Chapter 8
Applying SOAR Strategies to Curb Digital Distractions While Note Taking and Studying

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ABSTRACT

Students are distracted by mobile technology in the classroom when learning from lectures and outside the classroom when studying. Students are susceptible to distractions because they are not fully engaged in learning. In the classroom, they record notes mindlessly that capture just one-third of important lesson ideas. When they study outside the classroom, they study information in a piecemeal fashion and employ mindless repetition strategies. These weak and unengaging learning strategies open the door for digital distractions. One potential means to engage students in meaningful learning and to offset digital distractions is an integrated strategy system called SOAR, which stands for select, organize, associate, and regulate. This chapter describes SOAR and how instructors can maximize SOAR's components to curb digital distractions by improving student note taking in the classroom and study behaviors outside the classroom. The chapter concludes by specifying how instructors can teach students to SOAR on their own.

INTRODUCTION AND BACKGROUND

Students are distracted by digital devices both in the classroom when attending lectures and outside the classroom when studying. In the classroom, students should be paying attention to the lesson and recording lecture notes, yet many students bring portable devices like laptops and smart phones to the classroom, which distract their attention and note taking. Surveys in the last decade (e.g., Aguilar-Roca et al., 2012; Morehead, Dunlosky, Rawson, et al., 2019; Peverly & Wolf, 2019; Witherby & Tauber, 2019) showed that 22%–64% of college students bring laptop computers to class for note-taking purposes. However,

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when students were asked how they use laptop computers during lectures, 81% reported checking emails, 43% reported surfing the internet, 25% reported playing games, and 35% reported other non-academic activities (Fried, 2008). Another observational study found that students engaged in off-task computer activities (e.g., using social media websites) for nearly two-thirds of class time (Ragan et al., 2014). Additionally, seventy to ninety percent of college students text during lectures (Kornhauser et al., 2016; McCoy, 2016), and they send or receive 12–20 text messages per lecture period (Dietz & Henrich, 2014; Pettijohn et al., 2015). One study (Kuznekoff & Titsworth, 2013) showed that when students received and responded to text messages during a lecture, their note taking decreased by 18%–40%. This study also found that digitally distracted students recalled 50% fewer lesson ideas than non-distracted students (Kuznekoff & Titsworth, 2013), consistent with other studies showing that classroom digital distractions decrease note taking and achievement (Carter et al., 2017; Flanigan & Titsworth, 2020; Glass & Kang, 2019; Hembrooke & Gay, 2003; Kuznekoff et al., 2015; Ravizza et al., 2017).

Students face the same digital distraction temptations outside the classroom when they study for tests (Flanigan & Kiewra, 2018; Morehead, Dunlosky, Rawson, et al., 2019). More than 60% of college students wander off-task to read emails, check Facebook, or surf the internet while studying outside of the classroom (e.g., Jacobsen & Forste, 2011; Judd, 2013; Junco & Cotten, 2012; Mokharti et al., 2015; Rosen et al., 2013). Calderwood et al. (2014) observed college students studying during a 3-hour period and reported that students were distracted by their digital devices 35 times on average. Similarly, Junco and Cotten (2012) reported that students spent an hour on Facebook and sent more than 70 text messages per day while completing schoolwork. These digital distractions outside of the classroom have been found to decrease students' study time, schoolwork completion rates, assignment performance, course grades, and cumulative college grade-point average (Calderwood et al., 2014; Junco & Cotten, 2012; Lepp et al., 2014; Ravizza et al., 2014).

Instructors can perhaps curb digital distractions by following the instructional strategies recommended by Flanigan and Kiewra (2018), such as (a) improving student awareness of digital distractions, (b) adopting and enforcing classroom technology policies that limit unwarranted use of mobile technology, (c) planning active learning activities, such as small-group work and class discussions, to keep students engaged, and (d) using mobile technology as a teaching tool. However, such instructional strategies rely heavily on the instructor and do not tackle the core problem: Students are susceptible to distractions because they are not engaged in learning, and they are not engaged in learning because they do not really know how to learn effectively (Kiewra, 2021).

College students often use weak learning strategies when recording notes and when studying. Regarding note taking, most students record verbatim notes that capture only one-third of key lesson ideas (Flanigan & Titsworth, 2020; Jairam & Kiewra, 2010; Luo et al., 2016). Verbatim note taking is associated with "mindless" low-level processing (Mueller & Oppenheimer 2014, p. 1166), and incomplete note taking is associated with low achievement (Peverly et al., 2003; Williams & Worth, 2002). Regarding studying, students commonly (a) study notes in linear form (e.g., outlines or lists) rather than convert notes to graphic organizers, (b) learn in a piecemeal fashion (e.g., using flashcards to memorize individual facts one at a time) rather than meaningfully associate information, and (c) employ redundant practices (e.g., rereading or recopying their notes) rather than creating and answering practice questions mirroring those likely to be on the actual test (Daher & Kiewra, 2016; Dunlosky et al., 2013; Jairam & Kiewra, 2010; Morehead, Dunlosky, Rawson, et al., 2019; Wissman et al., 2011). As a result, student learning is not engaging, challenging, or productive, which opens the door for digital distractions (Flanigan & Kiewra, 2018; Lepp et al., 2014). Therefore, students need engaging and effective strategies if they are to avoid the temptations of digital distractions and boost achievement.

One potential means to engage students in meaningful learning and to offset digital distractions, both when recording notes in the classroom and when studying outside the classroom, is SOAR, an integrated strategy system developed by Kiewra (2005, 2009). SOAR is an acronym for the system's four components: select, organize, associate, and regulate. The select component is aimed at improving classroom note taking; the organize, associate, and regulate components are aimed at improving study behaviors outside the classroom.

