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How Metacognitive Instructors Can Use Their Learning Management System to Facilitate Student Learning

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Abstract: This article explores ways instructors can be metacognitive about course design and delivery, including using tools in their institution's learning management system (LMS) to support student learning. It offers strategies for being intentional about learning within the LMS and examples of online modules that can be directly incorporated into course instruction or can be self-contained, student directed, and stand-alone. It argues that purposeful use of LMS tools can provide opportunities for instructors to monitor student progress toward learning goals, make adjustments to their instructional method, and offer students opportunities to learn about their own learning.

Keywords: backward design, scaffolding, self-regulation, learning management system.

Metacognitive instructors are intentional about how they facilitate student learning (Scharff & Draeger, 2015). They ask questions about when, why, and how students need to acquire knowledge and skills. They monitor student progress before, during, and after class so they can make adjustments that better facilitate student learning (Tanner, 2012). We define metacognition as an ongoing awareness of a process (self-monitoring) with a willingness to use that awareness to make intentional adjustments when necessary (self-regulation). In this article we focus on three processes, namely, course design, course delivery, and student learning. The goal is to help instructors become more metacognitive about their instructional process, including intentional course design, purposeful use of tools in a learning management system (LMS), monitoring student progress, and making adjustments based on student need. Metacognitive instructors can also help students develop their own metacognitive habits.

Promoting Metacognition Through Backward Design

This article promotes metacognition in four interrelated ways. First, it encourages instructors to be intentional about their course design. Metacognitive instructors ask questions. Who are the students in the course? What knowledge and experiences are they likely to bring? What do they need to know by the time they leave the course? What skills will they need to practice? In answering such questions, instructors can better understand what is most relevant to the student experience and how a learning environment can be set up to foster that learning.

An instructional design framework can guide instructors through the course design process. Principles of backward design, for example, ask instructors to consider their content and determine what is most worth learning. This framework asks instructors to identify the desired results, appropriate assessments, and learning experiences. It asks what learning needs to happen by the end of the semester and then backtracks to figure out the steps to get students there. It helps align learning activities and assessments with desired learning objectives (Wiggins & McTighe, 2005). When instructors make the rationale behind their teaching transparent, students can better understand why they are engaging in course tasks (Hattie, 2012). Purposefully designed courses with a clear rationale also provide benchmarks for regular check-ins with students, a common vocabulary to discuss progress toward learning goals, and opportunities to make meaningful adjustments.

Second, intentional course design includes using the right features within an LMS for a given course context. How can difficult content be broken into digestible chunks? What guidance can be offered to help students engage with that content in meaningful ways? How might class sessions build on each other for maximum effect? How might online material offer guidance and support? Such questions extend from choices about course design to choices about features within an LMS that can help facilitate student learning. Using a backward design approach, for example, can ensure that the relationship between learning objectives, assessments, activities, and technology is intentional. Course design that demonstrates intentional alignment can help students realize the purpose and relationship between the objectives, assessments, and learning activities (Kumar et al., 2019). Intentionally designing a course within an LMS using the same design principles can promote transparency and reinforce the relevance of each course component.

Third, metacognitive instruction requires continuously monitoring student progress toward the learning goals established during course planning and making appropriate adjustments (Tanner, 2012). Metacognitive instructors regularly check in with their learners. Do students know what they need to know? Are they developing the skills they need to develop? Are students progressing according to the plan? If not, what is standing in the way? What changes might need to be made to get them back on track? Metacognitive instructors select features and tools within an LMS that provide them with opportunities to monitor student progress and make meaningful adjustments. These tools can provide students with multiple pathways to learning and ample opportunity to practice. This is good for students because it supports a variety of learning needs, but it is also good for instructors as a way to track student progress. If students are not making anticipated progress, then instructors can adjust in their face-to-face meetings or apply further interventions through an LMS. Likewise, if students are regularly asked to reflect within an LMS (e.g., journals, discussion boards), then their responses can give instructors further insight into why and how students are struggling as well as provide opportunities to discover student strengths that might not otherwise be apparent.

Intentional course design, purposeful use of tools within an LMS, and continuously monitoring student progress are all strategies employed by metacognitive instructors. Each promotes student learning, especially when they are purposefully aligned.

