed for content analysis. By using the coding form, the researchers coded whether the teachers provided their students with instructional or non-instructional supports, types of SRL activities to which teachers' supports were intended, types of supports, direct quotes to evidence teachers' supports, and links or URLs to the documents if available. The same coding scheme for the interview was also applied to the coding for content analysis. Given that the inter-rater reliability was already established from coding the interview, one researcher coded all the documents first and asked for the other researcher's opinion on parts where he felt a second opinion was needed. The two researchers discussed any discrepancies until they reached an agreement.

RESULTS

Types of Teachers' Support for Students' SRL

Based on the interviews and content analysis, teachers' practices of supporting their students' SRL development were more closely examined. **Table 3** summarizes the coding result of the interview transcripts.

Direct guidance

The most frequently identified type of support, which consisted of 31% of the total support coded, was teachers' direct guidance to the students. For the purpose of coding, direct guidance was defined as "teachers directly provided students with guidelines, information, materials, or strategies for them to engage in an SRL activity." Direct guidance needs to be distinguished from direct instruction of SRL skills, where teachers provide students with instruction to teach how to use SRL skills and why those skills are necessary and important. For example, a case of direct guidance can be a teacher's saying to the students, "Here are the goals for this unit task," whereas a case of direct instruction can be teachers' teaching the students how to set goals appropriate for their learning and teaching them why goal setting is important and necessary for their successful learning experience. Some of the instances of teachers' direct guidance were found in the transcripts. For example, Evan mentioned:

> What I do is, I always start by talking about what we're going to be doing and how it relates to either prior content knowledge or prior skills that they've built, whether it's things they should've done in elementary school, because so many of our kids are transient in the sense of, they're coming into our school as ninth-graders or as tenth graders.

In this case, students could activate their prior content knowledge or experience, which was one of the SRL activities. However, it was the teacher who gave them direct information to do that instead of the teacher encouraging them to think of prior knowledge or experience by themselves. Another example from Evan is:

> That is something we are always talking about with our students. I do it a lot when I am reviewing with them in a more explicit way, but I do it throughout my instruction. It is talking to them about really focusing on studying the things that they need more time on. I try to explain that there are

> certain things that come easier to us, and there are certain things we have to work more on and try to get them to go beyond what feels good, because when you're studying something that you're interested in or that you're good at, they tend to want to gravitate and spend more time there.

In this example, students could decide on which things to devote more or less effort to, which was also one of the SRL activities. However, Evan, the teacher, was the one who gave them the strategy for them to be engaged in the SRL activity.

Prompting

In this study, prompting was defined as "teachers use the question format to facilitate students' engagement in an SRL activity." Compared to the direct guidance, which was a direct delivery of information from teachers to students, prompting was an indirect way of facilitating students' thinking related to SRL activities or students' engagement in those activities. For example, Pam mentioned:

> Then every week, what I do is I reach out to students via email and parents for anybody who is behind pace. Within that, I will ask them questions like, "Are you having trouble getting started? Are you unmotivated about class? Are you out of town? Are you unwell? Have you been sick?" Something like that. You just try to identify a little bit in the email … that is going on because sometimes we can handle those situations easily.

In this example, Pam was asking prompting questions, and by answering the questions, the students were presumably involved in SRL activities such as monitoring their learning and monitoring their motivation or feelings. Sara also described her practice of prompting as:

> Sometimes I have students – especially if I have a sense that they do not feel confident or maybe have questions that they're not asking me – sometimes I ask them to describe to me verbally what they think and what they're going to do the second. I ask them simple factual questions such as when is this due. When are you going to work on it to get finished on time? I ask some probing questions.

In Sara's case as well, by answering her questions, students can be engaged in SRL activities, such as the perception of a task or time and effort planning. Instead of providing them with direct advice or information, such as "this was what the task was about" or "you should do this today and do that tomorrow," Sara used prompting to help students be engaged in those SRL activities naturally.