In the remainder of this chapter, we describe (a) SOAR and document its theoretical and empirical support, (b) how SOAR's select component can improve note taking and perhaps curb digital distractions in the classroom, and (c) how SOAR's remaining three components (organize, associate, and regulate) can improve study behaviors and perhaps curb digital distractions outside the classroom.

SOAR

In this section, each SOAR component is described. Then, SOAR's theoretical and empirical support are each described.

SOAR Components

SOAR's first component, select, refers to selecting and noting all main ideas, relevant details, and examples from a lecture. For example, a complete set of notes from a lecture on operant conditioning might look like those in Figure 1. Research shows that note completeness is positively correlated with achievement (Baker & Lombardi, 1985; Kiewra, 1987).

SOAR's second component, organize, refers to organizing linearly noted ideas (like those in Figure 1) into graphic organizers such as hierarchies, sequences, and matrices, as shown in Figure 2. A hierarchy organizes information from top to bottom and reveals superordinate-subordinate relationships. A sequence organizes information from left to right and reveals order relationships. A matrix organizes information in columns (by topics) and rows (by categories) and reveals comparative relationships. The matrix is perhaps the most powerful organizer because it can be created by extending any hierarchy or sequence, resulting in a cross-classification table that allows one to see comparative patterns or associations with just a glance. Notice that the matrix in Figure 2 quickly and easily reveals this important relationship when examining a single matrix row: positive and negative reinforcement both increase behavior, whereas positive and negative punishment both decrease behavior. This same relationship is obscured in the Figure 1 notes, which would require the learner to examine four separate rows of information separated by intervening information to derive the same relationship.

SOAR's third component, associate, refers to connecting lesson ideas to one another or to other information in order to form meaningful relationships. There are two types of associations: internal and external. Internal associations are those made within the new material being learned. External associations are those made between the new material and ideas outside that new material, such as the learner's background knowledge. When examining the operant theory matrix in Figure 2, the following internal associations are evident:

- Reinforcement increases behavior, whereas punishment decreases behavior.
- Positive techniques involve presenting a stimulus, whereas negative techniques involve removing a stimulus.

In addition, external associations can be created by linking the new material with background knowledge, such as:

- An example of positive reinforcement is when a parent gives a child his favorite candy for reading 10 pages, and the child reads even more thereafter.
- An example of extinction is when one stops putting money into a vending machine when the machine does not dispense food.

SOAR's last component, regulate, refers to assessing one's own learning using practice questions in advance of real tests. Practice questions can tap various learning outcomes such as facts, relationships, concepts, and skills. Returning to the operant theory material, here are some sample practice items students might generate while studying:
Fact items:

- For which technique does behavior increase due to the removal of a stimulus?
- In time out, is the stimulus presented, removed, withheld, or unavailable?

Relationship items:

- Which two techniques involve a decrease in behavior?
- Which two techniques involve presenting a stimulus?

Concept items:

- Cars make a beeping sound until you fasten your seatbelt. What operant technique is this?
- When Julia gets her homework assignments done on time, her parents allow her to watch TV for 30 minutes. As a result, Julia completes homework assignments on time most every day. What operant technique is her parents using?

Skill items:

- Jacob does not like to do his house chores and finds excuses to escape these when his parents assign him chores to complete. Come up with a plan based on operant theory that gets Jacob to do his chores.
- Susie pulls books from a bookshelf whenever her father is around. Her father believes that Susie is doing this to gain his attention. Describe how Susie's father can use (a) extinction and (b) time out to solve this problem.

In summary, SOAR's first component, select, can help students focus their attention during classroom lectures as they seek to record effective notes, thereby limiting the threat of digital distractions.

SOAR's remaining components (organize, associate, and regulate) can help students engage with their study materials in meaningful and effective ways, thereby limiting the threat of digital distractions. In addition to the usefulness of each component, SOAR is an integrated strategy system with theoretical and empirical support.

Figure 1. A set of complete notes from the operant theory lecture

Operant Theory

Reinforcement
- o Positive Reinforcement
  - ▪ Behavior: Increased
  - ▪ Stimulus: Presented
  - ▪ Example: Animal performs desired trick, is given food, and does trick more often
- o Negative Reinforcement
  - ▪ Behavior: Increased
  - ▪ Stimulus: Removed
  - ▪ Example: Animal receives slight shock, animal performs desired trick, shock is turned off, animal does trick more often

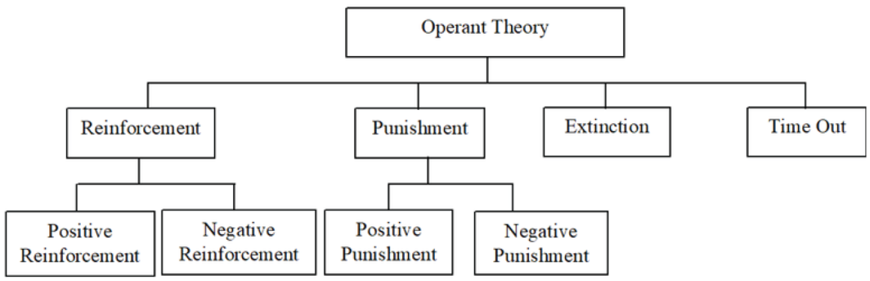
Punishment
- o Positive Punishment
  - ▪ Behavior: Decreased
  - ▪ Stimulus: Presented
  - ▪ Example: Student does not return library books on time, is reprimanded, and stops returning books late
- o Negative Punishment
  - ▪ Behavior: Decreased
  - ▪ Stimulus: Removed
  - ▪ Example: Student does not return library books on time, is fined, and stops returning books late

Extinction
- o Behavior: Decreased
- o Stimulus: Withheld
- o Example: Child throws tantrum (which has been reinforced previously with adult attention), adult ignores tantrum, tantrums stop occurring