The fourth theme calls attention to student metacognition. In particular, intentional use of tools within an LMS can help students learn about their own learning. The literature demonstrates that student learning improves when students engage in metacognition. For example, students with gains in metacognition have shown improvement in reading comprehension (Dabarera et al., 2014), problem solving (Promentilla et al., 2017; Schraw et al., 2006), critical thinking (Hogan et al., 2015), writing ability (Negretti, 2012), study skills (Mynlieff et al., 2014; Thiede et al., 2003), exam performance (Isaacson & Fujita, 2006), and the transfer of key skills from one learning context to another (Billing, 2007). Moreover, students with heightened metacognition are more likely to take ownership of their own learning (Panadero et al., 2017; Wolters & Hussain, 2015). Metacognitive learners are aware of what they are doing and why. They use that awareness to make intentional adjustments to their learning strategies to learn more effectively. They consider their learning context (e.g., what type of learning is being called for in a particular class session or project), their approach to learning (e.g., whether they are prepared for the task at hand), and the strategies that are called for in each particular learning environment (e.g., what skills and competencies could contribute to success on a current project). Metacognitive instructors use features within an LMS that offer opportunities for self-directed learning, frequent self-monitoring, and strategies for meaningful adjustment.

The following sections illustrate these themes in several learning contexts. One considers ways of using features within an LMS to organize student learning and provide regular opportunities for reflection, practice, and engagement with the material. One considers online modules that are self-contained, student directed, and optional. Another considers online strategies that can enhance face-to-face, blended, or online instruction. These examples can be adopted or adapted depending on the needs of a course and the students. This again underscores the importance of metacognitive instruction and being intentional about how learning is facilitated.

Being Metacognitive About Using an LMS to Support Instruction

This section explores concrete strategies that can align course goals with LMS elements and provide opportunities to monitor students' learning progress. Many instructors, for example, aim to cover a certain amount of content. Instructors may want students to exit the course with the essential building blocks to be successful in the next course in a sequence or their program of study. Or instructors might want students in an elective course to come away with an appreciation of an academic discipline not their own. Backward design encourages instructors to align assessments and activities according to the learning objectives. It recommends developing a reasonable timeline and using a chunking strategy to organize course content (Wiggins & McTighe, 2005).

An LMS can often serve as a repository for course resources (e.g., syllabus, handouts, course assignments) and as a tool for communication (e.g., announcing upcoming assignments, gradebook, feedback on assessments). In this view, an LMS can support face-to-face instruction. Even so, metacognition can guide course structure and content organization. Course design elements available within an LMS can be used so the course visually represents those important features and reinforces the purpose of course content and learning activities to students. Even something as simple as changing the label from "unit one" to the name of the big idea contained in that unit can signal an instructor's intent to be explicit about big ideas. Including the associated student learning objectives within each module or unit is another strategy instructors can use to be explicit about the intended goal of the content and learning activities (Knowles, 1984). Likewise, announcements and calendar functions can be set up to be as explicit as possible about course expectations and the importance of completing assignments in a timely manner.

Intentional course design within an LMS can also reinforce knowledge acquisition. If, for example, students need to be able to identify important concepts as building blocks for more advanced learning, then self-guided videos with quizzes offering correct/incorrect feedback can be developed to give students unlimited practice opportunities. Adaptive release settings could also be used to provide custom feedback generated by a specific score on an assessment item. For example, if a student answered a question incorrectly, they could receive immediate prepopulated feedback from the instructor based on the answer provided.

Likewise, an LMS can monitor student performance on a particular assignment. If a student falls below a certain threshold, then adaptive features can unlock additional opportunities to reinforce learning. Instructors can use data from quizzes, assignments, and other learning activities to make adjustments along the way. Metacognitive course design can result in tailored enrichment opportunities for students. Adaptive release settings, for example, can be applied to assessments within the LMS, revealing additional resources (videos, readings, podcasts, etc.) for students in need of support or enrichment.

Grouping features within an LMS can be used to sort students based on their needs and interests, allowing instructors to provide customized materials and activities. For example, groups could be created for majors and nonmajors; majors might be provided with a preview of content in the next sequence of courses for majors while nonmajors are offered authentic application scenarios.