Institutional support

Unlike direct guidance and prompting provided by teachers, institutional support, which consisted of 11% of the total support, was provided by the institution, not teachers. For this study, institutional support was defined as "institutions, in this case, schools, directly or indirectly support students' SRL activity by their institutional policy or by providing extra services." One example of this institutional support could be identified in Pam's interview as:

> That is not given by me, but that is given by the school. We have a different model that we use where we have … We call them mentors, and they are former teachers who are currently operating in mentor capacities, so they are not really counselors, and they are not really teachers. They happen to be both former teachers. Their jobs are to get the students to their classes and then get them through their classes in the theory that then the teachers would be more focused on the academics. That is what they do. Those people talk to their students on a daily … excuse me, on a weekly basis. They send out newsletters. They run little workshops with students. They do graduation planning with them, and they also connect the students to their counselors so that they can work through issues like making their applications for college and that sort of thing. It is not something that I provide, but it is something that the school provides by having these extra people who are there to be the first contact for students.

In this case, the school provided mentors for the students, and the mentors were closely interacting with the students and supporting them in several SRL activities, such as time and effort planning, monitoring learning, motivation, or feelings. Another type of institutional support is related to a school-wide policy, as identified in Stella's interview:

> The other thing we use, and this is just part of Florida Virtual School, is we have a discussion-based assessment that is via the phone. We do have to talk to them on that one. Part of what we are doing is we are just checking to make sure that they are ready for the midterm or for the final exam in my course.

In this case, students were assumed to be engaged in SRL activities, such as monitoring their learning behavior through the discussion-based assessment that was school-wide policy.

Mentoring conversation

Another type of support, which showed 8%, was mentoring conversation. It was defined as "teachers use a one-on-one conversation with students outside the class instruction to support students to be engaged in an SRL activity, which is not necessarily related to the content of instruction." Marie described her mentoring conversation support as:

> I have talked to some kids 2-3 times a week. It just depends. You can tell which ones are really, you know, needing that help, or they really just want to have that personal communication on a regular basis, because each student is trained here to know that you are the only student in the room at all times, even though we have other students. It is all about you, so they know that they are going to get that individual attention, and that is what makes it, you know, such a special place to learn because they don't have to wait in line. We have 25 or 30 other kids. They are the number one all the time.

Pam described her support that she purposefully tried to keep open communication via email, messages, even a call to remind learning events, helping them stay on top of their learning and be more engaged.

Instruction piece

The instruction piece was another type of teachers' support, which also consisted of 8%. The instruction piece was defined as "a part of instruction, such as a quiz that students were required to take, that supports students' engagement in an SRL activity." Evan described his practice as:

> Sometimes it is a matter of providing some self-check wizards so that they can check to see what they have learned. They are ungraded so that they are not … our practice quizzes are not graded as part of their learning, but it is something they have available. Going through the instruction piece, in this case, self-check wizards, students were more likely to be engaged in monitoring their learning or reflecting on their learning.

Parental involvement

Parental involvement, in this study, was defined as "parents are involved in supporting students to be engaged in an SRL activity," and it consisted of 6% of the total support provided to the students, based on the interview analysis. Examples include what Tammy mentioned in her interview as:

> We also have support from the parents at home, and that's essential for parental support. My most successful students are the ones whose parents take an active interest in what is going on. They will help them print out a schedule.

Sara also described her practice related to involving her students' parents:

> I call parents sometimes. When the child is really struggling, I will call the parent or maybe notify the counselor that the student seems to be giving up. When I have time, I will call a parent just to tell them that their student is doing really well and that their student is a pleasure to have in class.

> When they start getting that kind of feedback from someone other than me, then the confidence goes way up, and that is difficult to do otherwise.

Elicited practice

The elicited practice was defined as "teachers utilize an instruction format such as group work, where students are naturally engaged in some degree of SRL activities." Unlike other types of supports, elicited practice did not give us a clear idea of which SRL activities it serves for students to be engaged in because it was a nature of the instruction format that made us assume that students would engage in some sort of SRL activities.

In her interview, Tammy said, "We also have breakout rooms, and I will send them to breakout rooms where they will work with a team to solve whatever problems we are working on that day" to describe the elicited practice element in her practice. In addition, Evan also described another type of elicited practice where students could naturally engage in some sorts of SRL activities. He mentioned,

> … where I am trying to give the students multiple avenues to learn the content. I give them the goals of what you need to learn. Then I give them a lecture recording, and I give them a textbook reading, pages that they can get the information out of. I always give them the option of if you want to do online research, you can do that. I am trying to build in more diversity of instruction as a way to help them achieve the goals.

