An Application of the Learning Science Evaluation Checklist: Use Case Report

Science of Learning and Readiness (SoLaR)

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An Application of the Learning Science Evaluation Checklist:

Use Case Report

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Science of Learning and Readiness (SoLaR)

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EXECUTIVE SUMMARY

The dynamic and high-stakes nature of education and training requires reliance on evidence-based practices and policies to make decisions about technology adoption and implementation. In a previous report, we provide 16 recommendations for supporting distributed learning along with a learning science evaluation checklist. This current report provides evidence on the effective use of our evaluation checklist. Two DoD training and educational organizations were successfully evaluated with the previously proposed Learning Science Evaluation Checklist. This report provides a how-to guide for the checklist's implementation and the results of the use case evaluations.

Implementation of the Learning Science Evaluation Checklist

The checklist was used to perform organizational and course level reviews on two target T&E organizations provided by the Advanced Distributed Learning Initiative. Organizational reviews were performed to determine overlap with the recommendations from our recommendation report. These reviews consisted of semi-structured interviews with higher-level representatives at the organization that had positions of oversight within the organization. The courses were reviewed to determine compatibility with the course level recommendations and the learning science evaluation checklist. The courses were reviewed independently by two coders using the course coding system used to operationalize the heuristic evaluation metrics. One organization's identity was blinded. The second organization, Naval Postgraduate School, permitted the use of their name.

Findings of the evaluation

Our organization-level review of the Organization 1 was positive for the most part. Organization 1 received exemplary scores for human-centered evaluation, information technology infrastructure/data use, and flexible class sizes. The organization was rated acceptable in terms of its network of education expertise, support infrastructure, and trust metrics. An adequate score was obtained for academic and social support for students. Organization 1 was not observed to be lacking on any metrics.

Our course level review of Organization 1 was not as positive as the organizational review. This could be because Organization 1 provided a course that required updating rather than their exemplary course. The course did not receive exemplary scores on any measures. However, the course was rated acceptable for supporting student self-regulation and the use of scaffolding within the class. An adequate score was obtained for supporting cognitive processing, interaction, motivation, and supporting a community of inquiry. The course was observed to be lacking in video and data collection for analytics metrics. The course had the possibility for both metrics but did not directly implement them.

Our organization-level review of the Naval Postgraduate School (NPS) was mostly positive. NPS received exemplary scores from both reviewers for a network of education expertise. The organization was rated acceptable in terms of its human-centered evaluation, IT Infrastructure/data use, and flexible class sizes, support infrastructure. An adequate score was obtained for academic and social support for students and trust metrics. NPS was not observed to be lacking on any metrics.

Our course level review of the NPS revealed several areas of excellence as well as opportunities for improvement. The NPS course received exemplary scores for supporting human cognitive processes, supporting student self-regulation, and supporting communities of inquiry. The organization was rated acceptable in scaffolding student experiences. An adequate score was obtained for supporting student motivation and interactions. The course was observed to be lacking in the integrated use of user data analytics and the use of video.

1 OVERVIEW

The dynamic and high-stakes nature of education and training requires reliance on evidence-based practices and policies to make decisions about technology adoption and implementation. In a previous report, we provide 16 recommendations for supporting distributed learning along with a learning science evaluation checklist (Craig & Schroeder, 2020). While that report provided all the tools needed for expert evaluation of learning organizations and courses, it did not provide a practical example of how the checklist can be used. It also did not provide evidence of the type of data that can be obtained in the form of real use cases.

The current report provides this evidence by successfully evaluating two DoD training and educational organizations using the proposed Learning Science Checklist. This report provides a summary of how the checklist was implemented and the results of the use case evaluations.

1.1 PREVIOUS WORK

The checklist is a product of the work done to fulfill the goals of the Science of Learning and Readiness (SoLaR) project. The SoLaR project's main goal is 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. To identify these grounded policies, this project implemented a combination of literature review and data collection from stakeholders and exemplar organizations.

Our efforts resulted in three reports. Our State-of-the-Art Report (SoAR) summarized our findings from the literature and our survey results (Craig, Schroeder, et al., 2020). Our second report interviewed representatives from exemplar organizations (Craig, Li, Prewitt, Morgan, & Schroeder, 2020). Our third report combined the findings from the first two reports to provide the previously mentioned recommendations for implementation and heuristic checklists for evaluation (Craig & Schroeder, 2020).

Our literature review summarized evidence-based practices within institutional systems, courseware, and pedagogical methods. Methodologically, this review emerged from a broadly scoped review process comprising more than 200 formal database searches to identify research literature across academic, military, and industry resources. Overarching findings were that (1) fundamental principles of human learning from the learning sciences apply to blended and learning-at-scale environments; (2) human learning within these environments must be supported by technology; (3) the technology must report data on the learning process to the learning organization; and (4) learning organizations must use data to (a) support learners with learning, social, and academic guidance, and (b) support members of the learning institutions with training, support, and recognition.

We surveyed learning organizations representing public, private, and academic sectors. We observed a consistent discrepancy: Implementation of best practices fell short (i.e., ratings of implementation were significantly lower than ratings of perceived importance). This pattern was most striking within military organizations. The survey sample was small and thus has limitations in generalizability. Nonetheless, the high perceived importance of best practices suggests a readiness for a transition to advanced distributed learning methodologies.

Our interviews revealed that experts suggest a "think-before-you-act" mentality when scaling up, as it is essential to consider scale from the start of an initiative. Otherwise, an opportunity can be overlooked because of a single-minded focus on fulfilling the immediate cohort's needs. Every interviewee

mentioned having responsive leadership. All interviewees reiterated the importance of data in student success and staff training. This included both automated data from the systems and human data on the use and abilities as collected by usability and experimental data collection. A final theme was that supporting comprehensive human infrastructure is required.

Based on this work, we provide 16 recommendations for supporting distributed learning. The eight institution-level 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). The eight course-level recommendations deal with course infrastructure (e.g., data support, facilitating best practices), and content design (e.g., providing scaffolding, video integration).
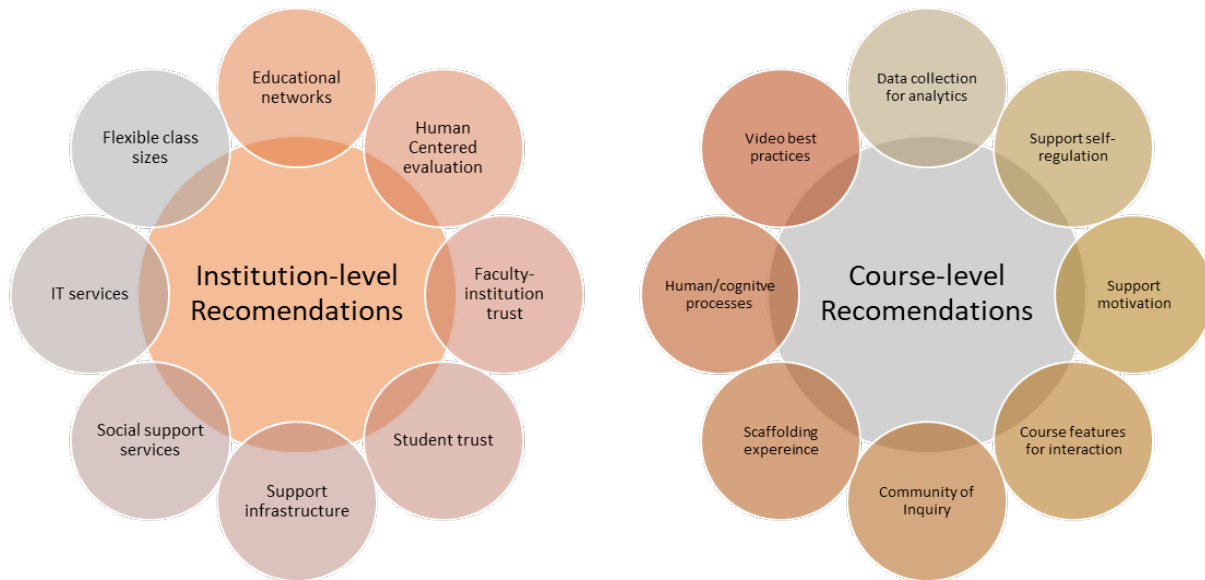
1.2 THE GOAL OF THIS REPORT

The Arizona State University Project team coordinated with three DoD training/education organizations identified by the Advanced Distributed Learning initiative, to analyze their current distributed/blended learning enterprises against the Learning Science Evaluation Checklists created to evaluate the recommendations set out in our recommendations report (Craig & Schroeder, 2020). The team analyzed the organizations' current distributed/blended learning systems (e.g., organizational factors) and individual courseware offerings identified by the organization.

This work was conducted to support the greater impact of the learning sciences on readiness. This evaluation provided a concrete operationalization of the review process needed to assess our previous recommendations. The two use case evaluations covered in this report are a test of our recommendation's ability to provide successful application within existing DoD-relevant training and educational organizations. This use case report serves as an example of how the Learning Science Evaluation Checklist could be applied to provide useful and actionable recommendations for improving these recommendations.

2 EVALUATION METHODOLOGY

2.1 PARTICIPANT ORGANIZATIONS

Three DoD training and learning organizations took part in this evaluation. One organization pulled out of this evaluation at the initial stage of the evaluation due to internal reasons unrelated to the project. The two remaining organizations completed the evaluation process. One organization was kept anonymous. The second organization permitted identifying their participation in this report.