Instructors could also use tests, surveys, or rubrics within an LMS to build in self-assessment opportunities for students to monitor their own progress as they work to acquire fundamental course content or explore beyond strict course parameters.

Reflective tools such as blogs or journals with tailored prompts can be paired with these self-assessment opportunities to help students be more metacognitive about their learning. Digital support materials need not be developed for each and every unit; metacognitive instructors intentionally design their courses and select tools within the LMS in ways that reinforce the content and skills most essential to student success.

Intentionally developed learning objectives can inform course design, modality (face-to-face, blended, online), and technology use (McGee & Reis, 2012). Metacognition is even more essential for instructors developing blended or online courses, as the organization and design must be as explicit as possible (Esani, 2010). Using the backward design framework, instructors can identify the most important elements of the course and build a plan for learning. A well-designed course within an LMS can serve as a roadmap, even if the map is ultimately in service of instruction. But being metacognitive about use of an LMS as an organizational tool also requires monitoring to ensure the design meets student needs. If not, metacognitive instructors will need to make adjustments. This next section offers an example of intentional scaffolding of content within an LMS that enhances instruction.

Building Self-Contained and Self-Directed Opportunities to Learn

Al Mamun et al. (2020) explored the use of a predict, observe, explain, and evaluate (POEE) scaffolding strategy within online inquiry learning modules. This POEE model is informed by constructivist theories of learning, where students construct their own knowledge. These online modules are designed to act as optional activities to assist in student construction of knowledge within course-specific content areas. The modules do not incorporate direct instructor or peer interaction and are not linked to any formal assessment for the course.

Each content module follows a predictable structure. The content presented is divided into digestible chunks. Students are offered multiple pathways (e.g., images, videos, visual organizers), inquiry questions, and instructional guidance along the way. Moreover, the POEE model provides students a tool for learning how to learn. Because each content module uses the POEE structure, students have opportunities to practice this learning strategy. The self-directed nature of the content module design promotes learning independence. The reflective nature of the POEE strategy provides students with opportunities to check in on their own learning and build habits of self-regulation. The authors illustrate their approach with an online content module focused on heat using the POEE model to guide student inquiry.

The predict phase is designed to engage students in predicting the possible answer to a question or problem posed at the beginning of the module. In the heat module, students are given a scenario regarding the transfer of heat energy, supplemented with a visual representation, and asked to predict why this scenario might occur. Cognitive conflict questions are used to facilitate students' self-awareness of their thinking. Student uncertainty, along with self-awareness of the discrepancy between their current knowledge and the information in the scenario, prompts students to investigate the concepts further.

The observe phase is designed to have students interact with activities in the module and observe how the information in the activities contrasts with the ideas generated during the predict phase. In the heat module, students are guided to interact with and make observations about online simulations that demonstrate thermal expansion (e.g., video, interactive activities, visual representations).

In the explain phase, students are presented with two types of inquiry questions—concept check questions and confidence check questions. Concept check questions ask students to explain their understanding of concepts and justify their ideas through written explanations. In the heat module, students are shown a visual representation of an iron plate and asked to explain what would happen to a hole in the plate when heated. Concept check questions are followed by confidence check questions, giving students the opportunity to rate their level of confidence in their understanding of what they just learned.

In the evaluate phase, students receive immediate feedback designed to clarify and evaluate their understanding of concepts. In the heat module, students are given a written explanation of thermal expansion, a visual model of thermal expansion, and a video demonstration of thermal expansion. Students evaluate their own understanding in this phase, using the immediate feedback to consider how well they understand the concepts within the module.

Al Mamun et al. (2020) used WordPress to host the online modules, but other LMSs could be used. Within the LMS, course content could be strategically chunked into learning modules (e.g., a heat module). Within a content-focused learning module, separate folders could be used to organize each phase in the POEE model. These folders could be implemented sequentially, where students access each phase (predict, observe, explain, evaluate) in the order specified by the instructor. Adaptive release settings within the LMS can be applied to ensure that students complete one phase before moving on to the next.

