Science of Learning and Readiness (SoLaR) Recommendation Report

Science of Learning Practices for Distributed Online Environments

30 April 2020

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14. ABSTRACT

This report provides recommendations on best practices for supporting and creating modern learning ecosystems. The recommendations are based on findings from our two previous reports. The first report, the State of the Art Report, was a review of the state of the art for distributed learning environments that searched for best practices with evidence of supporting learning and improving learning organizations. The second report, The Exemplar Report, was a review of exemplar learning organizations that have successfully grown their learning enterprise.

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Science of Learning and Readiness (SoLaR)

Recommendation Report:

SCIENCE OF LEARNING PRACTICES FOR DISTRIBUTED ONLINE ENVIRONMENTS

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EXECUTIVE SUMMARY

The Science of Learning and Readiness (SoLaR) project seeks to demonstrate to Defense and other Government stakeholders the "art of the possible" for high-quality distributed learning and to create a practical guide for how to infuse such qualities into the broader Department of Defense (DoD) distributed learning ecosystem. This report is the third in a series of three reports examining the state of the art for advancing the applications of distributed learning. This report provides recommendations for setting up modern learning ecosystems that incorporate distributed learning techniques. The report consists of specific, actionable recommendations the DoD can use for enhancing its distributed/blended learning institutions (i.e., the overall system), courseware, and associated learning strategies/tactics.

This report provides recommendations on best practices for supporting and creating modern learning ecosystems. The recommendations are based on findings from our two previous reports. The first was a review of the state of the art for distributed learning environments that searched for best practices with evidence of supporting learning and improving learning organizations. The second report was a review of exemplar learning organizations that have successfully grown their learning enterprise. The summarized findings from our review of best practices are provided below as four high-level results:

- The basic principles of human learning from the learning sciences still hold within learning-at-scale environments.
- Human learning within these environments must be supported by technology.
- The technology must provide data on the learning process to the learning organization's stakeholders.
- Learning organizations must use data to support: 1) the learners in the form of learning, social, and academic guidance, and 2) the members of the learning institutions for providing training, support, and recognition.

Our findings from interviews of exemplar learning organizations are summarized below:

- A "think-before-you-act" mentality is needed for successfully growing the learning initiative. Detailed planning and flexible policies should be in place before and as the organization grows.
- A technological infrastructure is needed that provides data on learner success and staff training and performance.
- Training is needed to keep all stakeholders on the same page.
- Knowledgeable, responsive leadership and cross-sector strategies/policies are needed to successfully grow.

Description of Report

The findings of the two previous reports have been condensed into a series of recommendations at the institution and course creation level. At the institution level, we provide eight specific recommendations. These recommendations include human-level strategies (e.g., educational networks, human-centered evaluations, facilitating trust) and organization support-level strategies (e.g., support services, humans and technological support infrastructures, and class size flexibility). At the course level, we provide eight recommendations that deal with course infrastructure (e.g., data support, facilitating self-regulation, supporting motivation, facilitating interaction and facilitating engagement/creativity with Community of Inquiry ideas) and content design (e.g., scaffolding, cognitive constraints, video integration). The recommendations are supported by two heuristic checklists that experts (independent external experts or internal members of the organization educational network) can use to evaluate the recommendations at the organization and course levels.

RECOMMENDATION REPORT: SCIENCE OF LEARNING PRACTICES FOR DISTRIBUTED ONLINE ENVIRONMENTS

This report provides recommendations on the best practices for supporting distributed online environments. This report provides 16 recommendations based on the science of learning literature and lessons learned from exemplar organizations. It provides examples of these recommendations. Finally, we provide two heuristic checklists that can be used to make observations of learning organizations and courses for compliance with the recommendations.

RECOMMENDATIONS FOR LEARNING ORGANIZATIONS

Learning organizations are rapidly adapting how they provide education and training. These changes are both technology-driven and practical to provide education and training to greater numbers of learners at a rapid pace. Many of these learners are immersed in online learning environments. For example, there are estimated to be 6,651,536 students enrolled in online education courses at the postsecondary level. These 6.7 million students account for 33.7% of the current student population and are part of a growth trend of online learning which has continued for the last 13 years in the United States.

ORIGINS OF THE RECOMMENDATIONS

This report provides recommendations on best practices for supporting and creating modern learning ecosystems. The recommendations are based on findings from our two previous reports. The first was a review of the state of the art for distributed learning environments that searched for best practices with evidence of supporting learning and improving learning organizations. The second report was a review of exemplar learning organizations that have successfully grown their learning enterprise. The summarized findings from our review of best practices are provided below as four high-level results:

1) The basic principles of human learning from the learning sciences still hold within learning at scale environments.
2) Human learning within these environments must be supported by technology.
3) The technology must provide data on the learning process to the learning organization.
4) Learning organizations must use data to support both learners with learning, social, and academic guidance, and organization members by providing needed training, support, and recognition.