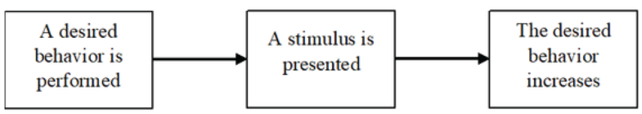
Time Out
- o Behavior: Decreased
- o Stimulus: Unavailable
- o Example: Child throws toys in his room, child is removed from his room, toy throwing occurs less often

Figure 2. Hierarchy, sequence, and matrix for operant theory

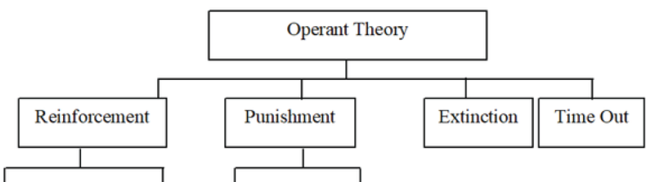
Hierarchy:



Sequence: Positive Reinforcement



Matrix:



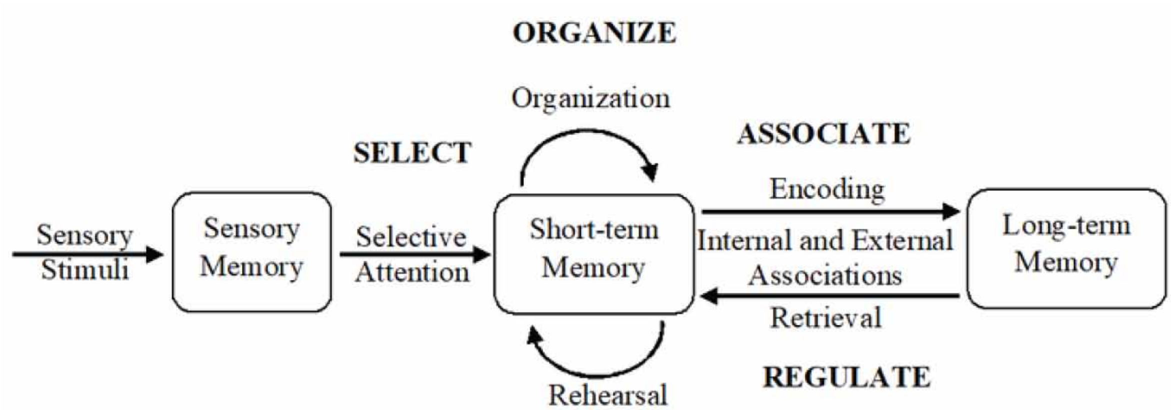
Type:	Positive Reinforcement	Negative Reinforcement	Positive Punishment	Negative Punishment		
Behavior:	Increased	Increased	Decreased	Decreased	Decreased	Decreased
Stimulus:	Presented	Removed	Presented	Removed	Withheld	Unavailable
Example:	Animal performs desired trick, is given food, and does trick more often	Animal receives slight shock, animal performs desired trick, shock is turned off, animal does trick more often	Student does not return library books on time, is reprimanded, and stops returning books late	Student does not return library books on time, is fined, and stops returning books late	Child throws tantrum (which has been reinforced previously with adult attention), adult ignores tantrum, tantrums stop occurring	Child throws toys in his room, child is removed from his room, toy throwing occurs less often

Theoretical Support

SOAR is rooted in the theoretical framework of information processing theory (Atkinson & Shiffrin, 1971). According to information processing theory (Atkinson & Shiffrin, 1997), learners engage in several cognitive processes as they acquire information. First, the attention process moves information from sensory memory to working memory. Next, the encoding process moves information from working memory to long-term memory. Finally, the retrieval process moves information from long-term memory back to working memory where it is accessible.

Each SOAR component is linked with one of these cognitive processes. As shown in Figure 3, the select component is linked to the attention process because attention determines what information is selected for further processing (Sternberg, 1985). The organize component is linked to the organization process in short-term memory because organized information can be processed more economically in short-term memory and eventually stored more economically in long-term memory (Baddeley, 2007). The associate component is linked to the encoding process because encoding depends on building associative links among ideas in memory and also aids information storage in long-term memory (Mayer, 1996). The regulate component is linked to retrieval because retrieval paths are strengthened by self-testing and other retrieval-based practices (Gettinger & Seibert, 2002; Karpicke, 2012). In summary, the SOAR system reflects and promotes effective information processing.

Figure 3. Memory system illustration with SOAR components in CAPS and bold (adapted from Kiewra, 2021)



Empirical Support

Thus far, five studies (Daher & Kiewra, 2016; Jairam et al., 2014; Jairam & Kiewra, 2009, 2010; Luo & Kiewra, 2019) have investigated the SOAR system for learning and writing among college students. Two of those studies (Jairam & Kiewra, 2009; Jairam et al., 2014) tested the effect of providing SOAR supplements to college students as they learned from a single text. College students were assigned randomly to SOAR or non-SOAR groups. SOAR groups were trained to use SOAR supplements, which consisted of a matrix organizer that selected and organized all text facts in a two-dimensional table, a list of associations, and regulation practice questions with provided answers. Non-SOAR groups were trained to use their preferred strategies (Jairam & Kiewra, 2009) or were trained to use the popular SQ3R (survey, question, read, review, recite) strategy system (Jairam et al., 2014). In both studies, all participants practiced their strategies, studied a single text using provided materials and trained strategies, and were tested. SOAR studiers outperformed non-SOAR studiers (both preferred-strategy users and SQ3R studiers) on relationship learning, with large effect sizes. Furthermore, SOAR studiers outperformed SQ3R studiers on fact learning and concept learning (Jairam et al., 2014), with medium to large effect sizes.