Technology system support

Technology system support, which made 4% of the total number of supports, was defined as "when technology system functions automatically support students' engagement in SRL activities." In her interview, Marie described,

> Okay, when self-monitoring, the student basically, all they have to do is go to their grade book, it is color-coded. There green will indicate that you did really great. Yellow will indicate that you need some improvement, and red means you need to, you know, back it up and do it over and those types of … those colors come with the different assignments, and it will let them know you know if you would like to raise a grade, you can do this … When you see that they've turned in their assignments, our learning management system will tell us exactly how many assignments they turned in, the names of all the assignments, and lets you know that they're kind of meeting expectations.

Sarah also described the technology system support as follows:

> The assignments are what I grade, and so when they see a checkmark and the word assignment, they know they must fully devote themselves. When they see a star in the label "activity," they know this is something that will help me reach my goal, but I don't have to spend a lot of time here if it's easy, and then I can move on.

Peer teaching and learning, demonstration, modeling, and incentives

The types of supports that helped students be engaged in SRL activities but appeared less frequently in the interviews were peer teaching and learning, demonstration, modeling, and incentives.

Peer teaching and learning was defined as "teachers utilize peer teaching and learning to facilitate students' engagement in SRL activities." Tammy described,

> I have actually pulled in students from higher-level math to come who were with me in the previous class. I've pulled them into a meeting with a lower-level course to teach some of the material because, one, it helps my upper-level students to remember things that they used that would be useful to them moving on, and at the same time, it helps my lower-level students, my students in ninth and tenth grade. They will have a twelfth grader or eleventh grader. That is a peer teaching experience, and they just really love it when their peers come down and meet with them and teach

> them. It has been some very good experiences where I have had the upper-level students will actually design their own five-to-ten-minute lesson and come into the class and teach the students really quickly how to do it. That is one of my favorite things to do is pulling them in.

The demonstration was defined as "teachers directly demonstrate an SRL activity to students." It included teachers' demonstration in a live session or sharing of a video recording with students. Pam described,

> I think that for those specific skills, those are the ones that I hit harder at the beginning of the semester, specifically, with the webinars where we will go through. For example, with time management, we will look at a couple of different schedules. We'll look at what a block schedule might look like versus a daily schedule so that they can look at, "Do I want to do all of my language arts in one day, or do I want to do it an hour per day?" They get to be the ones to make those decisions, but I think that the instruction for that comes at the beginning of the semester.

Modeling referred to "teachers indirectly model an SRL activity with their usual practice." For example, in her interview, Tammy mentioned,

> We also have the vocabulary, which I provide the students, and some of the vocabularies come up again and again and again until they really, really understand, "Wow, Pythagorean theorem – this thing is happening throughout my lessons. I'm going to keep seeing this," so they know what to focus on, what the big, important issues are going to be, theorems and proofs that they're going to need to work on. I like to really do a flashcard type situation for those proofs and theorems.

In her instruction, she utilized a repetition strategy for her students to eventually understand essential vocabulary by having the vocabulary appear several times in her instruction. This was modeling for her students to learn a cognitive strategy that they could use for their own learning.

Lastly, the incentive was another type of support for SRL activities identified in the interviews with the teachers. It was defined as "teachers utilize incentives, such as extra credit or other rewards, for students to be engaged in SRL activities."

Content Analysis Results

The result of the content analysis triangulated the interview analysis in that no new type of support was identified; however, the types of support were supplemented by different examples that were not identified in the interview analysis. For example, in Evan's instruction Website, he had one page dedicated to studying skills where he compiled advice and tips from his past students to new students so that his new students could learn those tips from their peers who had taken the course before them. In addition, in Pam's Webinar, she often had mentoring conversations with students, such as to offer encouragement, which was not identified from the interviews. **Table 4** summarizes the results.

New Technology Needs

The second research question was, "What features or functions do teachers want to see from technology in order to improve their teaching of SRL skills?" A total of seven themes were identified, as shown in **Table 5**.