Our findings from interviews with exemplar learning organizations are summarized below:

1) A "think-before-you-act" mentality is needed for successfully growing the learning initiative. Detailed planning and flexible policies should be in place before and as the organization grows.
2) A technological infrastructure is needed that provides data on learner success and staff training and performance.
3) Training is needed to ensure all stakeholders share a common understanding.
4) Knowledgeable, responsive leadership and cross-sector strategies/policies are needed to grow successfully.

SUMMARY OF BEST PRACTICE RECOMMENDATIONS

The findings of the two previous reports have been condensed into a series of recommendations at the institution and course creation level. At the institution level, we provide eight specific recommendations. These recommendations include human-level strategies (e.g., educational networks, human-centered evaluations, facilitating trust) and organization support-level strategies (e.g., support services, humans and technological support infrastructures, and class size flexibility). At the course level, we provide eight recommendations that deal with course infrastructure (e.g., data support, facilitating self-regulation, supporting motivation, facilitating interaction and facilitating engagement/creativity with Community of Inquiry ideas) and content design (e.g., scaffolding, cognitive constraints, video integration). The recommendations are supported by two heuristic checklists that experts (independent external experts or internal members of the organization educational network) can use to evaluate the recommendations at the organization and course levels.

INSTITUTIONAL RECOMMENDATIONS

The following recommendations are a set of considerations needed for implemented a learning organization that can grow (scale up) and still meet the needs of its stakeholders and constituents. These recommendations could be implemented via company policy, an overall commitment to learning, and by building appropriate support systems into the organizations structure.

NETWORK OF EDUCATION EXPERTISE

A basic understanding and commitment to human learning at all levels of the organization, from administrators to SMEs/instructors, is crucial. This culture must be set from top-level administrators and supported throughout the organization. It is useful for all decision makers to have some level of understanding of good practices. Individuals should have detailed knowledge of learning principles with the trust/authority to support implementation throughout the institution's network. This is not a single person; rather, it is a group of people spread throughout the levels of the organization, including educational specialists serving as higher level directors,

learning engineers, instructional designers, and SME/instructors that are domain-based educational researchers.

EXAMPLE

Examples of designing strategies for learning within an organization include:

- Establishing a distinct set of guidelines that outline how the learning ecosystem will be structured and how the ecosystem will function between stakeholders.
- Identifying the leaders and contributors to the learning ecosystem and its maintenance.
- Allowing for learning meetings among the learning network.
- Promoting understanding of learning with focused learning meetings or specialized training for all levels of management.
- Building a learning community or learning network within the organization. Identify their expertise within the organization.
- Calculating the financial impact to the organization.
- Collecting and interpreting learning analytics to improve the learning ecosystem's design and functionality.

ESTABLISH HUMAN-CENTERED EVALUATION PROCESSES

Organizations must understand the strengths, weaknesses and needs of all stakeholders. Modern learning ecosystems are large, complicated structures with diverse stakeholders. To serve the entire organization and make informed decisions, it is essential to understand the needs of distinct groups. Human-centered evaluations should be used to evaluate the functionality of computer and technological systems and to collect data on how humans function within a learning ecosystem.

Human-centered design and evaluation will allow for a better understanding of the overall performance of the learning organization. It should have useful data-gathering methods for all levels of deployment. Early evaluation (e.g., needs assessments, contextual interviews) allows for understanding the needs of the users to better set requirements and design support into the system. Mid-level evaluation of systems (e.g., usability testing) allows for identification of problems that users will have with the system before it is implemented on a larger scale. Late evaluation (e.g., experimental testing and mixed method interviewing) of completed systems provides evidence of effectiveness. This cycle can increase confidence and engagement from end users. This could be applied new learning supports integrated into classes or to better understand the current state of areas within the organization.

EXAMPLE

Human-centered evaluations within eLearning courses might take various forms. For instance, a usability evaluation might enroll students in online class shells, and then record errors and navigation behaviors as they locate materials and perform tasks. Such usability tests can span observational methods (e.g., digital observation via screen capture software) or think-aloud procedures (e.g., via video conferencing) wherein students talk about what they are attempting to accomplish. Within a larger organization, survey methods can be used to develop an understanding of general knowledge or perceptions about proposed implementations.

SUPPORT ORGANIZATIONAL TRUST

Organizations must also foster a sense of *trust* at all levels. In this case, "trust" broadly encompasses confidence in and positive appraisals of available technologies and between organization members. Administrators must encourage trust, foster relationships, and seek common ground for discussion and action between stakeholders, while also collecting and using data to facilitate change and support faculty in the online education endeavor. To be "trustworthy," administrative decision making should be guided by evidence-based tools and metrics. Evaluation of stakeholder performance should be fair and transparent, and evaluations should incorporate feedback from stakeholders. It should be grounded in policy that includes recognition of stakeholders' contributions (e.g., compensation or acknowledgement of time commitment).