2.2 ORGANIZATION LEVEL REVIEW

Organizational reviews were performed at our target T&E organizations to determine their overlap with the recommendations from our recommendation report (Craig & Schroeder, 2020). These reviews consisted of semi-structured interviews with higher-level representatives at the organization that had positions of oversight within the organization. The interview consisted of a series of 8 primary questions with secondary probing/clarifications questions. The interviews lasted about an hour and the interviewee could follow up via email with additional information as needed. The questions are available in Appendix A section 7.1.1.

The interviews were coded to identify basic themes for each of the 8 organizational review recommendations using the heuristic evaluation in Appendix A of our recommendations report (Craig & Schroeder, 2020). Based on these themes, the organization was assigned a rating from 1-4 by two reviews. Disagreements were discussed between reviewers. Final scores for a category were the average of the two ratings.

2.3 COURSE LEVEL REVIEW

Course level reviews were performed on a course provided by the T&E organization. The courses were reviewed to determine compatibility with the course level recommendations and the learning science heuristic evaluation measure (Craig & Schroeder, 2020). The courses were reviewed independently by two coders using the course coding system used to operationalize the heuristic evaluation metrics. The metrics are provided in Appendix A section 7.1.2.

2.4 SCORING

Each of our evaluations resulted in a number between 0 and 4 being assigned to each of our 16 categories. A score of zero was given only if a heuristic were absent. This did not occur in the current review.

Ratings	Description (Organization / Course)
Exemplary (4)	The organization provides ample resources compared to the current and projected needs. There are limited areas for improvement. / The course provides ample support for learners. There are limited areas for improvement.
Acceptable (3)	The organization provides the resources needed to meet current needs. However, there are still areas of potential improvement. / The course provides the support needed to meet the needs of learners. However, there are still areas of potential improvement.
Adequate (2)	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. / 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 (1)	The organization does not meet its constituents' needs and is not serving its constituents well. / The course does not meet learners' needs on this criterion in the current state.

3 REVIEWS FOR ORGANIZATION 1

3.1 ORGANIZATION LEVEL REVIEW
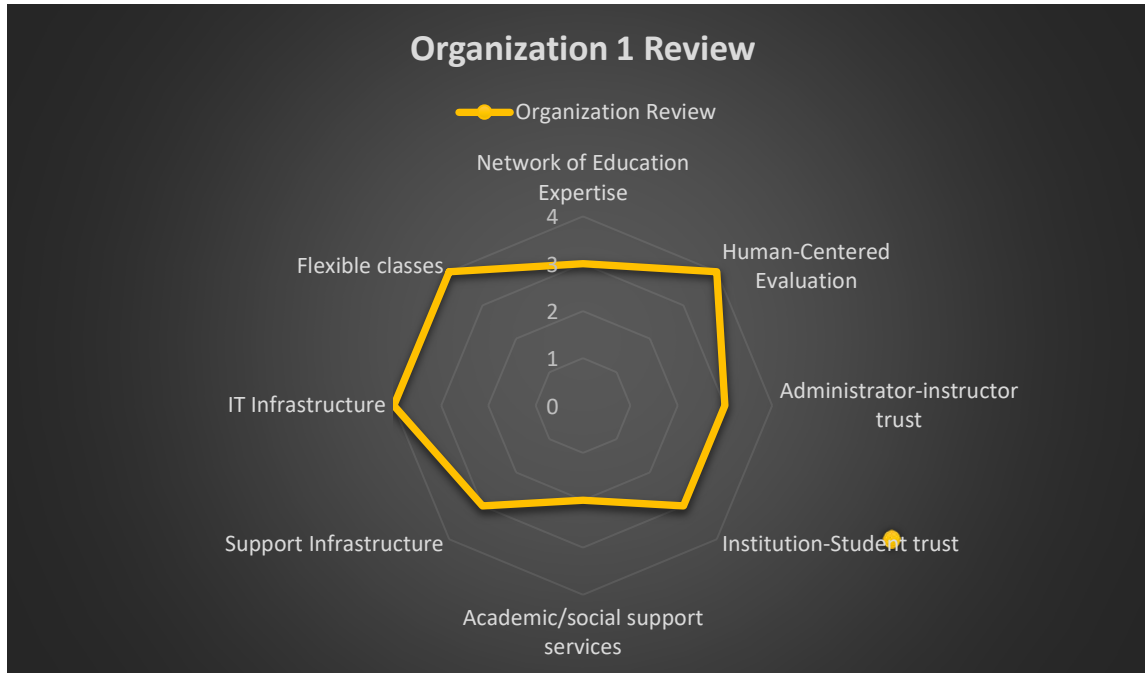
Our organization-level review of organization 1 was positive. Organization 1 received exemplary scores for human-centered evaluation, information technology infrastructure/data use, and flexible class sizes. The organization was rated acceptable in terms of its network of education expertise, support infrastructure, and trust metrics. An adequate score was obtained for academic and social support for students. Organization 1 was not observed to be lacking on any metrics. Definitions of these categories, the evidence observed from our organization review, and recommendations are provided below in the remainder of section 3.1 with a summary table provided in 3.1.9.

3.1.1 Network of education expertise

3.1.1.1 Definition:
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 by 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.

3.1.1.2 Comments:

The senior leadership is from diverse backgrounds. While the leadership might not have a traditional education focus, they have been active in ensuring they have exposure to current best practices for learning and have consistent participation in (and even organizing) relevant conferences. The organization evolved the Acquisition Learning Model (ALM) that has been its guidepost for years. Learning Science Applications Team is a combination of learning scientists and UX researchers/designers in the user experience department led by the Chief Learning Officer. Therefore, they have people who understand adult learning theory and other learning principles. There are learning analytics experts and SMEs in the Learning Science Applications division as well. There is also a learning engineering group that consists of system engineers with Instructional Systems Design (ISD) backgrounds. They are developing innovation, notional pilots, and applications in the larger ecosystem.

3.1.1.3 Recommendations:

We recommend building a learning community or learning network within the organization. This would involve identifying the leaders and contributors to the learning ecosystem and its maintenance as well as their expertise within the organization. The organization should promote understanding of learning with focused learning meetings or specialized training for all levels of management and staff.

3.1.2 Established human-centered evaluation process

3.1.2.1 Definition:

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 set better requirements and design support into the system. Mid-level evaluation of systems (e.g., usability testing) allows for the 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 provide evidence of effectiveness. This cycle can increase confidence and engagement from end-users. This could be applied to new learning supports integrated into classes or to better understand the current state of areas within the organization.

3.1.2.2 Comments:

The organization has been collecting surveys from students that are designed to inform stakeholders on the current state of our courses (e.g., design effectiveness learning). Additional surveys from the workforce to drive organizational needs have also been collected to help the organization determine what they need to offer in terms of the courses. These data come more in one-to-one perspective from people in the field that are called "functional leads (functionally integrated product teams)." What the organization offers is mandated congressionally (e.g., policy and regulatory changes). Therefore, the data is used to ensure that the organization is providing students with the knowledge and practices that they need in their positions.

The annual course evaluations based on students' feedback on courses have been implemented.

A tactical level of evaluation known as Health Indicator uses a traffic light system to indicate the annual condition and state of a particular course. The red, yellow, and green colors indicated what actions the course instructors and the different directorates are supposed to take and what content they need to update, improve, or modify. Moreover, those indications come from the feedback that they received from the help desk related to the frontline experience that students have had.

3.1.2.3   Recommendations:
The organization is shifting from a legacy system (e.g., metrics) over to a new system (e.g., Qualtrics). And they are at the beginning of implementing xAPI in the new system which will help them make decisions about the data strategy. We recommend conducting iterative usability tests for all stakeholders for all levels of deployment to serve the entire organization and make an informed decision. 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. Experimental testing and mixed-method interviewing could be effective methods to provide evidence of effectiveness regarding an innovation.

3.1.3   Support administrator-instructor trust

3.1.3.1   Definition:
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 acknowledgment of time commitment).

3.1.3.2   Comments:
Faculty are matrixed by the region in which they are located as well as by their career field. One might be a Contracting instructor located in the South region, reporting to the South dean, but also interacting with the Contracting Center Director at headquarters. There are also department chairs and an associate dean of academics at each region, but assignments vary quite a bit among the regions. Regional Deans are responsible for annual ratings with a mid-year component built-in, but beyond that regional leadership interacts with instructors on an ad hoc basis.

There is no formal observation rubric. The policies that guide instructor evaluation are handled by the directive, regional deans, or their designees observe instructors once a year. And observations are not tracked or reported at the enterprise level.

Goals are set each year but are very loosely performance-based, and there is no continuous, ongoing, formal observation and rating methodology for instructors. As a result, the linkage between recognition and compensation varies. The organization has an "on the spot award" mechanism so if someone has contributed outstandingly, they can be nominated, and if approved, cash or time off is awarded. The organization also names an outstanding instructor at its annual award ceremony.

3.1.3.3 Recommendations:
Due to the metrics of success are quite nebulous, they do not have a formal evaluation model to evaluate instructors' performances. We recommend that each region can develop and implement its regional performance evaluation metric and provide clear and actionable performance feedback periodically. This evaluation model could be similar to the Faculty Professional Development (FPD) program which helps acquisition subject matter experts to better take ownership of being a course manager and work with students. A formal and clear performance evaluation metric could identify and provide support for SMEs (Subject Matter Experts) through technical assistance and course design/development assistance. Moreover, the clear workload and compensation model based on such a metric can be established to recognize SMEs' efforts to increase their engagement and motivation.

3.1.4 Support institution-student trust

3.1.4.1 Definition:
Trust is crucial at the student level. Students' trust in instructors and class content directly impacts course grades. Student trust can be established by the 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.

3.1.4.2 Comments:
There are student councils (e.g., 508 group and review board) to help students address their issues. Besides, there is a ticketing system assisting instructors in identifying struggling students and supporting faculty rethink the course content, such as whether it needs to be changed or corrected in some ways. Lastly, policies are needed that require an explanation of class expectations to the students.