Automated personalized communication

The most frequently mentioned need was to have a function for system-generated and personalized communication, including reminders and announcements. For example, in her interview, Marie mentioned:

> Maybe their own personal Voki pop up and … say, you personalize their name and say, "You need to do this today. You need to do this today" … [I]t would be nice … once again, individualize. It would be nice if, when they log in, that their little avatar is waiting there for them, saying, "Oh please use me today" or "Please go to this site today," or own your own, it is like … computers could read and know exactly where they are, not just a number but … basically tell them, "You're doing assignment 204 today. Let us take a trip here. This is what you need to do to prepare for this lesson. This is what

> you need to know to do this lesson; let us work on this together." It would be really cool if they have their avatars, especially if they could, like, individualize them and fit what they look like.

Similarly, Stella also mentioned that having a function to send a text to the students who meet certain criteria only without having to go through all students' data would be great. The teachers who indicated the need for automated personalized communication based their opinions on two different perspectives. One is to promote more student engagement by personalization, and the other is to have higher efficiency when communicating with students.

Table 4. Content analysis results

Teacher	Documentation	Support	SRL activity
Evan	Course introduction letter	Direct guidance Mentoring conversation	- Time and effort planning - Judge initial confidence
	Instruction website – Introduction	Direct guidance	- Goal setting - Use cognitive strategies - Decide why, when, from whom to seek help
	Instruction website – Study skills and advice from past students	Peer teaching and learning	- Time and effort planning - Plan on how to monitor learning - Study environment perception
	Instruction website – Why history activity	Instruction piece, Prompting	- Activate value
	Instruction website – Unit reflection journals	Instruction piece, Prompting	- Monitor learning - Reflect how well they did
Sara	Pace chart and assignment check-off with reflection	Direct guidance	- Time and effort planning - Monitor effort, time use, need for help
	Assessment tracker for portfolio	Direct guidance	- Monitor effort, time use, need for help - Time and effort planning - Reflect how well they did
	Course announcements	Direct guidance	- Goal setting - Time and effort planning - Monitor effort, time use, need for help - Decide why, when, from whom to seek help
Pam	Unit questions	Instruction piece, Prompting	- Time and effort planning - Judge initial interest - Judge initial confidence - Goal setting
	Self-reflection questions	Instruction piece, Prompting	- Reflect how well they did (study skills, time and effort management) - Choose to do an additional task - Evaluate how effective the task was
	Pre-assessment questions	Instruction piece, Prompting	- Activate prior content knowledge
	Goal setting assignment	Instruction piece, Prompting	- Goal setting - Task perception
	Pacing guide	Instruction piece, Prompting	- Time and effort planning - Monitor effort, time use, need for help - Decide why, when, from whom to seek help
	Course introduction quiz	Instruction piece, Prompting	- Time and effort planning - Plan on how to monitor their learning
	Course introduction	Direct guidance	- Decide why, when, from whom to seek help
	Webinar	Direct guidance, Mentoring conversation	- Time and effort planning - Use cognitive strategies
	Study guides	Instruction piece, Prompting	- Activate metacognitive knowledge - Activate prior content knowledge - Use cognitive strategies

Table 5. Themes for technology needs

Themes	Coding frequency
Automated personalized communication	5
More integrated tools	3
Forced communication	3
Interoperability / Open network	2
Communication to mass	2
Online tutoring system	1
Stable network	1

More integrated tools

All the teachers who participated in the interviews were using some sort of learning management system (LMS) in their institutions. The teachers also indicated that it would have been helpful if there were more tools built-in or integrated into the LMS. Tammy, who was teaching math in high school, said:

> I would love to not have to mess around with plugging in a calculator. If Blackboard Collaborate could include a calculator that is fully functional, I could just go click on it. Here is my calculator, my scientific calculator, graphing calculator. If I did not have to go out and share …

Pam also mentioned her needs for integrated tools in the system where students can be engaged in multiple related activities with multimedia resources under one theme. Moreover, she wished to see a goal-setting app, a reminder app, or an incentive app integrated into the system or even on students' phones.

Forced communication

Another theme that was mentioned three times by the teachers was to have a forced communication function in LMS. Evan, who was teaching social studies at high schools, mentioned his thoughts about forced reminders as follows:

> I would love to have something in the LMS or in the different technologies that I use where they have to read the goals and acknowledge them before they're able to move on. Or in the calendar item, the first thing that pops up when they open stuff in the morning is the calendar. Acknowledge it, and that way, they are at least saying, "Yes, I've read this user-release agreement or whatever it is you click online" … You will not tell if the student completed the calendar item, but at least we know that it has been presented to them. I guess that is the one thing that comes to mind from a technology perspective.