EXAMPLES

Examples of helping establish organizational trust include:

- Implementing clear evaluation metrics.
- Developing performance evaluations that follow metrics and are transparent.
- Providing clear and actionable performance feedback.
- Recognizing stakeholders' contributions to success.
- Providing visible acknowledgement of effort.
- Identifying and providing support for online instructors through technical assistance and course design/development assistance.
- Establishing clear workload and compensation models based on metrics and effort.
- Establishing course quality control methods to ensure accessibility and engagement.

SUPPORT INSTITUTION-STUDENT TRUST

Trust is crucial at the student level. Students' trust in instructors and class content directly impacts course grades. Student trust can be established by social engineering of the learning environment (i.e., building logical class structures that minimize negative events), frequent communication, maintaining a positive and consistent instructor persona, supporting peer-to-peer mutual interaction (e.g., collaboration), involving students in decision making and communication, defining clear policies, and creating clear and transparent oversight.

EXAMPLES

Examples of helping establish trust include:

- Eliminating student barriers to online learning by helping students locate and use external resources, such as library services, tutoring services, and technology services.
- Minimizing anxiety over computer use and access through the provision of computer access and training.
- Establishing positive rapport through respectful and fair treatment during online interactions.
- Providing understandable and thorough instructions for student interactions with online course content by providing an up-to-date syllabus, course goals, and realistic workload expectations.
- Pre-emptively designing fair evaluation measures of course and student success based on the nuances of online instruction.
- Explaining course grading and evaluations prior to beginning the course.
- Monitoring course completion and drop rates in real time to redeem struggling students.

STUDENT ACADEMIC/SOCIAL SUPPORT SERVICES

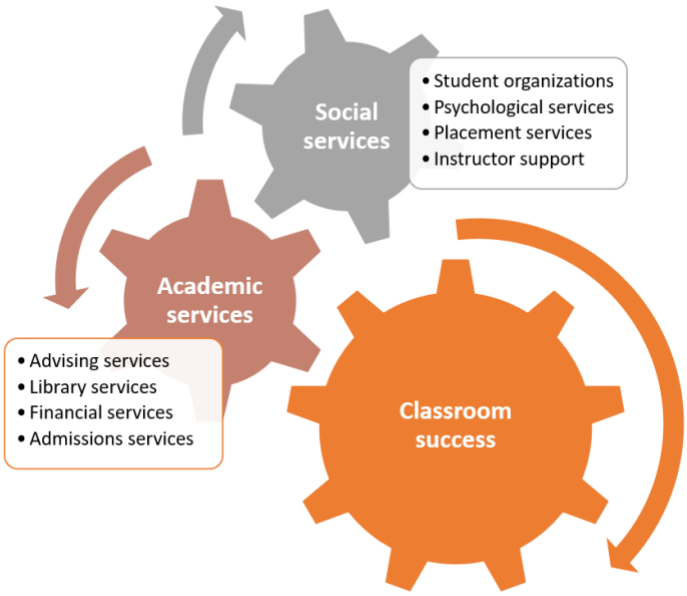
Learners must have adequate academic and social support structures from the institution. As online distributed learning technologies continue to advance and propagate, the potential for isolating students is a problem that must be addressed. Virtual interactions and asynchronous environments may result in fewer opportunities for students to interact with peers or the organization in meaningful ways. This can decrease the learner's connection to the organization and long-term engagement in the learning process.

Learning organizations must offer student support services and mindfully enable additional social structures. There are several categories of support, such as academic services (e.g., advising, library, financial, and admissions) and social services (e.g., student organizations, psychological services, placement services, and instructor support). These services interact with and build upon other essential factors, including students' family framework, personal satisfaction, and perceived course relevance. All these elements play critical role in students' decisions to persist or drop out of online courses.

EXAMPLES

Examples of student social support include:

- Providing students with administrative contact persons for individualized counseling.
- Instituting institution-wide communication standards and evaluate communication flow at regular intervals.
- Making students aware of financial obligations and sources of help throughout the duration of the course.
- Discussing opportunities for inclusion in services offered by institutional services for persons with disabilities.



- Making students aware of counseling services.
- Making library services available to all enrolled students.

GENERAL SUPPORT INFRASTRUCTURE

The learning organization needs a clear hierarchy of reporting, networks of support, and training on technology and procedures. This support infrastructure will help to ease the burden of course creation on instructors and allow them to focus on higher quality content. This support includes:

- Providing educational design support from instructional designers.
- Providing learning strategy support from learning scientists or discipline-based educational researchers.
- Providing learning technology integration support on best practices for using technology to support learning from learning engineers.

GENERAL IT INFRASTRUCTURE – INCLUDING ACADEMIC COURSEWARE, ANALYTICS INFRASTRUCTURE

Technological infrastructure support should be at the core of any learning organization. Without dedicated planning, organizations will struggle to deliver new technology= for users while also (a) maintaining legacy systems beyond their reasonable lifespans, (b) seeking interoperability between incompatible applications, and (c) doing so with dwindling resources. This requires a variety of supporting infrastructures included appropriate policies and processes, information and communication technologies, instructional support staff, technology hardware and facilities, and training. This comprehensive support structure must be in place for instructors, staff, and students with emphasis on technology support. Ideally, a modern infrastructure must transcend vertical and isolated systems to embrace open data formats that can integrate data from across the learning enterprise.