3.1.4.3 Recommendations:
We recommend eliminating student barriers to online learning by helping students locate and use external resources, such as library services, tutoring services, and technology services. Organizations should provide students with computer access and training to minimize anxiety over computer use and access. It is necessary to establish a positive rapport through respectful and fair treatment during online interactions.

The cultural diversity in online learning required learning organizations to pay more attention to understand diversity and inclusion. One approach is to preemptively design fair evaluation measures of course and student success based on the nuances of online instruction.

3.1.5 Student academic/social support services

3.1.5.1 Definition:
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.

3.1.5.2 *Comments:*
There are communities within the organization. For example, the social team handles student support services. Such support services, including but not limited to ask a professor where people in the field can send in a question, and there is their catalog. There are communities of practice help connect students who are working in a particular field with professors and center directors within the same field. An alumni association is a professional networking student support mechanism.

3.1.5.3 *Recommendations:*
We recommend instituting institution-wide communication standards and evaluating communication flow at regular intervals. The financial department should make sure students are aware of financial obligations and sources of help throughout the course. Student services should take the lead in discussing opportunities for inclusion for underrepresented minorities.

3.1.6 General support infrastructure

3.1.6.1 *Definition:*
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.

3.1.6.2 *Comments:*
The organization is federally mandated. At the university level, the organization has several directives that outline its responsibilities and obligations. Support comes at the supervisor and up level for employee actions. Teacher training and leadership training are dependent on the budget that is put forward that year within each department for internal training. Furthermore, additional training or leveling up skills can be put in requests for about a year in advance. Policy guidance (e.g., 704 and 702) guides course design and course content. All faculty are required to be versed in policy guidance.

3.1.6.3 *Recommendations:*
- We recommend three major support including:
- 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.

3.1.7 General information technology infrastructure

3.1.7.1 *Definition:*
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.

3.1.7.2 Comments:
The use of xAPI is at this initial stage. There is an IT support system that services faculty, staff, and students. There is a Learning Engineering group that oversees learning systems and provides technical training.

3.1.7.3 Recommendations:
We recommend building a general IT infrastructure that includes both academic courseware and analytics infrastructure. Specifically, a comprehensive support IT structure must be in place for instructors, staff, and students with an 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. Furthermore, the use of data analytics should be considered to improve the learning ecosystem's design and functionality.

3.1.8 Allow for flexible class sizes

3.1.8.1 Definition:
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 the 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 classes, whereas topics that entail lower-level thinking (e.g., recall) may be taught in larger classes.

3.1.8.2 Comments:
The class size for resident courses and online courses is capped at 30 per class. Factors such as geographic location, costs, and special circumstances will affect the prioritization of taking a course. For example, different priorities are given for students who may have a situation where they are about to be deployed or have minimal time to complete the course. Due to the limited dedicated classroom space, students will be waitlisted if there was a very high demand for a course. The organization does not have multiple sections of a course at the same time.

3.1.8.3 Recommendations:
We recommend planning for both scaling up and scaling out to accommodate growth. Smaller class sizes are often when teaching high-level content. Instead of scaling up to one larger class, breaking the larger class into several smaller groups with its lead instructors would fit better with the observed current culture. Lastly, the organization should optimize technology for maintaining student interaction.

3.1.9 Organization recommendation summary table

Ratings	Description
Exemplary (4)	The organization provides ample resources compared to the current and projected needs. There are limited areas for improvement.
Acceptable (3)	The organization provides the resources needed to meet current needs. However, there are still areas of potential improvement.
Adequate (2)	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 (1)	The organization does not meet its constituents' needs and is not serving its constituents well.

Category	Rating (1-4)	Comments and Recommendations
Network of Education Expertise	3	Comments: 1. The organization evolved a learning model that has been its guidepost for years. 2. Learning Science Applications is a combination of learning scientists and UX researchers/designers in the user experience department led by the Chief learning officer. 3. A learning engineering group consists of system engineers with Instructional Systems Design (ISD) background. Recommendation: Facilitate an integrated network with representatives from different units to build a learning community or learning network within the organization. Integration learning systems is a great start.
Established human-centered evaluation process	4	Comments: 1. Surveys have been collected from students and the workforce. 2. the organization is mandated congressionally 3. Annually course evaluation based on the feedback of course from students has been implemented 4. Health indicator – a tactical level of evaluation indicating the annual condition and state of a particular course. Recommendation: 1. Conduct iterative usability tests for all stakeholders for all levels of deployment to serve the entire organization and make an informed decision.

		2. Experimental testing and mixed-method interviewing could be effective methods to provide evidence of effectiveness regarding an innovation.
Support administrator-instructor trust	3	Comments: 1. Faculty are matrixed by the region in which they are located as well as by their career field. 2. There is no formal observation rubric. Observations are not tracked or reported at the enterprise level. 3. Goals are set each year but are very loosely performance-based, and there is no continuous, ongoing, formal observation and rating methodology for instructors. Recommendations: 1. Each region can develop and implement its regional performance evaluation metric and provide clear and actionable performance feedback periodically. 2. A formal and clear performance evaluation metric could identify and provide support for SMEs through technical assistance and course design/development assistance.
Support institution-student trust	3	Comments: 1. Student councils help students address their issues. 2. The ticketing system helps instructors to identify struggling students and help faculty rethink the course content, such as whether it needs to be changed or corrected in some ways. 3. Policies require an explanation of class expectations to the students. Recommendations: 1. Build logical class structures that minimize negative events. 2. Frequent communication 3. Maintain a positive and consistent instructor persona 4. Support peer-to-peer mutual interaction 5. Involve students in decision-making and communication; define clear policies and create clear and transparent oversight.

Student academic/social support services	2	Comments: 1. There are communities within the organization. 2. There are communities of practice help connect students who are working in a particular field with professors and center directors within the same field. 3. the organization's alumni association is a professional networking student support mechanism. Recommendations: 1. Implement institution-wide communication standards and evaluate communication flow at regular intervals. 2. Make students aware of financial obligations and sources of help. 3. Student services should take the lead in discussing opportunities for inclusion for underrepresented minorities.
General support infrastructure	3	Comments: 1. the organization is federally mandated. 2. Support comes at the supervisor and up level for employee actions. 3. Teacher training and leadership training are dependent on the budget that is put forward that year within each department for internal training. 4. Additional training or leveling up skills can be put in requests for about a year in advance. 5. Policy guidance (e.g., 704 and 702) guides course design and course content. 6. All faculty are required to be versed in policy guidance. Recommendations: 1. Establish a clear hierarchy of reporting, networks of support, and training on technology and procedures. 2. Providing educational design support from instructional designers. 3. Providing learning strategy support from learning scientists or discipline-based educational researchers. 4. Providing learning technology integration support on best practices for using technology to support learning from learning engineers.

General IT infrastructure	4	Comments: 1. The use of xAPI is at this initial stage. 2. There is an IT support system that services faculty, staff, and students. 3. Learning Engineering Group oversees learning systems and provides technical training. Recommendations: 1. General IT infrastructure should include academic courseware and analytics infrastructure. 2. Comprehensive support IT structure must be in place for instructors, staff, and students with an emphasis on technology support. 3. A modern infrastructure must transcend vertical and isolated systems to embrace open data formats that can integrate data from across the learning enterprise.
Allow for flexible class sizes	4	Comments: 1. The class size for resident courses and online courses is capped at 30 per class. 2. Factors such as geographic location, costs, and special circumstances will affect the prioritization of taking a course. 3. Instead of having multiple sections of a course at the same time, students will have to waitlist that course if there was a very high demand for it. Recommendations: 1. Smaller class sizes are recommended when teaching high-level content. 2. Class sizes, regardless of content, should be limited when learner or instructor support is limited. 3. Optimize technology for maintaining student interaction.