Marie also mentioned that she would love to see a function where students must check the feedback so that she could personalize the messages more too, and not only for grading feedback but also for reminders or for instructions (e.g., forced slideshows).

Interoperability / Open network

A couple of the teachers also indicated the need for interoperability and an open network in their interviews. Interoperability refers to the ability of separate technology applications, tools, or systems to work with one another seamlessly. Tammy described her thoughts on interoperability and open network in her interview as follows:

> There are a lot of students who cannot get in to see the videos that I share because they are through YouTube. Blackboard does not interface very well with other programs. So, Khan Academy, for example, I cannot go to Khan Academy and show a video. If I want to show a Khan Academy video, I have to go to YouTube. The problem is, if I go to YouTube, my students cannot see it, whereas if I could just find a way to interface with those other websites, that would just be wonderful, really. Really just amazing to me is, "You mean I can actually go to the real website and use it, and I don't have to use YouTube, and my students can actually see the thing?" I have tried… There is another

> program called TeacherTube, which will actually make it possible for teachers to show a YouTube video for students who are blocked from YouTube. When we use TeacherTube, Blackboard often crashes. If you could get it to work with TeacherTube, that would really help on our level.

Another similar thought on open networks was found in Sara's interview, where she mentioned:

> School sites are very concerned about keeping their networks safe, so they do not allow access to everything that would help those students. For example, I teach social studies, and that means that video is very helpful, and I am not allowed to do anything. If it is on YouTube, my students are not allowed to view it. There are problems with access to technology, even though the technology is there. There are other minor things, but I think YouTube is a very good example of education and technology that my students do not have access to.

Communication en masse

Another theme was the function of communication in mass. Marie mentioned her needs in the interview:

> I think it would be really nice to be able to give that personalized voice message and send it out to a mass number of students … I think it would be really neat if you could, like, mass text to the entire classes some nice announcement or nice, like, just positive thing for the day because you could do so much more if you could do it in a mass thing, up to maybe 200 students or even 50 at a time or something like that.

Stable network

One of the teachers mentioned a stable network for additional needs for technology. However, this was a location-specific need pertinent to where she was located.

DISCUSSION

Although the teachers perceived teaching SRL skills was very important (Huh & Reigeluth, 2018), research literature also indicated that teachers generally spent little time on explicit strategy instruction (Hamman et al., 2000; Kistner et al., 2010; Moely et al., 1992). In fact, most of the teachers' instruction in SRL strategy took place in an implicit way, while explicit instruction and providing learning environments where students can learn SRL strategies were rare (Dent & Koenka, 2016; Kistner et al., 2010).

The nature of this study was exploratory, examining what types of supports the online K-12 teachers were providing to their students. Admittedly, it was expected to see more elicited practice and indirect modeling based on the previous research findings and literature. In contrast, the most frequent support that the teachers were providing to their online students was direct guidance. For example, instead of having them set goals for their learning, helping them to set goals, or teaching them how to set goals, the teachers instead gave the students goals directly, which more resembled traditional teacher control, teacher-regulated instruction. The teachers thought that providing this kind of direct guidance was also their support for the students to develop their own abilities to do SRL activities.

Moreover, the researchers could often find evidence that the teachers somewhat presumed their students to have SRL skills. In one of the SRL intervention studies (Dignath & Büttner, 2008), the authors explained the reason why interventions by teachers were less effective than ones by researchers, attributing it to teachers' insufficient knowledge of the SRL concept and inadequate or insufficient teacher training. It is probable that in this study, the teachers also had insufficient knowledge of SRL. In a few cases, the teachers seemed to assume that their students would act like self-regulated learners by themselves. For instance, they mentioned,

> "So, most of the time, the student, once you send off feedback, the students will usually come to you and what they're concerned about, and we go through them." Or "Just so many different things that happen with the students, and they usually have reached out to me first, and then we go from there because …"

This kind of presumption might prevent the teachers from providing the students with active support for developing SRL but instead provide passive, reactionary support, which often is doing it for the student.