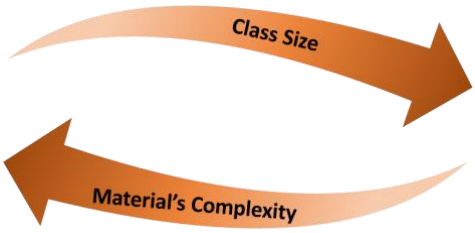
FLEXIBLE CLASS SIZES

Although learning at scale aims to provide worthwhile instruction to larger numbers of learners, this goal does not mean that class sizes can grow infinitely. Appropriate class size is a complicated question that must be considered by learning organizations, which should consider (a) the type(s) of information being taught and (b) the technologies available to support the learning environment. One generally recommended "rule" is that class size should be guided by nature of the content (see Bloom's taxonomy). Topics that require higher-level thinking (e.g., synthesis and evaluation) may be best suited to smaller class, whereas topics that entail lower-level thinking (e.g., recall) may be taught in larger classes.

EXAMPLES

Examples of implementation of class size recommendations include:

- Planning for smaller class sizes when teaching high-level content.
- Utilizing larger classes when foundational principles are the class focus.
- Limiting class sizes, regardless of content, when learner or instructor support is limited.
- Scaling courses at a commiserate pace with student engagement ability.
- Planning for transition time and course re-development of currently face-to-face courses.
- Optimizing technology for maintaining student interaction.



As material complexity increases class size should decrease.

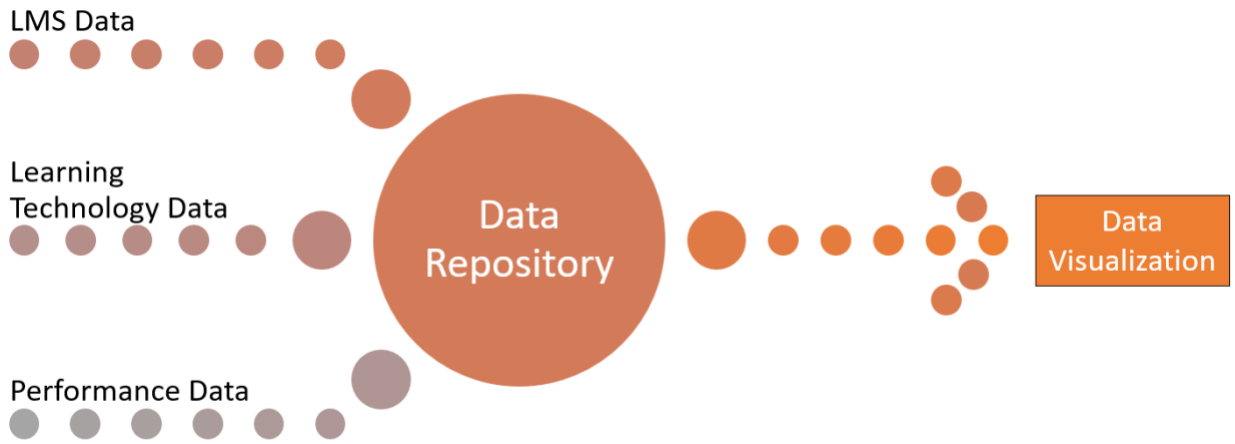
COURSE CREATION RECOMMENDATIONS

Course creation is going to be one of the most important expenses within learning organizations. The adage “content is king” is popular for a reason. Without well-crafted and supported content any learning enterprise will fail. To continue with the analogy, context is the kingdom. A king is useless without a kingdom. The course should consist of well-structured content, but also must have learning supports around it to create a robust course. How to build this support can vary based on resources, culture, need, and implementation time. However, the recommendations below provide a structure of required elements that can be implemented in some form regardless of the individual composition of the learning organization.

COURSE-LEVEL RECOMMENDATIONS

DATA-SUPPORTED COURSES

Technology should collect and support data within courses. To modernize courses and enable information sharing, learning technologies must be able to collect and output learning data. Several data standards are already in use. For example, xAPI is a popular method for capturing, standardizing, and sharing human performance data.



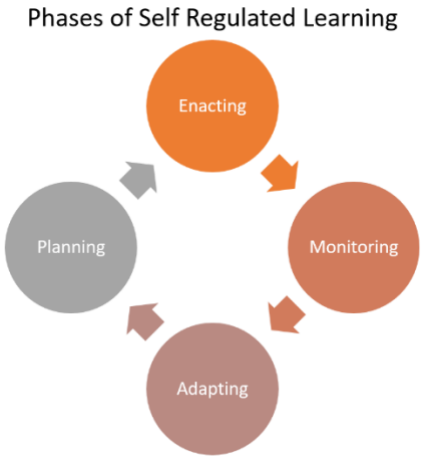
EXAMPLE

Use a standardized approach when capturing the interaction of students in the system (e.g., xAPI). An adapter can be developed to generate xAPI statements from existing or proprietary systems. Utilize existing xAPI Profiles Specification to enable successful and semantically interoperable xAPI implementation. Visualizations that use user data must be transparent to the users (i.e., users can understand how the data led to the visualization). When designing a visualization, relevant information to its intended user must be considered. The visualization should incorporate interactivity to allow for visual exploration and to prevent overwhelming the

users. Information Seeking Mantra can serve as a guide when designing interactive visualizations: overview first, zoom and filter, then details-on-demand.