Jairam and Kiewra (2010) also investigated the effectiveness of student-constructed SOAR materials in a computer-based learning environment. Students asked to study a computer-based text either received construction aids that helped them create their own SOAR study materials (SOAR group) or received no construction aids and created their own preferred study materials (non-SOAR group). Following the study period, students completed a test. The SOAR group outperformed the non-SOAR group on both fact and relationship test items, with large effect sizes. SOAR's advantage was especially robust for relationship learning: SOAR studiers scored almost four times higher than non-SOAR studiers.

Daher and Kiewra (2016) extended SOAR investigations by examining whether students can be trained to create SOAR materials independently when learning from multiple texts. College students were assigned randomly to either the SOAR group or the non-SOAR group. The SOAR group received 30 minutes of SOAR training and practice using three texts. The non-SOAR group received the same practice texts but was instructed to use their preferred study strategies during the 30-minute training period. Following training, participants studied five new texts and created their own study materials on a provided notepad before taking an achievement test covering fact, relationship, and concept learning. SOAR training positively impacted study behaviors. The SOAR group recorded more notes (select), created more graphic organizers (organize), and generated more associations (associate) and practice questions (regulate) than the non-SOAR group, with medium to large effect sizes. Furthermore, the SOAR group outperformed the non-SOAR group on all three tests: fact (74% vs. 65%), concept (57% vs. 46%), and relationship (70% vs. 39%), with the largest effect size for relationship learning.

SOAR was also investigated in two experiments as an aid for writing from multiple texts, also known as synthesis writing (Luo & Kiewra, 2018). Experiment 1 examined whether providing students with SOAR supplements improved synthesis writing. Experiment 2 examined whether training students to create their own SOAR materials improved synthesis writing. In both experiments, SOAR helped students write better synthesis essays. Experiment 1 found that providing students with SOAR supplements helped them produce more complete essays (select), better-organized essays (organize), and essays containing more intertextual connections (associate). Experiment 2 showed that training students to create their own SOAR materials improved information selection and essay organization.

In summary, these SOAR investigations found that SOAR-based methods were more effective than non-SOAR methods for aiding (a) text learning (Jairam & Kiewra, 2009; Jairam et al., 2014), (b) computer-based text learning (Jairam & Kiewra, 2010), (c) multiple-text learning (Daher & Kiewra, 2016), and (d) writing from multiple texts (Luo & Kiewra, 2019). There is also evidence from surveys that students enjoy SOAR and find it more engaging than their typical learning strategies (Daher & Kiewra, 2016; Jairam & Kiewra, 2009; Luo & Kiewra, 2019).

In the next two sections, we describe and demonstrate how SOAR methods can curb digital distractions and aid learning in classroom settings as students learn from lectures and outside classroom settings while studying for tests.

HOW SOAR CAN CURB DIGITAL DISTRACTIONS AND AID LECTURE LEARNING

Students are distracted by mobile digital devices when in class. Laptop computers and smart phones afford students easy access to the internet and other non-academic applications such as games, emails, and social media. As reviewed earlier, several studies reported that students often engage in off-task activities when they use laptop computers during classroom lectures (e.g., Carter et al., 2017; Glass & Kang, 2019; Morehead, Dunlosky, Rawson, et al., 2019; Ravizza et al., 2017) or have smart phones available in class (Kornhauser et al., 2016; Kuznekoff et al., 2015; Kuznekoff & Titsworth, 2013; Lawson & Henderson, 2015). The temptation to use digital devices for non-academic activities in class increases when students feel bored during the lecture (Baker et al., 2012; Tindell & Bohlander, 2012). One way that students can combat digital distractions during lecture learning is to employ effective note-taking strategies (Brady et al., 2021; Flanigan & Kiewra, 2018), as advocated by SOAR's select component. Effective note taking encourages students to focus attention on the lecture (Katayama & Crooks, 2003; Kobayashi, 2005; Piolat et al., 2005) and prompts them to meaningfully assimilate lecture ideas with prior knowledge (Peper & Mayer, 1986; Shrager & Mayer, 1989). Such cognitively demanding activities are also likely to minimize boredom (Westgate & Wilson, 2018).

Note taking is one of the most practiced learning strategies among college students historically and presently (Charters, 1924, 1925; Danskin & Burnett, 1952; Hartley & Davies, 1978; Morehead, Dunlosky, Rawson, et al., 2019; Peverly & Wolf, 2019; Van Meter et al., 1994). In a recent survey of nearly 600 college students (Morehead et al., 2019), 96% of them reported taking notes in classes (both in-person and online classes), and 88% deemed note taking as essential for learning. Students are correct and wise to record lecture notes because note taking boosts achievement (Kiewra, 1989; Kobayashi, 2005, 2006).

The bad news, though, is that most students are incomplete note takers, recording just one-third of important lesson ideas (Austin et al., 2004; Flanigan et al., submitted; Luo et al., 2016; Titsworth, 2004). Furthermore, students note fewer lesson ideas as lectures proceed and attention wanes (Scerbo et al., 1992). Incomplete note taking is problematic because it is linked with lower achievement (Peverly et al., 2003; Williams & Worth, 2002), and it opens the door for digital distractions to take hold because lesson engagement is weak. Therefore, it stands to reason that if instructors can boost student note taking, then the temptation and opportunity to engage digital distractions is lessened. SOAR's first component, select, targets note taking and provides ways to increase notes. Next, instructional methods for boosting note taking are reviewed.