3.2 COURSE LEVEL REVIEW
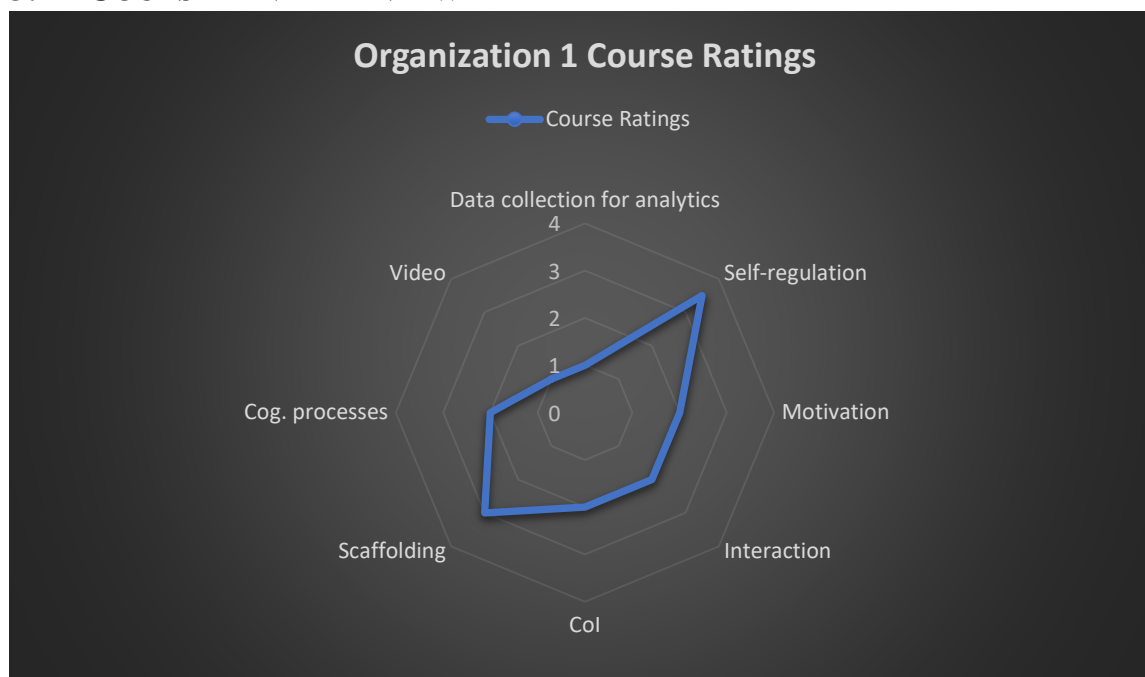
Organization 1 Course Ratings

Our course level review of Organization 1 was not as positive as the organizational review. But this is not surprising, since Organization 1 provided a course that needed updating and not their exemplary course. This being the case, the course still has bright spots. The Organization 1 course did not receive exemplary scores on any measures. However, it did receive a 3.5 on supporting student self-regulation which was approaching this category. The course was rated acceptable for the use of scaffolding within the class. An adequate score was obtained for supporting cognitive processing, interaction, motivation, and supporting a community of inquiry. The course was observed to be lacking in video and data collection for analytics metrics. The course had the possibility for both metrics but did not directly implement them. Definitions of these categories, the evidence observed from our organization review, and recommendations are provided below in the remainder of section 3.2 with a summary table provided in 3.2.9.

3.2.1 Fundamental data collection for analytics

3.2.1.1 Definition:
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. To use data to facilitate learning, visualizations with relevant information to its intended use must be considered. The visualization should incorporate interactivity to allow for visual exploration and to prevent overwhelming users.

3.2.1.2 Comments:
While the organization scored well on data analytics overall, this course scored quite low. There was no evidence that the CON320 course system collects students' data for analytics purposes using any standardized approaches. The visualization for displaying analytics results to inform students and instructors was not found in this course.

3.2.1.3 Recommendations:
A data collection for creating visualizations can help students to reflect on what they are doing in the class, such as xAPI metrics. A well-designed course regularly uses a standardized approach to capture the interaction of students in the system (e.g., xAPI) and designs comprehensive visualizations for intended users to interpret and utilize students learning data completely and informatively. Moreover, visualizations are needed to be highly relevant to the intended users and easy to understand including both descriptive information and informative analytic information to help (1) students, (2) stakeholders, (3) instructors (asking students for feedback about the course regularly and revise content as needed), and (4) learning organizations make data-informed decisions strategically.

3.2.2 Support self-regulation

3.2.2.1 Definition
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 following 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.

3.2.2.2 Comments
CON320 course is a self-selected class based on individual interests. The course provides the necessary support to meet learner's needs in terms of the four phases of self-regulation. More support should be devoted to helping students frame their intrinsic goals and needs of learning. This rating is considered the minimum needed for course delivery and may not be at appropriate levels for all learners.

3.2.2.3 Recommendations:
Students should be asked to create a plan for their learning and given the content and information necessary for them to construct a plan. Make courses flexible for learners to make changes based on their own goals and needs. For example, a pre-course assessment survey about prior knowledge or time management (e.g., how well you manage your time as an online student) within the first week of the class could be a good start in assessing students' prior knowledge and knowing their plan of study.

3.2.3 *Support motivation*

3.2.3.1 Definition
Students exhibit varied levels of motivation while learning content is distributed as well as face-to-face or blended learning environments. Many theories of academic motivation 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 varying levels and types of motivation can improve course designs by considering different strategies for supporting students' motivation to learn the content.

3.2.3.2 Comments
There was no evidence that the CON320 course indicates any flexibility in the course for students to augment the goals. Although the quizzes may provide feedback, the ability for students to work towards

their own learning goals outside of the ridged course materials is not available. No extra external goals to motivate the students are provided. No online system for student commination seems to present.

3.2.3.3   Recommendations:
A clear understanding and realistic external goals are set to motivate students (e.g., earning extra credits/points). Instructors should encourage students to explore external resources and share their own working experiences in the field to help better understand the subject matter. The course involves motivational pedagogical strategies that collaboratively develop students' soft skills. For example, use problem-based or project-based learning to help students with their interpersonal skills, persistence, communication skills, and other "soft" skills aside from academic skills.

3.2.4   *Support interaction with course features*

3.2.4.1   Definition
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, 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.

3.2.4.2   Comments
There was no evidence that the course presents any online systems for student commination. Assignments, quizzes, and activities are individually based. No formal instruction is given for how to use the site or navigate the lesson materials. Only one cooperative learning opportunity, the Sierra Case, is present throughout the course. Although a brief mention of general policy for the organization to provide accommodations is mentioned, this is buried deep into the course materials and would be difficult for those that require accommodations with the supportive technology to find.

3.2.4.3   Recommendations:
A student forum or discussion page would allow students to communicate and discuss the course content. The lack of interaction and discussion between students diminishes a wealth of learning experiences. A site home page that has an introduction video front and center that outlines who the instructor is and how to use the course site should be considered. Also, students can be required to record and upload an introduction video answering serval prompts provided by the instructors and comments on each other's videos. Instructors should prompt the student to answer a brief accommodation questionnaire about the technology level assessment when enrolling in the course, and then provide recommendations and extra supportive technology for those students.

3.2.5   *Fosters a community of inquiry*

3.2.5.1   Definition
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 three types: 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.

3.2.5.2   Comments
CON320 course allows students to choose their topics to work on group projects. The instructors are required to walk students through the course structure on BB and to focus on the application of the subject matter.

3.2.5.3   Recommendations:
Students' ongoing involvement in Communities of Inquiry (CoI) is an important factor when designing virtual learning experiences. CoI encourages professional growth through the exchange of ideas, collaboration, and resource sharing. We recommend the course establish some forms of formal CoI and encourage students to participate. This would include increasing the social presence of the instructor within the class via short videos and provided information spaces for students to collaborate and discuss the material. This will enable conversation and collaboration between the instructor and peers. This workspace can be a place to raise questions, provide feedback, or just discuss ideas.

3.2.6   *Provides scaffolding, including microlearning and feedback*

3.2.6.1   Definition
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.

3.2.6.2   Comments
CON320 course instructor plan has relatively clear guidance on how to teach this course. The course introduction plan explicitly indicated that students who are taking this course come with prior knowledge in this subject matter. This is a self-selected class based on individual interests. So, the course objectives gravitate towards hands-on experiences. This course is broken into eight lessons with separated learning objectives that build upon each other. Students were given quizzes after completing each lesson. They also are required to apply CAS and the Cost Principles to analyze the legal case. Instructors are expected to give students intermediate reviews on their analysis of each case to keep them on track. Once students have presented a case, instructors should provide all students with the case summary.

3.2.6.3   Recommendations:
We recommend taking an individual student's prior knowledge into account for a starting point and supporting students by recommending lessons that they may need based on their performance. The content of CON320 could be separated into sub-modules within each existing module, preferably with videos in each module instead of only using text-based materials. Instructors can use 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. Moreover, informative, and supportive feedback should be provided with dynamic timing to promote learning. Such feedback could be provided through prompts that provide opportunities for instructors to address domain-specific knowledge, guidance, and learner-strategies through explanations, references, visual aids, and project templates.

3.2.7 *Designed according to human cognitive processes*

3.2.7.1 Definition
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.

3.2.7.2 Comments
CON320 course is heavily text-based. Even though there are graphs in the slides and reading materials, student materials contain only PDF, Word, and PowerPoint files.

3.2.7.3 Recommendations:
The text can be broken down into small modules to reduce the number of texts presented in one lesson (e.g., lesson 1 includes a document consists of 36 pages of texts). The PPT presentations for the course should also be redesigned. The lesson's narration (lecture) should be supported with minimal text and the use of relevant imaging materials. The integration of narrative and visual information should be presented at the same time.

3.2.8 *Provides best practices for video content*

3.2.8.1 Definition
Courses should use instructional videos that follow specific research-based best practice strategies. The 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.

3.2.8.2 Comments
There was no evidence that videos are used in the CON320 course.

3.2.8.3 Recommendations:
We recommend breaking down the existing course module into smaller sub-modules and create 5-10-minute videos for each sub-module. The videos should not be recordings of the lectures without any engaging elements to promote active learning and critical thinking. Instead, it should be designed to fit the online learning environment. The video content should focus on modeling the knowledge for the students, such as showing the instructor in the video applying procedural knowledge related to the course or other students struggling through a successful learning experience. Moreover, all content of course videos should be engaging and promotes active learning. For example, instructors can ask questions to promote critical thinking and generate interest in acquiring additional knowledge. All environments around the

instructor are professional yet relatable, and the instructors' "digital" personality is well-expressed. Notably, all course videos should follow ADA accessibility guidelines, such as closed captioning.

3.2.9   Course recommendation summary table

Ratings	Description
Exemplary (4)	The course provides ample support for learners. There are limited areas for improvement.
Acceptable (3)	The course provides the support needed to meet the needs of learners. However, there are still areas of potential improvement.
Adequate (2)	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 (1)	The course does not meet learners' needs on this criterion in the current state.

Category	Rating (1-4)	Comments and Recommendations
Course Design		
Fundamental data collection for analytics	1	Comments: There was no evidence that the system collects student's data for analytics purposes; there was no evidence that visualization provided to students telling them how well they are doing in the courses. Recommendations: 1. Standardized metrics (e.g., xAPI) should be used as a starting point to evaluate the interaction of students and the online system. 2. Interpret and demonstrate the data using proper visualizations for students to monitor their progress (e.g., student-facing dashboard). 3. Provide instructors with students' learning analytics to help them facilitate learning. (e.g., instructor-facing dashboard). 4. Provide the stakeholders with valuable students and instructors learning analytics to inform the decision-making process for the institution.