SUPPORT SELF-REGULATION

Classes must support a learner's self-regulation. Self-regulation is a broad term that refers to one's ability to monitor and regulate their learning experiences. Self-regulation skills are essential for success in distributed learning environments. To successfully implement self-regulation, the follow steps must be supported.



- Phase 1: Learners should be allowed to plan and analyzing tasks for the class.
- Phase 2: Learners must be able to perform tasks and enact their chosen strategies.
- Phase 3: Learners must be able to monitor their performance and learning.
- Phase 4: Learners must be able to adapt future learning efforts based on their observed results.

It should be noted that these steps are not always easy in online settings. They can be facilitated by learning supports such as visual dashboards. During this process students often need to be monitored by faculty and to receive feedback, especially in Phase 2 when they are performing tasks.

EXAMPLES

A variety of ways to promote self-regulation exist in distributed learning contexts. One example is providing learners with goal-setting templates to support learners' free choice in their learning. It is a powerful method to help students unfold and frame their intrinsic goals or needs of learning (e.g., personal growth, meaningful relationships with others, or contributing to the community) instead of motivating them by extrinsic goals (e.g., fame, financial success, and physical appearance) or outside pressures (e.g., social comparison with peers).

Examples of self-regulation support include:

- Student-facing learning analytic dashboards, which can be effective tools for developing self-regulated learners because of their autonomous and informative feature (e.g., an adaptive recommendation system and interactive data visualization, etc.).
- A recommendation system that aims for a more coarse-grained unit of learning (e.g., course modules) while allowing learners to explore additional materials.
- An intelligent tutoring system that aims for the fine-grained solutions to the learning problems by providing specific feedback to learners as they work through the material.

SUPPORT MOTIVATION

Students exhibit varied levels of motivation while learning content in distributed as well as face-to-face or blended learning environments. There are many theories of academic motivation that examine motivation from different perspectives. Some of these theories suggest the need to consider both internal and external motivational factors, such as an internal desire to succeed versus the need for an external motivator. Knowing that students approach distributed learning with varied levels and types of motivation can improve course designs by considering different strategies for supporting students' motivation to learn the content.

EXAMPLES

Foster student motivation can take on many forms. However, supporting motivation may differ due to various types of content, context, and learner populations. For example, an individual taking a course that is critical to their career may feel an internal desire to succeed, whereas one taking a mandated course that has little relevance to their career may need more external motivators to succeed.

One example of providing motivation is through the types of feedback and communication provided to learners. For example, instilling a growth mindset, which is the perspective that one can always improve their intelligence, can be beneficial. Praising effort and progress can provide benefits to learners.

Personalized learning analytics applications such as student-facing learning analytics dashboards (SFLADs) can be helpful to increase learners' motivation by affording them ownership over their own learning. These SFLADs can provide information such as their own learning progression, trajectory, and goals so they can make decisions on whether they want to continue a class or how they want to continue it. In short, SFLADs should empower students to become data-informed learners. Specifically, a well-design SFLAD should focus on designing the learning experience for learners which underscores the learners' affective and non-cognitive skills (e.g., interpersonal skills, persistence, communication skills, and other "soft" skills). In addition, a variety of user experience design techniques (e.g., task analysis, questionnaires, interviews, usability testing, etc.) should be utilized to examine and evaluate the effectiveness of the SFLADs.

SUPPORT INTERACTION THROUGH COURSE FEATURES

Courses should be designed to support interactions. Building interactions with learning content is a staple task for many instructional designers. The goal of instruction is often for students to understand what the content means in the context of their own lives or careers, and therefore having students purposefully interact with said content can be effective for facilitating learning. This notion extends to distributed learning environments as well as face-to-face and blended learning environments. Student interaction with course content can come in many forms,

including augmented or virtual reality experiences or simulations (AR and VR, respectively), social media use, or cooperative learning opportunities. The appropriate use of each of these technologies or techniques will depend on the content and course being taught.

There are also additional considerations regarding the use of social media and cooperative learning activities, which include, but are not limited to:

- Making students aware of the risks and benefits of social media use in informal learning opportunities.
- Training students in digital citizenship.
- Protecting students' anonymity, privacy, and choice when using social media sites for learning (e.g., FERPA considerations).
- Accommodating assignments for students who are unwilling to engage in social media for learning.
- Instructing students on the location and platform for each assignment (LMS or social media sites) so that there is no division of the location of learning materials.