Instructors might choose to design optional self-contained content modules as just illustrated or they might choose to integrate the modules into direct course instruction. In either case, instructors can engage in metacognitive instruction. They can use data and reflection to assess and refine course design (Kumar et al., 2019). Each phase of the POEE model gives instructors opportunities to reflect on and use student data to determine if the modules are helping students achieve the learning objectives. In the predict phase, for example, instructors can identify trends in student predictions of answers to the questions posed. Patterns identified in these student predictions can inform instructors about student foundational or background knowledge. They can then redesign subsequent module components to provide additional support if needed. These patterns can help instructors redesign inquiry questions used within this phase. This information can also be used to help inform what activities, representations, and instructional guidance are needed in the observe phase as well as what questions are asked in the explain phase.

After students complete the explain phase, instructors can use student responses to the concept check questions and confidence check questions to gauge student understanding and determine whether the content and activities were sufficient in helping students reach the desired result. For example, if a student answered the concept check question correctly but rated their confidence as low, the instructor might use this information to provide more opportunities for practice (e.g., self-graded quizzes) to increase confidence. On the other hand, if a student gave an incorrect answer to a concept check question but rated themself with a high level of confidence, this might mean that the student's misconception is still present and additional supports might be needed in the predict or observe phase to help the student identify their misconception.

Confidence check questions in the explain phase prompt students to think about the explanation they gave when answering the concept check questions. Inquiry questions help students evaluate their knowledge and modify their understanding. Feedback in the evaluate phase prompts students to revisit simulations and activities. Feedback can help students become increasingly aware of what they understand and can prompt them to take steps to enhance their learning (Wong et al., 2019). Feedback depends on whether the content module is self-contained or embedded within a course. If modules are part of a course, then feedback can be individually tailored to student needs. If not, feedback will be uniform, automated, and more comprehensive. Metacognitive instructors are intentional about how they use feedback to provide advice or prompts on how to rethink or reframe the content or skill.

This section offered an example of an online self-contained and self-directed model that could complement other forms of instruction. The next section illustrates ways that online modules can be used to enhance face-to-face class sessions by providing students with online supports to develop crucial skills.

Developing Student Skills Through Intentional Scaffolding

Cunningham, Matusovich, and Blackowski (2018) offer a series of online modules that enhance face-to-face learning. The modules are available on a website (www.skillful-learning.org) but could easily be housed in an LMS with a separate folder for each module. Each module follows a predictable structure, including a video and preclass questionnaire, an in-class activity, and a postclass assignment. For example, an early module offers preclass questions prompting students to consider their current study habits (e.g., time, method, location) and an in-class activity where students consider which of these have worked in the past and whether they made adjustments along the way. The online questionaire before class prompts students to reflect on their own learning and prime them for class discussion. Learners are engaged before they set foot in the classroom. The prompts provide both structure and the opportunity for student self-discovery.

The modules are meant to move students from surface strategies (e.g., identification, memorization) to deeper learning strategies (e.g., ability to transfer learning from one context to another). Illustrating backward design, Cunningham, Matusovich, and Blackowski (2018) identify a desired result (deeper learning), determine what that would look like (students intentionally employing more sophisticated strategies), and plan learning experiences that provide students opportunities to practice those new skills. At each stage, students are prompted to prepare for their learning, engage in learning experiences, have opportunities to reflect and document their success, and receive ongoing feedback to ensure the learning cycle continues.

Purposeful checkpoints also encourage students to monitor their learning progress. For example, Cunningham, Matusovich, and Blackowski (2018) ask students to think about their own thinking, their planning, and how they know when they have been effective. There is enough structure so that the entire class is thinking about the same sorts of things (e.g., their study process), but plenty of room for students to give individualized answers. The alignment of preclass work and in-class discussion also reinforces the relevance of each and fosters transparency about learning goals. The postclass assignments prompt students to pause to capture important lessons from the thinking done before and during class as well as to integrate that understanding into their learning in the course as a whole.

Further, each module builds on the one before. For example, an early module prompts students to take stock in their learning process and identify what they have done in the past. It encourages open-ended exploration. A subsequent module uses a video to introduce concrete learning strategies, and the inclass activity has students consider the benefits and pitfalls of their past strategies in light of the information contained in the video. The postclass assignment offers graphic organizers that allow students to reflect on their progress and feedback rubrics that provide opportunities to keep the conversation going. The structure and sequence of the modules align with student learning objectives, namely, developing deep-learning strategies.