Require or Suggest Longhand Note Taking

Several studies investigating longhand versus laptop note taking during lectures (Bui et al., 2013; Fiorella & Mayer, 2017; Flanigan et al., submitted; Luo et al., 2018; Morehead, Dunlosky, & Rawson, 2019; Mueller & Oppenheimer, 2014) revealed that longhand note taking promotes more meaningful processing than laptop note taking. Students recording notes on laptops tend to transcribe instead of think. They record notes in a verbatim fashion reflective of shallow, less-meaningful processing. Longhand note takers, meanwhile, tend to record paraphrased notes reflective of deeper, more meaningful processing. Not only does longhand note taking result in more meaningful processing, but it produces more meaningful notes than laptop note taking. Longhand notes tend to be more paraphrased (Bui et al., 2013; Luo et al., 2018; Mueller & Oppenheimer, 2014), include more signals designating what is most important (Luo et al., 2018), and include more images (Fiorella & Mayer, 2017; Flanigan et al., submitted; Luo et al., 2018) than laptop notes, rendering longhand notes more meaningful for later review than laptop notes (Luo et al., 2018). In some cases, longhand note taking also produces higher achievement than laptop note taking (Flanigan et al., submitted; Luo et al., 2018; Morehead, Dunlosky, & Rawson, 2019; Mueller & Oppenheimer, 2014). Results from these studies favoring longhand note taking are even more compelling because all of them were conducted under controlled settings where students could not use their laptops to cyber-slack (e.g., surf the internet, check email, play games) as they are apt to do. When students use a laptop computer to take notes in an actual class, they might receive notifications on their computer (e.g., a new email message, breaking news) or simply choose to surf the Net, which can distract them from the lecture and note taking. In fact, non-academic internet use is common practice among laptop note takers attending lectures (Morehead, Dunlosky, & Rawson, 2019; Ragan et al., 2014; Ravizza et al., 2017). Therefore, taking longhand notes not only produces better notes than laptop note taking, it also lessens the obvious temptations and distractions that laptops offer.

Although longhand note taking aids lecture learning, recording longhand notes might be more difficult for students with learning disabilities (Hughes & Suritsky, 1994; Suritsky & Hughes, 1991). Students with learning disabilities often struggle with handwriting, spelling, paying attention to the lecture, and identifying important information to record (Boyle & Rivera, 2012; Hughes & Suritsky, 1994). Nonetheless, research shows that even for students with learning disabilities, longhand note taking benefits lecture learning (Boyle, 2010), especially when provided with note-taking frameworks, lecture cues, or lecture pauses (Boyle & Rivera, 2012).

Provide Note-Taking Frameworks

Instructors can provide note-taking frameworks, also called partial notes, to better engage students while note taking and to help them record a more complete set of notes. Note-taking frameworks provide a lesson's main ideas or terms interspersed with blank spaces for note taking to complete those provided ideas.

For example, imagine a psychology lecture wherein the instructor is teaching about schedules of reinforcement as shown in the boxed portion of Figure 4. The instructor can provide a note-taking framework in an outline form (Figure 5) or in a matrix form (Figure 6) to boost student note taking. In one study (Kiewra et al., 1995), students attended a lecture and recorded notes with or without a matrix framework. Students using the matrix framework recorded more lecture ideas and scored higher on an achievement test than those who took notes without the matrix framework. A recent study (Ponce et al., 2020) upheld the benefit of note-taking frameworks in that students given a matrix framework for note taking scored higher on a posttest than students who took notes without the framework. Furthermore, this study used eye tracking to reveal that students using a matrix framework engaged in more meaningful (comparative) processes than those without the note-taking framework. Additionally, note-taking frameworks also improve note taking among students with learning disabilities (Boyle & Rivera, 2012; Hamilton et al., 2000).

Figure 4. A lecture on schedules of reinforcement

Schedules of Reinforcement

Okay, class, we've just covered reinforcement. Now, we'll see that there are different schedules one might use in delivering reinforcement. Suppose you have a pigeon, and you want to train it to peck a key. To train the pigeon, you reinforce it by giving it food pellets for pecking the correct keys. Today, we will cover four schedules of reinforcement and five categories common to each. The type of schedule used determines several things about the pigeon's behavior.

First, let's talk about reinforcement delivery for fixed-ratio schedules. Fixed-ratio schedules deliver reinforcement following a fixed number of responses. The pigeon, for example, might receive food following every 10 key pecks. Fixed-ratio schedules produce rapid responding, although the pigeon pauses briefly following reinforcement. It is relatively easy to extinguish (eliminate) behaviors learned on this schedule.

Variable-ratio schedules deliver reinforcement after a predetermined but variable number of responses. The pigeon, for example, might receive food after making 5, 15, 2, and 18 pecks for an average ratio of 10 pecks. Now let's address the response pattern associated with variable-ratio schedules. Variable-ratio schedules produce rapid and steady responses. It is difficult to extinguish behaviors learned on this schedule.

Fixed-interval schedules deliver reinforcement following the first response after a fixed time interval. The pigeon, for example, might receive food for its first peck after a 10-second interval. Fixed-interval schedules produce slow response rates that contain pauses in responding. It is relatively easy to extinguish behaviors learned on this schedule.

Variable-interval schedules deliver reinforcement following the first response after a predetermined but variable time interval. The pigeon, for example, might receive food following intervals of 5, 15, 2, and 18 seconds for an average interval of 10 seconds. Variable-interval schedules produce slow but steady response rates. It is difficult to extinguish behaviors learned on this schedule.

Figure 5. Note-taking outline framework for schedules of reinforcement

Schedules of Reinforcement

Fixed Ratio

Reinforcement delivery:

Example:

Response rate:

Response pattern:

Extinction:

Variable Ratio

Reinforcement delivery:

Example:

Response rate:

Response pattern:

Extinction:

Fixed Interval

Reinforcement delivery:

Example:

Response rate:

Response pattern:

Extinction:

Variable Interval

Reinforcement delivery:

Example:

Response rate:

Response pattern:

Extinction:

Figure 6. Note-taking matrix framework for schedules of reinforcement

	Schedules of Reinforcement			
	Ratio		Interval	
	Fixed	Variable	Fixed	Variable
Reinforcement delivery:				
Example:				
Response rate:				
Response pattern:				
Extinction:				

When providing note-taking frameworks, it is important to include ample space for note taking. The larger the space provided, the more notes students include (Boyle, 2012; Hartley, 1976). In the same vein, when providing PowerPoint slides during lectures, there should be ample space on or below each PowerPoint slide for students to take notes. In a study comparing students' lecture note taking with or without PowerPoint slides (Susskind, 2005), students guided by PowerPoint slides recorded more extensive and organized notes compared to those who took notes without PowerPoint slides. When providing PowerPoint slides, note-taking space should be in close proximity to the slide content so that associations between presented information and notes are easily made, as supported by Mayer's spatial contiguity principle for designing instructional materials (e.g., Moreno & Mayer, 1999).