Support self-regulation	3.5	Comments: Students' four phases of self-regulation are considered in the CON320 course at a basic level. Students need to take open-ended question quizzes and analyze the legal cases to demonstrate their mastery of the knowledge. Students get feedback from instructors about the legal case. Each lesson is intended to be in sequential order as the subject matter is covered. Recommendation: 1. Include these guides and materials for the students in the same area as the preliminary quiz, with the materials and quiz indicating what students might need to focus on so that they can plan their learning experience and ask them to create a plan for their learning. 2. For the legal case assignment, design a simulated situation where students play different roles to act out how the subject matter is used in real life.
Support motivation	2	Comments: The learning objectives are provided for each lesson. Feedback is given for legal cases assignment. The quizzes are standardized tests about the understanding of key concepts. The group project is utilized in this course to apply the subject matter knowledge (e.g., legal case assignments). Recommendation: 1. Allow students to implement their group assessment instead of all working on the Sierra Case. This would allow students to guide their learning to the desired area of CON 320. 2. Allow students to find their cases and articles to read for discussions. 3. Provide the students to turn in write-ups of causes related to the exam's materials for extra points, or some other form of related extra credit opportunity. 4. A student forum or discussion page would allow students to communicate and develop their soft skills.

Support interaction with course features	2	Comments: Students are encouraged to have a group discussion regarding the cost and/or CAS principle being litigated and resolved (or not) for their legal case assignments. But it does not mention where students can have those discussions. Recommendation: 1. Establish a formal place for students to have these discussions throughout the course. (e.g., slack) 2. Adopt proper technologies in this course to facilitate peer interaction and students-instructors interaction. Such technologies could be discussion forums or group chats or video-conference platforms. 3. Roleplay could be an interesting instructional method to conduct legal case analysis assignments collaboratively.
Fosters a Community of Inquiry	2	Comments: 1. The course is not able to be altered from the setlist of goals and assignments. 2. The instructor's presence was not found in this course, no interaction opportunities on the site seem to be present at all. 3. No communication outlets are provided. Recommendation: 1. Allow students to propose alternative assignments to the course Exams and Sierra case. 2. Creation of a discussion forum where the instructor could interact with active students and proactively guide the growth. 3. Create a discussion forum, and then monitor that forum for misinformation/abuse.
Provides scaffolding, including microlearning and feedback	3	Comments: The lessons are grouped into modules; the amount of materials in these modules is immense and overwhelming. Recommendations: 1. Break the information into materials into small and easily digestible sections. 2. Providing the student and the entire book is not conducive to microlearning. Instead, a slide or five-minute video highlighting key points would be useful.

Designed according to human cognitive processes	2	Comments: 1. The text provided is dense and long, sometimes entire books being posted with a lesson plan. 2. No online narrative is provided, just text, making it separate and not at all in timing. 3. No key points are highlighted in the readings or text. Recommendations: 1. Provide video slideshows that accompany the lesson, using minimal text and relevant images. 2. Provide videos with slideshows that accompany the lesson, using minimal text and relevant images. 3. Highlight key points in written text and group them into subtopics of a smaller size.
Provides best practices for video content	1	Comments: No videos are provided, only long documents and case files. Recommendations: Instructor slides can be turned into short videos within 10 mins. Videos can be used to demonstrate what the procedure of a legal case analysis is. Such as how to ask the right questions to get the optimal solutions. Lesson 4 (student materials) includes step-by-step instructions for accessing the FPRA. Instead of using screenshots, it could be designed as a short video clip that demonstrates how to do that. Follow ADA accessibility guidelines, such as closed captioning.

4 NAVAL POSTGRADUATE SCHOOL

4.1 ORGANIZATION LEVEL REVIEW
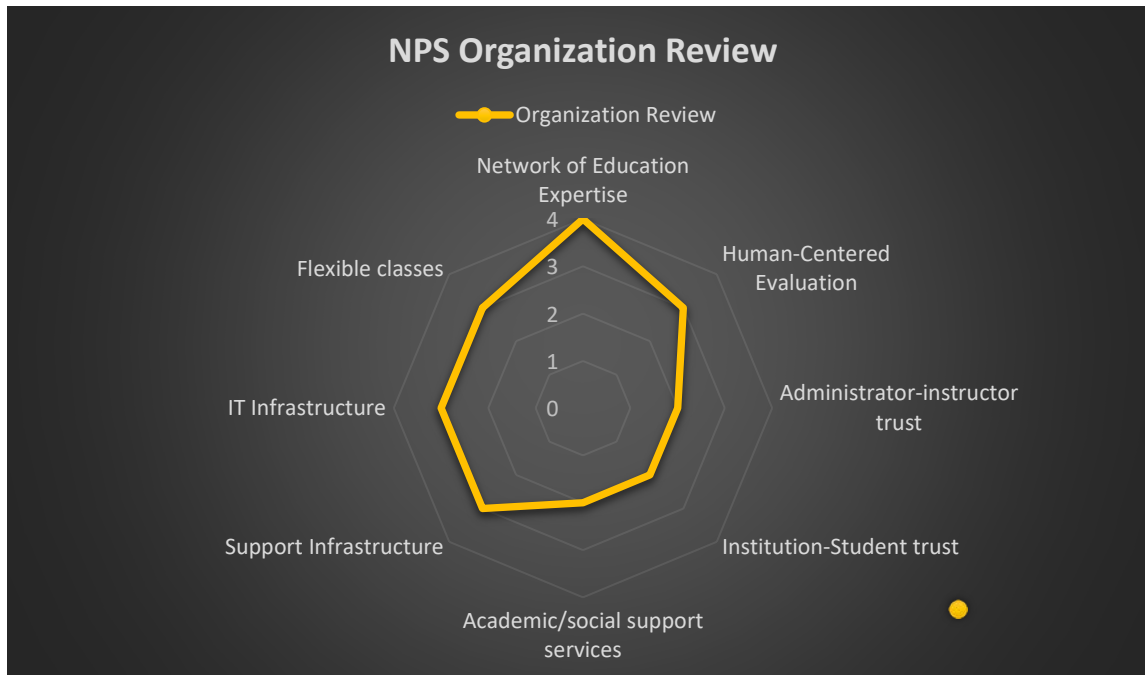
Our organization-level review of the Naval Postgraduate School (NPS) was mostly positive. NPS received exemplary scores from both reviewers for a network of education expertise. The organization was rated acceptable in terms of its human-centered evaluation, information technology infrastructure/data use, and flexible class sizes, support infrastructure. An adequate score was obtained for academic and social support for students and trust metrics. NPS was not observed to be lacking on any metrics. Definitions of these categories, the evidence observed from our organization review, and recommendations are provided in the remainder of section 4.1 with a summary table provided in 4.1.9.

4.1.1 Network of education expertise

4.1.1.1 Definition:

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 by 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.

4.1.1.2 Comments:

Individuals at all levels of the organization have a commitment and connection to the betterment of learning at this organization. The existing network starts with the top of the administration with provosts that report to the president, to vice provosts for the faculty, and an impressive thirty-three people working in the Graduate Education Advancement Center. The organization shows further commitment to this network by contracting instructional designers to support their faculty and offering support services

for distance learning. The business operations department handles the budget and financial management of these systems and has direct ties to the network of education experts.

The organization houses a vast network of individuals that are committed to education. These individuals must be able to easily connect through a network within the institution.

4.1.1.3   *Recommendations:*

A dedicated communication platform outside of email that connects this network of individuals is needed. Additionally, a series of training meetings to discuss the learning philosophies of the organizations and best practices would be useful.

4.1.2   Established human-centered evaluation process

4.1.2.1   *Definition:*

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.

4.1.2.2   *Comments:*

The framework for identifying problems, evaluating performance, and understanding needs are very well structured in the organization. Demographic data of the students and instructors are collected and examined for trends. This is part of the great number of surveys that are sent out to faculty, students, and on the organizational level. Teaching and Learning Commons faculty also go to individual departments for focus group interviews, these interviews are done on a continuous rotation.

The demographic data and trends are examined for students, instructors, and the organization. However, the active group interviews are only done at the instructor and organizational level, which could omit useful information from students. Additionally, there is no mention of observational data.

4.1.2.3   *Recommendations:*

Create an opportunity for students to participate in a separate focus group session. Digital observation data via screen capture software, or xAPI data, would also improve the human-centered evaluation process with data that is not easily collectible through surveys. This xAPI data could also be extended into visual dashboards for management and external stakeholders.

4.1.3   Support administrator-instructor trust

4.1.3.1   *Definition:*

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.

4.1.3.2   *Comments:*

All stakeholders are recognized from the top-down, with higher-level administration encouraging the lower levels to innovate and improve the courses. Instructors are further supported by the

administration in their education endeavors, this is done by employing a large staff of technical support and course design professionals to assist the instructors.

Instructors would benefit from evaluations of their courses that standardized and transparent. No mention of compensation models based on metrics or efforts is discussed. Although support is offered, there is no mention of an established course quality control method to ensure that instructors remain engaged and on the same common ground as the administration.

4.1.3.3   Recommendations:

Provide standardized and transparent evaluations, with feedback that is clear and actionable regarding anything that needs improvement. To further improve this, provide acknowledgment to staff through compensation models based on metrics and the efforts made. Establish a course quality control group within the organization, to assess instructors clearly and fairly.