Cunningham, Matusovich, and Blackowski (2018) also incorporate a specific learning strategy into the later modules to further frame student efforts and encourage the move from surface strategies to deeper ones. They employ an instructional model (Svinicki, 2004) that encourages students to identify Goals and Active study techniques that are Meaningful, allow for Explanation, and engage in

Self-monitoring (GAMES). The constituent elements, and the catchy acronym, prompt students to move beyond rehearsal strategies where they identify and memorize. Because of the design, surface strategies are nonstarters on assignments in the GAMES model. In this way, the assignment design nudges students toward the skills instructors want them to practice. The GAMES model encourages students to ask metacognitive questions about their own learning. What are their learning goals? What study strategies have been employed in the past? Have they worked? Might active strategies be more effective? It prompts students to think about what is most meaningful and not simply the information that they will need to identify for the exam.

The iterative nature of the modules helps develop metacognitive skills by providing practice opportunities. The module components (the videos, preclass questions, and in-class activities along with the postclass assignment) provide students opportunities for self-directed learning outside of class that align with discussions in class. The modules help establish the expectation that students will take a metacognitive approach to their learning. They raise awareness about the importance of having learning strategies and monitoring whether they work. As students build better metacognitive habits, they have the tools to ask themselves critical questions about their learning goals, planning, and progress toward those goals.

Intentionally designed modules can help students become more metacognitive about their learning, but metacognitive instructors will also monitor student progress and adjust when appropriate. They will align course design and module design with learning objectives and draw on student responses to preclass questions, comments made during in-class discussions, and responses to postclass assignments. Each provides instructors with opportunities to check in. Are students making progress toward stated learning goals? How are they struggling? Where are the gaps in their understanding? How is the pacing of instruction? Do they need more time to practice? What are some alternative instruction strategies that could be used? Metacognitive instructors can use this awareness to tailor class discussions. They might also offer feedback, individually or in groups, responding to student engagement with the modules.

These modules illustrate how intentional scaffolding can help students develop important skills (e.g., metacognition). In this case, the configuration of features used within the LMS (e.g., preclass, postclass materials) align with the intentional course design (e.g., the aim to promote deep learning). The online elements prepare and engage students in ways that set them up to learn more effectively in face-to-face class meetings as well as provide students with opportunities to practice on their own. These modules could be adopted as is or adapted to meet the needs of a course, or they could serve as a template for an alternative module design. The crucial point is that the intentional design of the online learning space enhances student learning and the development of crucial habits.

Conclusion

Metacognitive instructors are intentional about how they facilitate student learning. Beginning with a backward design framework, metacognitive instructors ask critical questions about what is most important to student learning and design the student learning experience around the concepts and skills most essential for that course. This framework helps instructors be intentional about each element of their course design and purposefully incorporate assessments, learning activities, and instructional approaches to align with learning objectives. In this article we argued that intentional course design includes selecting tools within an LMS that support student learning.

Metacognitive instructors intentionally organize their content, assessments, and activities within an LMS in ways that highlight the most essential elements. This can promote transparency around the importance of learning objectives. It can provide students with predictable and coherent structures that support their learning. For example, using an LMS to provide students with regular opportunities to practice important skills can underscore the importance of practice as well as offer further guidance. Likewise, providing regular opportunities for student reflection and self-assessment can highlight that these are part of the learning process. Purposeful use of an LMS can promote metacognition in students by prompting them to become more aware of their learning process and when they need to adjust their approach.

The illustrations offered here can serve as adaptable models. For example, online modules can be directly incorporated into course instruction or they can be self-contained, student-directed, and stand-alone. These models provide a blueprint that creates a predictable structure, along with strategies for chunking course content, scaffolding learning, and providing opportunities for self-regulation. These modules can promote student metacognition when the design raises student awareness around their learning process. Modules built using the GAMES (Cunningham, Matusovich, & Blackowski, 2018) or POEE (Al Mamun et al., 2020) scaffolding strategies are two such examples.

Metacognitive instructors also monitor student progress. Student responses in LMS modules can provide instructors with opportunities to check in on student progress and guide any adjustments that might need to be made as well as help students develop their own metacognitive habits. This metacognitive approach to instruction, including the use of tools within an LMS, can support the student learning cycle.

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