EXAMPLE

Interactions with course content should be intentional and contextually relevant. Consider for example, AR or VR learning environments. AR or VR experiences or simulations have been used in a variety of fields. However, they have the potential to be time and cost intensive to develop, and therefore may not be appropriate for every use case. There is also a broad range of what these experiences or simulations may look like. For instance, a simple AR simulation may entail additional information showing on a screen when the camera picks up an object within its view, whereas a complex VR simulation could be used for training pilots.

FOSTER A COMMUNITY OF INQUIRY

Build interactions into the course. These interactions should include interacting with the content, but also with the instructor and other students. In the past, distributed courses were critiqued for a lack of interaction that made learners feel disconnected from the topic and class. Building interactions with course content helps this by building a community of inquiry within the course.

A community of inquiry is a connected group of learners with common goals. It fosters critical thinking, reflection, and discourse. To create this collaborative community, a class must have a feeling of presence (being present) associated with it. There are thee type: cognitive, teaching, and social.

- Cognitive presence is the ability of the learner to manipulate the content in relation to their own lives.
- Teaching presence refers to how well the instructor designs and facilitates the course. The instructor should be part of the course both visually in the form of video and as an interactive partner by providing feedback and responses to student questions.
- Social presence refers to how cohesive the class of students is, or how well they openly communicate. This can be facilitated by providing communication outlets for students such as forums, discussions, or interactions on social systems such as Slack. However, these interactions should be monitored by the instructor to identify incorrect information or abuse.

EXAMPLES

Examples for increasing presence include:

- Establishing a strong teaching presence as a moderator of the social and cognitive presences through using interaction opportunities and through establishing class administration early in the course cycle.
- Helping students engage and collaborate through thoughtful, relevant, authentic group learning activities.
- Segmenting content into sizes that suit the level of the learner (novice versus expert).
- Providing strong evaluation rubrics and feedback that reward students for effort in multiple dimensions of class projects.
- Helping students connect with peers through intentional community engagement activities.
- Helping students transition from traditional lecture-based learning to collaborative learning through metacognitive strategies such as reflection.
- Ensuring students' peer-peer and peer-instructor interactions are safe and respectful.

CONTENT DESIGN

PROVIDE SCAFFOLDING, INCLUDING MICROLEARNING AND FEEDBACK

Provide guidance (scaffolding) within eLearning courses. There are many types of scaffolding, guidance, and feedback that can be critical elements of effective instruction in these contexts. Microlearning techniques can help in this process. Within microlearning, larger content is subdivided into smaller coherent topics. These topics can be provided to learners either in an ordered sequence or to give extra guidance if learners are struggling with a specific concept.

EXAMPLES

Examples of providing scaffolding and guidance include, but are not limited to:

- Using authentic scenarios or cases that emphasize the general rules and principles of a discipline and highlighting how these rules and principles can be transferred into new situations.
- Providing worked examples to lower extraneous cognitive load for novice learners.
- Devising mechanisms for calling attention to unfamiliar vocabulary and principles or systems, such as flashcards, low-stakes quizzing, and demonstrations.
- Setting realistic expectations for PBL/IL by remembering these tools promote meaning and understanding and are not a means for knowledge acquisition.
- Providing human support and materials support, such as task overviews, scope of learning overviews (learning objectives or goal statements), task requirements, and ideal task representations so that students can emulate the ideal solution.
- Providing microlearning opportunities to provide just-in-time teaching and support.

Examples of providing feedback include, but are not limited to:

- Delivering supportive feedback through prompts that provide opportunities for instructors to address domain-specific knowledge, guidance, and learner-strategies through explanations, references, visual aids, and project templates.
- Encouraging reflective feedback using process maps, models of expert solutions, and hints and questions to guide learners through the process and to identify knowledge gaps.
- Providing guidance to students by modeling good performance, providing task explanations, setting accomplishable task expectations, and providing expert guidance.
- Delivering “feed-back” through giving specific, individual, timely, regular, detailed, purposeful, task-appropriate, assignment-directed, and future-driven statements that are expressed in concrete and understandable ways for all student assignments.
- Using peer feedback for the benefits of providing students with other perspectives on their assignments.

DESIGNED ACCORDING TO HUMAN COGNITIVE PROCESSES

The limitations of human cognitive processing should guide the design of instruction and instructional content. Research has shown that the working memory capacity is limited, instructional sequences should be designed to prevent overloading the working memory capacity. In addition to instructional sequencing, one must also consider the visual design of the materials presented.

General recommendations from the research principles include:

- Avoiding presenting complex text and visual images unless there is adequate time to process the information and guidance to facilitate understanding.
- Avoiding the use of images unless they are needed and relevant to the explicit point being made. Images need to help the learner visualize the information. Otherwise, the images will hinder learning.
- Presenting an exact narration of printed text should be avoided unless it is needed for a specific learner population (For example visually impaired learners).
- Integrating narrative and visual information when presented at the same time.
- Presenting a complex diagram or complex written document by highlighting key points when they are relevant. This might require taking a longer text or narrative information and turning it into a series of subtopics with relevant linking information highlighted in each.