Provide Pre-Questions

Providing a set of questions prior to a lecture alerts students to key lesson ideas and guides note taking. Several studies confirm that pre-questions boost both note taking and achievement (e.g., García-Rodicio, 2015; Ponce et al., 2020; Rickards & McCormick, 1988; Weinstein et al., 2010). In one study (Rickards & McCormick, 1988), students who received pre-questions noted more critical information from the lesson that followed and performed higher on a recall posttest than those who did not receive pre-questions. A recent study (Ponce et al., 2020) using eye tracking to explore how pre-questions direct attention found that pre-questions focused student attention on key lesson ideas and promoted generative (relationship) learning.

Returning to the schedules of reinforcement lecture, the instructor can provide a set of pre-questions, such as:

- What are the four schedules of reinforcement?
- What is the response rate for each schedule?
- What is the response pattern for each schedule?
- Which schedules are difficult to extinguish?

Provide Lecture Cues

Instructors can also use cues to direct students' attention and bolster note taking. There are two types of note-taking cues: importance and organizational. Importance cues refer to written, verbal, or nonverbal cues that signal important information. For example, instructors can write key concepts on the board (e.g., the four types of reinforcement schedules). One study found that students recorded 86% of information written on the board (Locke, 1977). Instructors can also cue students by saying things like, "This is important," or by repeating critical information (e.g., a definition) to signal its importance. Another study (Scerbo et al., 1992) found that providing importance cues especially boosted students' note taking in the middle segment of a three-segment lecture. Even though note taking declined in both the cued and un-cued groups as the lecture advanced, cued students recorded more notes in the middle segment and performed better on a recall test than did un-cued students.

Organizational cues convey a lesson's structure. For example, an instructor can begin a lesson by saying, "Today, we will cover *four schedules of reinforcement* and *five categories common* to each. Other organizational cues might include: *First,* let's talk about *response delivery* for *fixed-ratio schedules*," and "Now let's address *the response pattern* associated with *variable-ratio schedules*. Organizational cues, such as these, boosted students' note taking and achievement (Titsworth, 2001; Titsworth & Kiewra, 2004). Titsworth and Kiewra (2004) reported that students receiving organizational cues noted about 40% more organizational points and 45% more details than those not receiving cues. Moreover, cued students scored higher on posttests than did un-cued students. Lecture cues also aided note taking among students with learning disabilities (Boyle & Rivera, 2012; Hughes & Suritsky, 1994). For example, Hughes and Suritsky found that college students with learning disabilities recorded about 30% more cued notes than un-cued notes.

Provide Pauses for Note Taking and Revision

Students struggle with lecture note taking, in part, because of lecture processing demands (Bui & Myerson, 2014; Peverly et al., 2013). College students can only write about 22 words per minute (Brown, 1999; Connelly et al., 2005) and type about 50 words per minute (Dhakal et al., 2018), while most college lectures are delivered at about 100–175 words per minute (Simonds et al., 2006; Wong, 2014). Therefore, students, in general, and students with learning disabilities (Suritsky, 1993), in particular, are not well equipped to record complete lecture notes. Rapid lecture rates might cause students to fall behind, become frustrated, and abandon note taking, thereby further opening the door for digital distractions to command their attention.

Instructors can provide pauses throughout lectures to allow students to revise notes and make them more complete. During revision, noted ideas serve as retrieval cues for later recalling and recording associated lecture information that was not originally noted. In a two-experiment study (Luo et al., 2016), students in Experiment 1 who revised notes following a lecture had more notes and higher achievement than students who recopied their notes, as many students are apt to do. In Experiment 2, students were given time to either revise their lecture notes during pauses spaced throughout the lesson or just one time at the end of the lesson. Revising during lesson pauses produced greater note taking and achievement than revising just once at the end, with revision time constant across the groups. Another study (Flanigan et al., submitted) confirmed that when students revise notes during lecture pauses their notes are made more complete. This was especially true for longhand note takers who added three times as many lesson ideas to their notes during pauses than did computer note takers.

Lecture pauses also aid note taking and achievement for students with learning disabilities (Boyle & Rivera, 2012; Suritsky, 1993). Ruhl and Suritsky (1995) assigned college students with learning disabilities to view a 15-min videotaped lecture with or without pauses. The pause group viewed the lecture with three 2-min pauses interspersed throughout the lecture, during which students could revise and update their notes, whereas the no-pause group viewed the entire lecture without pauses. Immediately after the lecture period, students completed a free recall test. The pause group scored higher on the free recall test and recorded more complete notes than the no-pause group.

Note-Taking Summary

Students are often tempted by digital distractions when they use laptop computers during lectures (e.g., Carter et al., 2017; Glass & Kang, 2019; Morehead, Dunlosky, Rawson, et al., 2019; Ravizza et al., 2017). Students are especially vulnerable when they are bored and disengaged from the lecture (Baker et al., 2012; Tindell & Bohlander, 2012). One way to combat digital distractions during lecture learning is to boost student note taking (Brady et al., 2021; Flanigan & Kiewra, 2018). Although most students record notes, their note taking is often incomplete, recording just one-third of important lesson ideas. SOAR's first component, select, suggests a range of instructional strategies aimed at boosting note taking, including (a) requiring or suggesting longhand note taking, (b) providing note-taking frameworks, (c) providing pre-questions, (d) providing lecture cues, and (e) providing pauses for note taking and revision. These instructional strategies for increasing note taking have proven effective for the general student population and for students with learning disabilities. Students guided by these instructional methods are more likely to remain on task, sidestep the lure of digital distractions, and have more complete notes and higher achievement than those not guided by these methods.