4.1.4   Support institution-student trust

4.1.4.1   Definition:

Trust is crucial at the student level. Students' trust in instructors and class content directly impacts course grades. Student trust can be established by the 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.

4.1.4.2   Comments:

Library and tutoring services are made available to all students, removing barriers made by online learning. The students can evaluate the instructor and the course itself, fostering student involvement in the decision on how to improve the education within the organization.

In addition to extra resources such as tutoring services, basic instruction must be given to students on how best to use their online resources. A clear outline of each course should be provided, transparency in what is expected of students will facilitate trust as their efforts are met with expected outcomes. The online interaction between institutions and students also plays an important role in establishing trust, making sure to treat all students in the same fashion.

4.1.4.3   Recommendations:

Provide training to students in computer use and how best to access the learning management system. This includes both advanced and basic training in the use of the online site. Provide standard policies that preemptively explain course grading, course goals, and workload expectations to the students.

4.1.5   Student academic/social support services

4.1.5.1   Definition:

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. Learning organizations must offer student support services and mindfully enable additional social structures. These services interact with and build upon other essential factors, including students' family framework, personal satisfaction, and perceived course relevance.

4.1.5.2   Comments:

Across the organization, the administration has made it possible for students to obtain direct contact. Be this with the dean, international representatives, or military branch representatives, the students can reach out. Library and online services are made available to all students, for day-to-day support and in-depth help with improving writing skills and thesis assistance. Students are also able to evaluate the communication of their instructors at regular intervals through course evaluation feedback.

The students are supported academically, but there were fewer social support services observed. These support services are quite varied and include the financial aspect, of students being aware of the cost of the program, the emotional needs of students including contact representatives, and specific support for students with a disability.

4.1.5.3   Recommendations:

Make sure students are aware of the financial obligation required to finish the program, and what sources of financial aid are available to them. Providing a counseling service for students that are in need and making the student population aware of this service.

4.1.6   General support infrastructure

4.1.6.1   Definition:

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.

4.1.6.2   Comments:

The organization has done a good job of creating a general support infrastructure. The framework goes from the top of the institution down to individual offices. One such office is that of the Business Operations, which alone supports 33 people to set up courses, supply materials, enroll students, and support the faculty.

The infrastructure is well designed to meet the needs of the faculty and instructors. The only missing element is for this structure to include similar support for the student population. This may already be provided within the mentioned Business Operations Office, or another similar office, but is currently unclear.

4.1.6.3   Recommendations:

Further include technological support for the individual students as well as the faculty.

4.1.7   General information technology infrastructure

4.1.7.1   Definition:

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 an emphasis on technology support

4.1.7.2   Comments:

IT support is available throughout the entire organization. Faculty can collaborate easily using Microsoft Teams, training for which is provided to the staff. Software programmers are employed to improve learning management systems. These learning management systems have integrated grade books and media modules, with videography available for professional-looking videos. An Information Technology Office oversees the IT work to make sure all components run smoothly.

The learning system is a custom and isolated system, in which the data collected, is unable to be easily integrated or compared to data collected in other systems. Although the resources available to staff and detailed and comprehensive, IT support for students were not directly mentioned.

4.1.7.3   Recommendations:

Using a standardized learning management system, embracing open data formats. Offer IT support for the student population. Ideally, a modern infrastructure must transcend vertical and isolated systems to embrace open data formats that can integrate data from across the learning enterprise. Furthermore, the use of data analytics should be considered to improve the learning ecosystem's design and functionality. The data collected could be used to detect problems within the learning system and to quickly produce data visualizations when reporting out to the administration and external stakeholders.

4.1.8   Allow for flexible class sizes

4.1.8.1   Definition:

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 the nature of the content.

4.1.8.2   Comments:

Class sizes, in general, adhere to best practices. Advanced courses have a smaller number of students than the introductory courses, with advanced courses averaging 12 students. Class size being dictated by what dynamic is necessary to be achieved between the instructor and the student, and what size would support this dynamic. Additionally, courses with cooperative tasks have smaller class sizes, pacing the size of the course with the student's ability to engage.

Although the class sizes adhere to best practices, this seems to be done on a class-by-class basis. Ultimately, the class size can be changed based on the quota that the Navy desires. This means that with no strict policy on a student to teach ratio or hard limits on class size, these best practices being implemented could be temporary. The technology was not mentioned concerning the class size, where supportive technology is necessary for larger class sizes.

4.1.8.3   Recommendations:

Create policies that limit the class size depending on the course material and level of engagement required on the students, moving away from the case-by-case decision-making. Utilize supportive technology that allows instructors to interact with students easily in larger classes.

4.1.9 Organization recommendation summary table

Ratings	Description
Exemplary (4)	The organization provides ample resources compared to the current and projected needs. There are limited areas for improvement.
Acceptable (3)	The organization provides the resources needed to meet current needs. However, there are still areas of potential improvement.
Adequate (2)	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 (1)	The organization does not meet its constituents' needs and is not serving its constituents well.

Category	Rating (1-4)	Comments and Recommendations
Network of Education Expertise	4	Comments: Provost reporting to the president, associate provost for graduate, a vice provost for faculty, and vice provost for academic affairs. 33 people that work for graduate education advancement center, with oversight. Department Teaching and Learning, to improve the school and learning. Instructional designers are contracted and support the faculty. Supports the school, research, academic associates, curriculum, ALL THE WAY DOWN to individual faculty, and support services for distance learning. Educational Research and Program Development, starting to get involved in a sponsored research program, supporting the school, and all those that want to do distance learning. Business operations department, supporting contracts on and off-campus. Overseas the budgeting and financial management of the school. The schools themselves have representatives or IT, and NPS integrates with them. Teaching and learning commons. Recommendation: Create a dedicated network in which all these individuals may interact with each other. This would allow sharing knowledge and experience across levels and teams.

Established human-centered evaluation process	3	Comments:
		Demographic data of users and teachers look for trends.
		Surveys are done in great numbers, to engage with faculty and students to improve things immediately.
		Teaching and Learning Commons faculty go to individual departments and do focus group interviews on a continuous rotation.
		Surveys are conducted at the student, teacher, and organization levels.
		Upgrades and changes to the websites are done by tailoring the needs of the users.
		Meeting about how to make the information gathering better, how to improve the process.
		Recommendation:
		The framework for identifying problems, evaluating performance, and understanding needs are very well structured in the organization. The interview discussed the many ways in which surveys are implemented to gather data, as such the recommendation is to expand the methods in which data is gathered outside of surveys to observational methods and brainstorming sessions.
		For observation, digital observation via screen capture software would generate useful information on the user interface. As well as xAPI data would improve on the demographic information collected.
		Brainstorming sessions sound like they are taking place with the rotating department focus groups, and this should be expanded to include collecting focus group data on the student population.

Support administrator-instructor trust	2	Comments:
		All stakeholders are recognized from the top down.
		An abundance of support is available for instructors, with a large staff for a need from technical support to course design.
		Higher-level administration encourages the lower levels to innovate and make the courses better.
		Recommendations:
		Provide the professors with clear evaluation metrics of their courses, with clear and actionable feedback regarding what needs improvement. These performance evaluations should follow standardized metrics and be transparent.
		Provide acknowledgment of the effort made by staff, with compensation models based on metrics and the efforts made.
		Establish course quality control methods to ensure accessibility and engagement.
Support institution-student trust	2	Comments:
		Library and tutoring services are available to the students.
		Students can evaluate the professor and the course.
		Recommendations:
		Provide training to students in computer use and access to the learning management system. This includes how to use the online sites, as well as providing the students with understandable and thorough instructions for student interactions with online course content by providing an up-to-date syllabus, course goals, and realistic workload expectations.
		Preemptively explain course grading and evaluations and monitor the course dropout/completion rates to aid students that are at risk of dropping out.
		Establish a positive rapport through respectful and fair treatment during online interactions.

Student academic/social support services	2	Comments: On an institutional level, a dean of the institution, international representatives, and military branch representatives all have direct contact with the students. There is a course evaluation form for students to provide feedback to the instructors and institution. Library offers direct support to students to improve writing and help with thesis. Recommendation: Make sure students are aware of the financial obligation they must finish the program, and what sources of financial aid are available to them. Offer institutional services for persons with disabilities, and make these services known. Making students aware of counseling services.
General support infrastructure	3	Comments: A framework that goes from the top of the institution down to individual offices. From the bottom, there is a business operations office, supports the 33 people and those outside of the organization to set up courses, have students enrolled on time, books supplied on time, and make sure the faculty are supported in making their course. Recommendations: Previously instructional designers and forming strategies from educational research were mentioned. The recommendation is to further include technological support for the individual students as well as the faculty, and that this support comes from learning engineers.

General IT infrastructure	3	Comments:
		Gradebooks and integrated media modules are available. Videography is done for professional videos.
		The faculty uses Microsoft teams, in which training is provided to the staff. Zoom and adobe collaborate are also used.
		Software programmers are employed to improve learning management systems.
		Instructional designers and technical people work together across campus. The information technology office oversees the process to make sure it all works smoothly. The learning technology roadmap is overviewed in monthly meetings to reassess what improvements should be focused on.
		Recommendations:
		The learning management system should be a system in which standardized xAPI data collection can be compared to other outside systems. Unsure based on the interview if this is already the case or not.
		Increase emphasis on technology support for students. The staff and instructors have an abundance of support and training for using the technology, but it is unclear what training or support is available to students.
Allow for flexible class sizes	3	Comments:
		Advanced courses have smaller numbers than beginning classes, 12 and 40, respectively. Classrooms with cooperative tasks have smaller numbers.
		Class size is based on a quota of what the navy wants, the physical size of the rooms, and what dynamic is to be achieved with the students.
		No strict policy was written about the student-to-teacher ratio, or what a hard limit would be.
		Recommendations:
		Utilize technology to maintain interaction between students and professors, particularly with larger classrooms.
		Create policies that limit the class sizes depending on course material and engagement levels, instead of the decision being purely on a case-by-case basis.