EXAMPLE

A considerable number of instructional design principles can be used to help prevent overloading the working memory capacity and improve learning. Examples include the modality principle, spatial contiguity principle, temporal contiguity principle, worked example effect, signaling principle, and more.

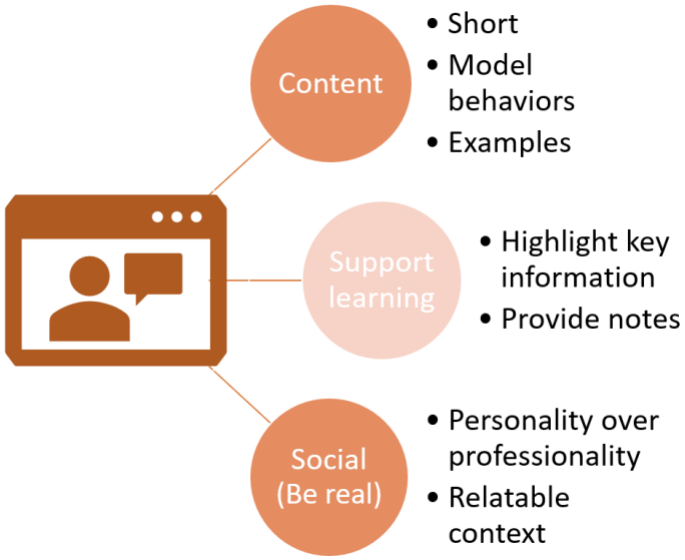
PROVIDE VIDEO CONTENT THAT INTEGRATES BEST PRACTICES

Courses should use instructional videos that follow specific research-based best practice strategies. Video should not be just a long recording of a lecture as a replacement for a face-to-face lecture. Ideally these videos should be short (five to 10 minutes at most) and should model best practices, provide procedural knowledge (how-to knowledge), or brief, concise explanations of concepts. When producing these videos, follow best practices for production, including cognitive-based organizational principles such as using multiple modalities or signaling (visually highlighting) important concepts. Create notes of the videos, follow the notes, and provide a version of the notes to learners.

Video environment and instructor persona are also important. Stay professional but show your personality. Similarly, make sure that the environment around the instructor is professional yet relatable.

EXAMPLE

Examples of how to design effective instructional videos include, but are not limited to:



- Ensuring that videos follow research-based instructional design principles based on human cognitive processes.
- Establishing that video content is relevant to the topic and will increase student engagement and active learning.
- Utilizing video messages with signaling and segmenting for learners to identify the important material quickly.
- Using videos that adhere to ADA accessibility guidelines.
- Considering the use of questions and reflection in videos for students to practice retrieval.

END OF REPORT APPENDIXES

APPENDIX A

Heuristic Evaluation Form – Organization Level

Instructions

This form is designed to help an organization determine how well it is meeting the needs of its distributed learning constituents at the institutional level. The person(s) completing this form should possess relevant expertise, such as a learning scientist or learning engineering. This form is not intended to be all-inclusive, but rather is designed to highlight the high-level requirements of an effective distributed learning organization.

The organization can be categorized as one of four different ratings for each criterion, which are defined as follows:

Rating	Description
Exemplary	The organization provides ample resources compared to the current *and* projected needs. There are limited areas for improvement.
Acceptable	The organization provides the resources needed to meet current needs. However, there are still areas of potential improvement.
Adequate	The organization provides the minimum resources to meet current needs. More resources should be devoted to the criterion. This rating is considered the minimum needed for operation and may not be appropriate for sustained operations.
Lacking	The organization does not meet its constituents' needs and is not serving its constituents well.

Organizations should strive to reach *Acceptable* or, if possible, *Exemplary* for all criteria. An organization with these ratings is likely in a good position to host effective distributed learning courses. Note that meeting these criteria alone does not indicate an effective distributed learning organization; rather, these criteria are indicative of having the capacity to be an effective distributed learning organization.

An organization that currently provides distributed learning may find that they have criterion rated at *Adequate*. As noted, this indicates a minimum level of proficiency and the organization should conduct a needs analysis to find out the most appropriate way to improve in this criterion.

Any criterion that is rated as *Lacking* should perform a needs analysis for that criterion to better understand why it is deficient, and then address these deficiencies before adding additional stress onto the organization.