HOW SOAR CAN CURB DIGITAL DISTRACTIONS AND AID STUDYING

Students not only profit from the process of note taking, they also profit from the product produced by note taking as they study those notes in preparation for tests. Studying notes increases achievement beyond non-studying, because it affords students further opportunity to make sense of notes as they organize them, create associations, and regulate learning, thereby better committing noted information to memory (Armbruster, 2000; Katayama & Robinson, 2000; Kiewra, 1989; Kobayashi, 2005, 2006). However, when studying notes, many students leave their notes unorganized (Rachal et al., 2007) or simply arrange them in a linear format such as lists or outlines (Gubbels, 1999). Linear organization obscures relationships and restricts relationship learning (Kiewra et al., 1999). Students also employ piecemeal learning when studying, which refers to learning one idea at a time, rather than meaningfully associating them (Gubbels, 1999). Furthermore, students simply re-read or re-write their notes (Bausch & Becker, 2001) even though repetition strategies are less effective than regulation strategies such as practicing retrieval or generating practice questions (Anderson, 1995; Karpicke, 2012; Weinstein et al., 2010). Overall, these weak strategies often fail to engage students in learning, thereby making them more vulnerable to digital distractions.

Therefore, students need to study in more attention-maintaining and effective ways. SOAR could be the solution. SOAR's remaining three components involve organizing notes, associating noted ideas, and regulating learning. If students engage in these study strategies, they will likely be less distracted by their digital devices and achieve more. To make this happen, instructors can provide SOAR materials that help students study more effectively and avoid digital distractions. The remainder of this section demonstrates how instructors might provide SOAR study aids to students. This chapter's concluding section describes and demonstrates how instructors might teach students how to engage SOAR strategies on their own.

Organize

Most students record notes in a linear fashion and are content to study notes in that way even though studying graphically organized notes produces higher achievement than studying linear notes (Kiewra et al., 1999; Robinson & Kiewra, 1995). SOAR's organize component helps convert linear notes to graphic organizers, such as hierarchies, sequences, and matrices.

Figure 7. Complete notes for schedules of reinforcement

Schedules of Reinforcement

Fixed Ratio
- Reinforcement delivery: after fixed number of responses
- Example: pigeon fed after 10 pecks
- Response rate: rapid
- Response pattern: pause after reinforcement
- Extinction: easy

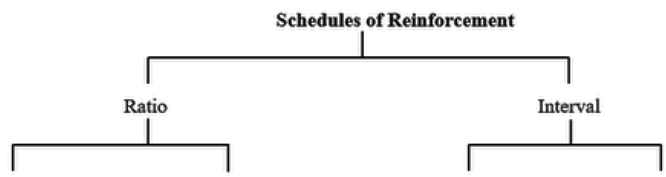
Variable Ratio
- Reinforcement delivery: after predetermined but variable number of responses
- Example: pigeon fed after 5, 15, 2, and 18 pecks
- Response rate: rapid
- Response pattern: steady
- Extinction: difficult

Fixed Interval
- Reinforcement delivery: after fixed time interval
- Example: pigeon fed for 1st response after 10 sec interval
- Response rate: slow
- Response pattern: pause after reinforcement
- Extinction: easy

Variable Interval
- Reinforcement delivery: after predetermined but variable time interval
- Example: pigeon fed after 5, 15, 2, and 18 sec intervals
- Response rate: slow
- Response pattern: steady
- Extinction: difficult

Returning to the schedules of reinforcement example, Figure 7 shows an example of complete notes from the lecture in a linear format. Figure 8 shows the same information in a matrix format. The instructor can provide graphic organizers like that in Figure 8 for students to study. Notice that the matrix places information that belongs together in close proximity, such as the response pattern information in the matrix's 4th row. The linear notes, meanwhile, place this same information over four different rows separated by intervening information. When related information is placed in close proximity, what Kauffman and Kiewra (2010) call localization, it is much easier and faster to form the kind of associations shown in the next section.

Figure 8. Matrix organizer for schedules of reinforcement



	Fixed	Variable	Fixed	Variable
Reinforcement delivery:	Reinforce after fixed number of responses	Reinforce after predetermined but variable number of responses	Reinforce first response after fixed time interval	Reinforce first response after predetermined but variable time interval
Example:	Food after every 10 key pecks	Food after 5, 15, 2, and 18 key pecks	Food for first key peck after 10 seconds	Food for first key peck after 5, 15, 2, and 18 seconds
Response rate:	Rapid	Rapid	Slow	Slow
Response pattern:	Pauses	Steady	Pauses	Steady
Extinction:	Easy	Difficult	Easy	Difficult

Associate

Most students fail to associate ideas and instead try to learn them separately in a piecemeal fashion (Gubbels, 1999; Jairam & Kiewra, 2010). Instructors can provide students with internal and external associations. Internal associations connect ideas within the newly learned material. External associations connect ideas from the new material with ideas outside that new material, usually stemming from the learner's background knowledge. An instructor can help students associate information in the Figure 8 organizer, by providing the following internal and external associations:
Internal:

- Ratio schedules deliver reinforcement based on the number of responses made, whereas interval schedules deliver reinforcement based on the amount of time passed since the last reinforcement.
- Ratio schedules result in a rapid response rate, whereas interval schedules result in a slow response rate.
- Fixed schedules deliver reinforcement based on a fixed number of responses (fixed ratio) or a fixed amount of time (fixed interval).

- Fixed schedules produce pauses in responding, whereas variable schedules produce steady responding.