4.2 COURSE LEVEL REVIEW
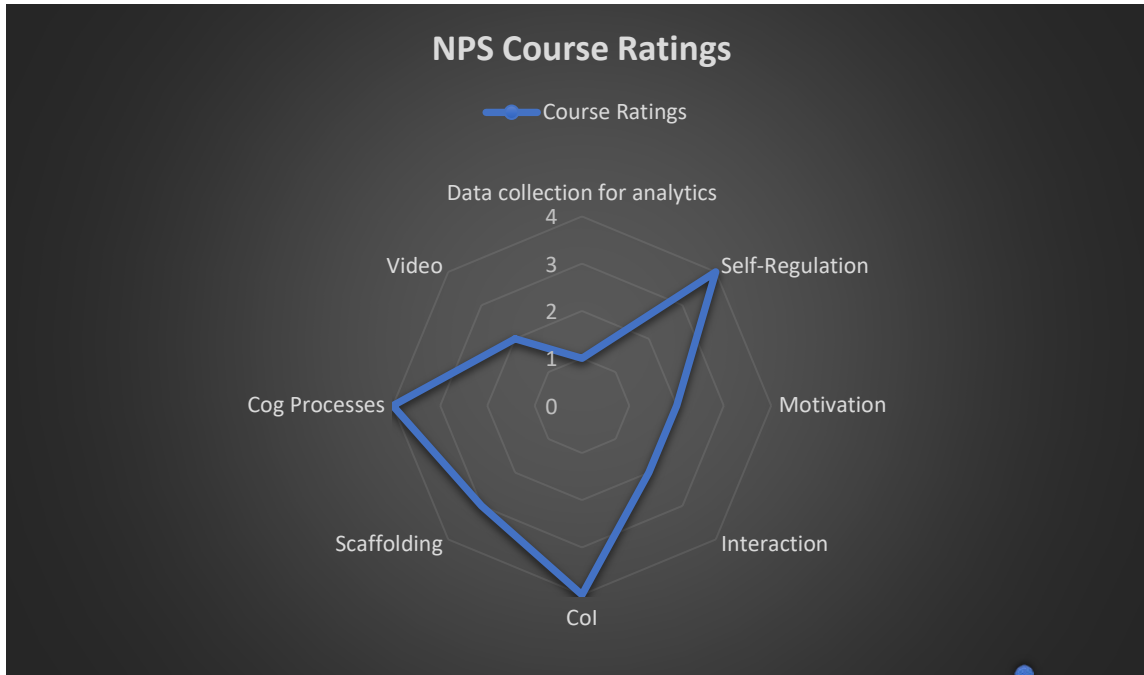
Our course level review of the Naval Postgraduate School (NPS) was revealed several levels of excellence as well as opportunities for improvement. NPS course received exemplary scores supporting human cognitive processes, supporting student self-regulation, and supporting communities of inquiry. The organization was rated acceptable in scaffolding student experiences. An adequate score was obtained for supporting student motivation and interactions. The course was observed to be lacking in the integrated use of user data analytics and the use of video. Definitions of these categories, the evidence observed from our organization review, and recommendations are provided below in section 4.2 with a summary table provided in 4.2.9.

4.2.1 Fundamental data collection for analytics

4.2.1.1 Definition:
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. For example, xAPI is a popular method for capturing, standardizing, and sharing human performance data.

4.2.1.2 Comments:
The system does capture the usage of the individual parts of the site, in addition to which users are more active on the site over others. This data is also presented visually in the form of pie charts and bar graphs.

The information regarding user data is not being captured or presented in a standardized format. Using a standardized format would remove inconsistencies in the way the data is presented. Furthermore, presenting the data to the student population would allow individual students to understand how they are doing in the course by comparison to peers. Finally, the data while presented visually also requires the necessary information to accompany the visuals. Keys and descriptions of the units being counted are necessary for users to extract the desired information from the visuals.

4.2.1.3   Recommendations:
Standardize how the data is captured and presented to the users. With this captured data, provide students the option to have their data be visible to the class, and for them also to be able to view the class's data. Along with the data being presented in a visual format, provide the necessary descriptive information about the data so that it may be understood.

4.2.2   Support self-regulation

4.2.2.1   Definition:
Self-regulation is a broad term that refers to one's ability to monitor and regulate their learning experiences. To successfully implement self-regulation, the following 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.

4.2.2.2   Comments:
This course does an excellent job of supporting the student's self-regulation. A course map is provided early on to show the students what the course will entail, allowing the students to plan out their best approach for learning. Students can develop and implement strategies to improve their performance during the span of the course. Feedback provided is formative and accurate to help the students reflect on what they have learned, which also allows students to adapt their future learning efforts based on the feedback.

This course can improve on supporting self-regulation by asking the students to construct a learning plan before the beginning of the course. Although the course offers a course map that provides the students with the necessary information to do this, the task itself of having the students creating learning plans is absent.

4.2.2.3   Recommendations:
Ask the students to create a plan for their learning. Having them plan strategically based on their prior learning experiences and allows flexibility in the course to fit the needs of the students' plans.

4.2.3   Support motivation

4.2.3.1   Definition:
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 varying levels and types of motivation can improve course designs by considering different strategies for supporting students' motivation to learn the content.

4.2.3.2   Comments:
The course goals are presented to the students, with detailed descriptions of each goal. The assignments related to each goal offer some flexibility in what the assignment entails. Finally, the course provides personalized and meaningful feedback to each student with each required task.

Although the goals and assignments of the course are quite varied, the students are not able to change the goals of the course within the subject matter. The assignments are done individually and do not motivate the development of communication or interpersonal skills. No extra external motivation is provided to the students.

4.2.3.3 Recommendations:
Allow the students to augment the goals of the course to some degree, to match their learning desires while staying within the subject of the course. Providing students with a team or group assignment would further the development of their interpersonal skills.

4.2.4 Support interaction with course features

4.2.4.1 Definition:
Courses should be designed to support interactions. 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.

4.2.4.2 Comments:
Communication platforms for the students are present in an open forum page, which the students can fully use for any discussion purposes. The students are encouraged to use this platform to interact with one another.

No formal instruction for how to use the course site is available to the students, not all students will begin the course with the same level of prior knowledge of this system. Cooperative learning opportunities are possible given the ability to communicate through the system, but currently, the learning activities are individually based. Although accommodations may be offered to students as a whole outside of the course site, there are no accommodations currently present.

4.2.4.3 Recommendations:
Provide formal instruction videos or information on how to use the online system the course resides in. Encourage cooperative learning by providing assignments or activities that promote group work. Make accommodations for students that are unable to engage with the technology provided.

4.2.5 Fosters a community of inquiry

4.2.5.1 Definition:
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. A community of inquiry is a connected group of learners with common goals. To create this collaborative community, a class must have a feeling of presence (being present) associated with it. There are three types: cognitive, teaching, and social.

4.2.5.2 Comments:
The course does an impressive job of fostering a community of inquiry. Students are given flexibility in assignments, allowing them to manipulate the content of the course to their interests. The instructor has a presence in the course by providing content that further connects the student's interests to extra content outside of the immediate coursework. Finally, there is a feeling of social presence for the students through the communication outlets and forums provided.

These comments are from not seeing the course in action. The instructor should take a proactive role in guiding the discussions online, and the communication outlets should be monitored for misinformation/abuse.

4.2.5.3   Recommendations:
COI encourages professional growth through the exchange of ideas, collaboration, and resource sharing. We recommend the course establish some forms of formal CoI and encourage students to participate. This would include increasing the social presence of the instructor within the class via short videos and provided information spaces for students to collaborate and discuss the material. This will enable conversation and collaboration between the instructor and peers. This workspace can be a place to raise questions, provide feedback, or just discuss ideas. Regularly inspect the chats to see if there is a positive way in which the instructor can move the conversation, while also checking for any abusive interactions between students.

4.2.6   Provides scaffolding, including microlearning and feedback

4.2.6.1   Definition:
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.

4.2.6.2   Comments:
The lesson plan builds on each assignment in a structured way. This building begins at a low starting point that would allow most students to begin on a similar footing to each other. The modules are groups in a logical manner, and the reading is given in small manageable sections. Lastly, feedback is provided to the students with appropriate timing, in their assignments, quizzes, and project.

Regarding scaffolding, the student's prior knowledge is not considered at the beginning of the course. For microlearning, the content in each of the modules themselves consists of large amounts of material.

4.2.6.3   Recommendations:
Assess the individual prior knowledge of each student through an assessment at the beginning of the course. This would allow data on what areas the student is already knowledgeable, and what areas they are lacking that could be trouble for the student as the course progresses. Providing more concise content will further promote microlearning, ideally content that is within the span of five to ten minutes in length per interaction with multiple interactions per module. Provide formative assessments/feedback with scaffolding after each interaction.

4.2.7   Designed according to human cognitive processes

4.2.7.1   Definition:
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.

4.2.7.2   Comments:
The course does an excellent job of considering human cognitive processes. The lesson's narration is supported with minimal text and images, all of which are used in time with the narration. Key points and ideas are highlighted with the instructor drawing interactively with the slides, again in time with narration. Cognitive support is provided in some lessons with additional materials and quizzes.

 The use of supportive materials is not present in each lesson.

4.2.7.3   Recommendations:
The inclusion of cognitive support materials in every lesson would fully support the students regarding human cognitive processes. The PPT presentations for the course should also be redesigned. The lesson's narration (lecture) should be supported with minimal text and the use of relevant imaging materials.