Organization-Level Criterion Summary

Topic	Explanation
Network of Education Expertise	Is there an organized structure of individual with educational expertise throughout the organization. Are they structured so they can support each other? Are they structured to support strong educational practices throughout the organization?
Established human-centered evaluation process	Does the institution have processes in place for formal or informal usability evaluations of courses or learning materials?
Support institutional trust	Are there efforts, policies, and procedures in place to support and understand trust within the organization?
Support institution-student trust	Are there efforts, policies, and procedures in place to support institution-student trust? (e.g., building logical class structures, frequent communication, involving students in decision-making, defining clear policies, etc.)
Student academic/social support services	Are there ample student support services in place (e.g., providing students with administrative contact persons for individualized counsel, instituting institution-wide communication standards and evaluating communication flow at regular intervals, making students aware of financial obligations and sources of help, opportunities for inclusion in services offered by institutional services for persons with disabilities, etc.)?
General support infrastructure	Are clear policies and supports in place so instructors know who to approach or what to do if they encounter issues with their courses?
General IT infrastructure	Is the general IT infrastructure available to support online courses at the scale the organization operates? For example, is there appropriate capacity to support the number of students accessing the system at once? Is an adequate analytics infrastructure in place?
Allow for flexible class sizes	Class size should be guided by the nature of the content and the technology infrastructure available to support the course.

Learning Organization Heuristic Evaluation Form

Use the form below to review the policies and procedures for the learning organization. Rate each category from 1 (Lacking) to 4 (Exemplary) based on the observed current state of the organization. In the following comment box, provide explanation of your rating and feedback for improvement.

Category	**Rating (1-4)**	**Comments**
Network of Education Expertise		
Established human-centered evaluation process		
Support administrator-instructor trust		
Support institution-student trust		
Student academic/social support services		
General support infrastructure		
General IT infrastructure		
Allow for flexible class sizes		

APPENDIX B

Heuristic Evaluation Form – Course Level

Instructions

This form is designed to inform on the potential for a course to meet learner needs. The person(s) completing this form should possess relevant expertise in learning science and learning engineering principles. This form is not intended to be all inclusive, but rather is designed to highlight the high-level requirements of an effective distributed learning course. In addition to the criteria listed here, a course should also adhere to standard best practices of accessibility and course design practices on assessment such as a clear link between content and assessment and clear explanations of assessment criteria. This form is not intended to be used as an instructor evaluation tool.

The course can be categorized as one of four different ratings for each criterion, which are defined as follows:

Rating	Description
Exemplary	The course provides ample support for learners. There are limited areas for improvement.
Acceptable	The course provides the support needed to meet the needs of learners. However, there are still areas of potential improvement.
Adequate	The course provides the minimum support to meet learners needs. More support should be devoted to the criterion. This rating is considered the minimum needed for course delivery and may not be at appropriate levels for all learners.
Lacking	The course does not meet learners' needs on this criterion in the current state.

Ideally, courses will have ratings of Acceptable or Exemplary for all criterion. A course with these ratings is likely in a good position to facilitate effective distributed learning. Note that meeting these criteria alone does not indicate an effective distributed learning course. These criteria are indicative of having the capacity to be an effective distributed learning course. Effective course facilitation is essential in the learning process and largely unaccounted for by this evaluation form.

A course may have criterion rated Adequate. This indicates a minimum level of proficiency and the course designer should conduct a needs analysis to find out the most appropriate way to improve in this criterion.

Any criterion that is rated as Lacking should perform a needs analysis of that criterion to better understand why it is deficient before the course is provided to learners.

Course-Level Criterion Summary

Course Structure and Alignment	
Topic	**Explanation**
Fundamental data collection for analytics	Does the course allow for the collection of fundamental data that could be used for analytics? Examples (non-inclusive list) may include quiz scores, final grades, attendance, etc.
Support self-regulation	Does the course include design features that support student self-regulation? Examples may include features such as a calendar of assignments and due dates, or an analytics dashboard.
Support motivation	Does the course include design features to support student motivation? Potential examples include tying the content to their career field or personal interests.
Support interaction with course features	Does the course contain adequate features to support student interaction with the content (e.g., virtual reality, augmented reality, social media, simulations, etc.)?

Fosters a Community of Inquiry	Does the course support cognitive, social, and teaching presence?
Content Design	
Provides scaffolding, including microlearning and feedback	Does the course include appropriate scaffolding (e.g., extra readings, videos, just-in-time teaching, or microlearning opportunities)? Does the course include frequent opportunities for the student to receive formative feedback?
Designed according to human cognitive processes	There are a considerable number of instructional design principles that can be used to help prevent overloading the working memory capacity and improve learning (e.g., the modality principle, spatial contiguity principle, temporal contiguity principle, worked example effect, signaling principle, etc.).
Provides video content integrates best practices	Videos should follow research-based instructional design principles based on human cognitive processes. In addition, videos can include content that will increase student engagement and active learning, adhere to ADA accessibility guidelines, and use questions and reflection for students to practice retrieval.

Course - Heuristic Learning Science Evaluation Form

Use the form below to review the policies and procedures for the learning organization. Rate each category from 1 (Lacking) to 4 (Exemplary) based on the observed current state of the organization. In the following comment box, provide explanation of your rating and feedback for improvement.

Category	Rating (1-4)	Comments
Course Design		
Fundamental data collection for analytics		
Support self-regulation		
Support motivation		
Support interaction with course features		
Fosters a Community of Inquiry		
Content Design		
Provides scaffolding, including microlearning and feedback		
Designed according to human cognitive processes		
Provides video content integrates best practices		