External:

- Fixed ratio example: A salesperson receives a commission for every five cars sold.
- Variable interval example: When teachers evaluate students using pop quizzes, students' studying behavior is steady throughout the semester because they never know when a quiz is forthcoming.
- To remember that variable schedules are difficult to extinguish, remember that something variable, such as the stock market, is difficult to predict.
- To remember that ratio schedules produce rapid responding, remember the three Rs: ratio, rapid, and responding.

Regulate

When students study, they often do so in a redundant fashion by rehearsing or recopying their noted information. This is ineffective (Nist & Holschuh, 2000). Meanwhile, students fail to regulate their learning (e.g., "Am I ready for the test?"). Instructors can help students regulate their learning by providing them with regulation materials such as practice test questions. Karpicke (2012) reported that students who practiced recalling newly learned material outperformed students who simply re-studied the material. Instructors can provide students with practice questions that tap various learning outcomes such as facts, relationships, concepts, and skills. Returning to the schedules of reinforcement material, here are some sample practice items an instructor might provide to promote regulation while studying:
Fact items:

- What are the four schedules of reinforcement?
- What is the response pattern associated with variable ratio schedules?

Relationship items:

- Which schedules of reinforcement deliver reinforcement based on time?
- Which schedules of reinforcement produce steady responding?

Concept items:

- Max's mother is trying to encourage Max to read more. Therefore, she gives him a candy bar for every 20 pages read. Which schedule of reinforcement is Max's mother using?
- Lisa's math teacher gives pop quizzes throughout the semester. Sometimes, the teacher gives two quizzes in one week. But other times, the teacher doesn't give a quiz for more than two weeks. Because Lisa never really knows exactly when the teacher might give a pop quiz, she studies every day to make sure that she is prepared. Which schedule of reinforcement does this example represent?

Skill items:

- Ms. Lee is trying to teach a disruptive student to raise her hand and wait for her turn before speaking. Based on schedules of reinforcement, come up with a reinforcement plan for Ms. Lee.
- A new restaurant offered a 20% discount every day for the first month and attracted a good number of customers. Moving forward, the restaurant wants to keep the customers without having to offer a 20% discount every day. Come up with a reinforcement plan for the restaurant owner.

Studying Summary

Instructors can provide students with SOAR study materials that aid learning and likely diminish the threat of digital distractions. Effective SOAR study materials include graphic organizers that organize information spatially so that related information is in close proximity, both internal and external associations, and practice test questions that aid regulation. When students study SOAR materials, they are more likely to be engaged in learning than if they study linear information one idea at a time in a redundant fashion. And, when students are engaged in meaningful learning, they are less likely to succumb to digital distractions. Just how to best teach students SOAR strategies is addressed in the concluding section that follows.

CONCLUSION

Digital distractions have a detrimental impact on students' lecture learning and studying (e.g., Flanigan & Titsworth, 2020; Hawi & Samaha, 2016; Liu et al., 2017; Ravizza et al., 2017; Taneja et al., 2015). When students use weak learning strategies during lectures and while studying, they are more likely to feel bored and disengage from learning (Baker et al., 2012; Tindell & Bohlander, 2012), which opens the door for digital distractions. One way that students can combat digital distractions is to employ effective learning strategies (Brady et al., 2021; Flanigan & Kiewra, 2018; Rosen et al., 2013). We described established SOAR methods that instructors can use to potentially improve student strategy use and offset the digital distractions student confront while learning during lectures inside the classroom and while studying on their own outside the classroom. Specifically, SOAR's first component, select, can be applied to curb digital distractions during lecture learning as teachers use various instructional strategies to help students record better notes. SOAR's other three components, organize, associate, and regulate, are powerful tools to combat digital distractions when students study on their own because these strategies require students to interact meaningfully with the study materials and monitor their learning. Therefore, instructors should guide students to use SOAR methods inside and outside the classroom.

As to how best to teach students SOAR strategies, Kiewra (2009) argues that instructors who already provide students with effective SOAR materials are just one step away from teaching students to SOAR on their own. The additional step is embedding strategy instruction in content instruction. For example, to teach students how to organize their operant conditioning notes, or any set of notes thereafter, an instructor might provide students with the operant conditioning graphic organizer (Figure 2) and then embed instruction on how students can create such organizers on their own. The embedded instruction might sound like this.

"Class, I noticed that many of you left your notes on operant conditioning in a linear format after you recorded them. With linear notes, it's difficult to spot relationships among the different types of operant techniques. So, I'm handing out a matrix organizer that allows you to better compare the different operant techniques. Research shows studying notes in graphic organizers like this matrix leads to better learning outcomes than studying notes in linear displays like outlines or lists.

"Let me show you how you can arrange your operant conditioning notes in a matrix organizer. A matrix is a cross-classification table that highlights comparisons among topics, such as the various operant techniques. To create this matrix, I put the six operant techniques in the top row as these are the main topics to compare. Next, I put the categories common to all operant techniques in the leftmost column. Finally, I filled in the details related to topics and categories in the corresponding cells. With this matrix, it is easy to spot relationships like positive techniques involve presenting a stimulus, whereas negative techniques involve removing a stimulus. Such relationships would be hard to spot in a set of linear notes.

"After this class, try to organize your notes in this way from today's lesson on reinforcement schedules. Then see what relationships you can spot in the matrix. When you organize information in this way and find relationships, you are likely to be less distracted by your technology devices and more likely to learn than if you leave notes in a linear form and study one idea at a time by repeating it over and over…."

In conclusion, SOAR-minded instructors employ effective instructional strategies and supply instructional materials that help students SOAR to success. They also embed strategy instruction within content instruction so that student learn to SOAR on their own. And, once students are SOARing, they are less likely to become distracted by their mobile devices and more likely to record effective notes, to study effectively, and to boost achievement.

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