A few implications were derived from the interviews and the content analysis, which might improve teachers' practices supporting students' SRL development.

Personalization

From the interviews, the teachers expressed new needs for technology with which they could personalize instructional elements such as announcements, reminders, and content based on individual students' differences. By adding a personalization function to instruction, the teachers would expect higher motivation and engagement from their students as well as improved efficacy of their practices as a teacher.

The motivation was one of the SRL areas that the teachers offered less frequent supports compared to such other areas as cognition and behavior (Huh & Reigeluth, 2018). Thus, having a personalization element can help increase the support for the students to be engaged in regulating motivation. Examples of the personalization element include (a) introducing an avatar for students and letting them create and manage it whatever ways they want, and (b) technology system support where an announcement or reminder is created based on individual information such as names, progress, and test results.

Another way to support personalization is to provide many different options for the students so that they can choose whatever they are more interested in or want to work on. By letting the students have their own choice for either learning content or project outcomes, teachers can add a personalization element to their instruction, which consequently supports higher student motivation and engagement in SRL activities.

Lastly, teachers can also help students personalize their learning environments. For example, Tammy noticed that many of her online students were more kinesthetic learners than visual learners, and many had attention deficit hyperactivity disorder (ADHD). Thus, Tammy asked her student to keep a physical timer nearby as a kinesthetic item and also asked them to put a bungee cord, attach it to the bottom of their chair, so while they're working, they could have something to push their foot against.

Learning Community

The teachers also mentioned the importance of parental involvement in the success of student learning and SRL development. Moreover, it is more important to create a sense of the entire learning community. One teacher mentioned working in partnership with students, parents, and mentors is critical for the students to be successful and better engaged in SRL activities. Other teachers mentioned they had various institutional supports, such as mentors, counselors, and flexible policies, to support the students' SRL development.

To better support the students' SRL, it is necessary and important to include all the stakeholders for student learning in the conversation and to create a learning community. The effort can include copying all the stakeholders in email conversations with the students and also involving other stakeholders in the decision-making process, especially goal setting and time and effort planning.

It is worth noting that one of the SRL areas with lower frequency rating was the context (i.e., study environments) (Huh & Reigeluth, 2018), and having parents and mentors involved in the students' learning could greatly address the context area of SRL because the students are normally remote at home or local labs, and parents or mentors are the ones who can be there with them and support their regulation of study environments.

A Balance between Teacher-regulated Learning and Self-regulated Learning

Direct guidance was the most frequent type of support that the teachers were providing to their students for them to develop SRL abilities, which is closer to teacher-regulated learning. In order to invite more support that is directly related to SRL activities, teachers need to utilize specific learning strategies, such as group work or peer teaching and learning, as well as direct instruction on SRL skills. Using more technology tools that enable the students to better interact with each other and complete group work, such as content creation and delivery tools like Google Drive, Google Sites, Wikis, and YouTube, can better facilitate students' engagement in SRL activities and create a balance between teacher-regulated learning and self-regulated learning.

It needs to be acknowledged that even though self-regulated learning is emphasized, an element of teacher-regulated learning should not be ignored. Because supports are on the continuum moving towards self-regulated learning, there should be some elements of teacher-regulated learning; and especially in K-12 online environments, teachers need to deal with young learners who tend to have less attention span and experience more distractions. That is most likely a reason why some of the teachers interviewed expressed their need for a new technology function where they could have forced communication, such as a forced pop-up reminder or announcement so that students could not move forward unless they read it and closed the pop-up window.

Future Research Direction

A meaningful follow-up study might be an in-depth case study where the researchers can obtain consent from every stakeholder, have access to every material that teachers and students use, and utilize multiple data collection methods including survey, interview, focus group, and observation. Another meaningful follow-up study could be design-based research (Wang & Hannafin, 2005) or formative research study (Reigeluth & Frick, 1999) where the researchers work with actual teachers in designing and implementing instruction that utilizes the findings from this study and has several iterations of data collection, analysis, and redesign efforts to improve the design of instruction to support students' development of SRL. Lastly it will be also interesting and meaningful to conduct the same study in higher education settings where the learners are more developed in cognition to see how higher education instructors are different in terms of supporting their students' SRL.

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