4.2.8   Provides best practices for video content

4.2.8.1   Definition:
Courses should use instructional videos that follow specific research-based best practice strategies. The 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.

4.2.8.2   Comments:
The lessons do have videos that provide the students with information on the course material. These videos also offer many realistic real-world scenarios for the students to model the knowledge they have learned. The instructor's personality and professionalism are well expressed in the introduction video.

Most of the videos go beyond the recommended ten-minute threshold, going close to thirty minutes in length. These videos, although containing relevant material, do not ask students to critically think or ask questions that would generate interest in acquiring additional knowledge. The instructor's digital personality is not felt in the lesson videos, only the voice-over and no pictures are provided. Lastly, the videos do not follow ADA accessibility guidelines.

4.2.8.3   Recommendations:
Reduce the length of the videos within the range of five to ten minutes and allow for multiple videos per module. Ask the student engaging and critical thinking questions regarding the course material. Instead of just lecture-type content, the videos should also focus on modeling the knowledge for the students, such as showing the instructor in the video applying procedural knowledge related to the course or students struggling through a successful learning experience. Have the instructor's digital personality in the course videos and follow ADA accessibility guidelines during the video's creation.

4.2.9 Course recommendation summary table

Ratings	Description
Exemplary (4)	The course provides ample support for learners. There are limited areas for improvement.
Acceptable (3)	The course provides the support needed to meet the needs of learners. However, there are still areas of potential improvement.
Adequate (2)	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 (1)	The course does not meet learners' needs on this criterion in the current state.

Category	Rating (1-4)	Comments and Recommendations
Course Design		
Fundamental data collection for analytics	1	1. The system does capture the usage of the individual parts of the site, in addition to which users are more active on the site over others. However, this does not seem to be done in a standardized xAPI approach. Even within its system, there are inconsistencies, such as Less Active users being displayed with a bar graph and Most Active users being displayed with a pie chart. 2. The data collected on user activity is not available to the student population, only the instructors. 3. The data is presented visually, however, the visuals lack some necessary information. Looking at the activity for the "Most Active Users", I can see one user has over 3000, but no unit for this activity is provided in a key. This makes it unclear to the user if this is hours, minutes, clicks, page visits, or anything else. Recommendation: 1. Standardize how the data is captured and presented to the users. 2. Provide students the option to have their data be visible to the class, and for them also to be able to view the class's data. 3. Provide a key or title for the visualization of the data, provide units descriptions for the data.

| Support self-regulation | 4 | Planning. Students are not asked to plan, rather a Course Strategy is provided for them. This includes a Course Map, a Big Picture graphic, and a Sakai Flow. However, this does not provide an opportunity for students to construct their plans.

Performing: The course is set up to provide ample feedback to the students and allows them to utilize the feedback to improve their performance. This can be seen in individual modules where feedback on assignments is provided, and in the course overall as groups of assignments are used to create improved Interim documents based on the feedback provided.

Monitoring: The feedback provided to the students throughout the course would allow them to reflect on what they had learned. Allowing students to understand misconceptions on earlier assignments before moving onto further projects.

Adapting: Students are provided feedback on individual modules and assignments. This feedback is given with the expressed purpose of the learner to revise and adapt their efforts to future assignments.

Recommendation:

Ask students to create a plan for their learning at the beginning of the course. Possibly have them go over the Course Strategy document and request that they identify specific areas in which they feel they may struggle, and for them to produce solutions based on their prior learning experiences on how they may best overcome these obstacles. Provide flexibility in the course for students to adapt the material to fit their needs. |

Support motivation	2	1. Although the goals are quite varied, and the assignments allow flexibility, the goals of the course do not seem to be changeable by the individual student. 2. No extra points or external motivation is provided to the students. 3. The course does not offer substantial development of student's soft skills. Although there may be an interaction between the students, the interpersonal, and communication skills are not focused on. Recommendations: One recommendation is to provide weeks in which the students can select or vote on a topic within the scope of the course material that has not already been covered/will be covered by a predetermined course goal. This would allow students to augment the course to match their learning desires while staying within the course material. Allowing students to write up an additional paper or assignment about the course material for extra credit would fulfill this recommendation. Changing one of the three individual projects into a group project would allow students the opportunity to work collaboratively on a problem-based project. Preferably, a group-based project that spanned the length of the course in addition to individual assignments would be instrumental in providing students the opportunity to develop their soft skills.
Support interaction with course features	2	1. No formal instruction on how to use the site is given. 2. Assignments, quizzes, and activities are individually based. 3. No accommodations are available for those unable to engage with the website. Recommendations: One recommendation is to provide a tutorial video on the overview/home page. Right next to the opening video on Course Strategy that acts as an introduction to the course, there could be a video that acts as an introduction to the site itself. Changing one of the three individual projects into a group project would allow students the opportunity to work collaboratively on a problem-based project. Alternatively, a group-based project that spanned the length of the course in addition to individual assignments. The material should follow ADA accessibility guidelines. This should include closed captioning on videos for the death, font size changing for the visually impaired, and a support chat function that connects users to someone for assistance.

Fosters a Community of Inquiry	4	1. The instructor has provided an extensive amount of additional video content for each module, to further connect the student's lesson to real-world applications outside of the course. 2. Communication outlets such as individual messaging and forums allow students to discuss and interact. Recommendations: 1. The instructor should further connect with the students in a discussion on the forums. Guiding those interested in fostering their growth further to the appropriate resources. 2. Monitoring these forums and messaging for misinformation and abuse is integral for students to maintain a healthy social presence.
Provides scaffolding, including microlearning and feedback	3	1. Although the course aims to start at a low starting point, there is no consideration of prior knowledge or recommendations based on this. 2. The modules are grouped logically and the reading material is in small manageable sections. However, the lecture content in the modules themselves still consists of large amounts of material. Recommendations: Having a non-graded quiz at the beginning of the course would allow students to see what areas of the subject they are already knowledgeable about. For the areas that they are lacking in the quiz can then directly provide recommended lessons so that the students can reach a similar starting point. The video for an individual lesson should be five to ten minutes in length. Breaking up the current videos that span close to half an hour-long into two or three smaller lessons would fulfill this recommendation.

Designed according to human cognitive processes	4	1. The narration is supported by bullet point text and relevant images. 2. Although this cognitive support is used in flashcard-like quizzes in the first module "Is it a system?", this idea is not carried over to all the other modules. Recommendations: 1. On some slides in the lectures, the bullet points can be so numerous and lengthy that they fill the page. Condensing this down to as minimal text as possible would be recommended. 2. The inclusion of more supporting materials spaced through the lessons, similar to that of the "Is it a system?" from module 1, would fulfill this requirement.
Provides best practices for video content	2	1. Many videos go beyond the 10-minute threshold. Some lectures are broken down into videos that come close to 10-15-minute videos, while others are close to 30 minutes in length. 2. The videos themselves simply provide information, not asking the students to produce a critical thinking task or generate additional knowledge. However, this is done in the assignments, and quite well. 3. The introductory video does a good job of showing the instructor's personality through a digital video, but this is not carried over into the lecture videos. 4. Introductory video does not allow subtitles or closed captioning for the deaf. Recommendations: 1. Reduce the length of the videos to ten minutes or fewer. Either by removing optional content or breaking the longer videos up into multiple, separate videos. 2. Have the topics of the assignments discussed in the video as the lecture is being done. Addressing the assignment at the beginning of the video, and then using the lecture to articulate the fine points of the assignment would have the students thinking critically while the lecture plays. 3. A small webcam picture in a picture of the professor talking during the video would add presence and a digital personality to the videos. 4. Follow ADA accessibility guidelines.

5 CONCLUSIONS

Overall, our Learning Science Evaluation Checklist appears to be sensitive enough to pick up differences at both the organizational level and the course level. It gave distinct patterns of data at both the organization and course level which were useful for providing recommendations for improvement.

While two good learning organizations were reviewed, the checklist application was able to differentiate their weaknesses and strengths. It showed common deficits in student social support such as student groups which could reflect the nature of similar organizations. It was also able to show them as having distinct profiles of strengths such as IT network infrastructure and Networks of learning Expertise. This allowed for tailored recommendations for each organization.

At the course level, we were able to review very different courses. One was more polished and completed and the second was in person or synchronous online course that required updating. This review found that both classes lacked critical data collection (e.g., xAPI) and data analytic tools (e.g., dashboards). But the more robust online class was observed to have higher support for student cognition, self-regulation, and community of inquiry. This is a pattern that would be predicted for the established online course. Again, our review allowed for tailored recommendations to be given to each class.

6 REFERENCES

Craig, S. D., & Schroeder, N. L. (2020). *Science of Learning and Readiness (SoLaR) Recommendation Report: Science of Learning Practices for Distributed Online Environments.* Arizona State University Tempe United States.

Craig, S. D., Schroeder, N. L., Roscoe, R. D., Cooke, N. J., Prewitt, D., Li, S., ... & Clark, A. (2020). *Science of Learning and Readiness State of the Art Report.* Arizona State University Tempe United States.

Craig, S. D., Li, S., Prewitt, D., Morgan, L. A., & Schroeder, N. L. (2020). *Science of Learning and Readiness (SoLaR) Exemplar Report: A Path Toward Learning at Scale.* Arizona State University Tempe United States.

7 APPENDIX A: EVALUATION MATERIALS

The two sections below prove the interviews used to conduct the organizational review and the coding system used to review the courses provided. These are the tools used to collect the data for the reviews. Additional information on the heuristic measures can be found in the DoD recommendation report (Craig & Schroeder, 2020).

7.1.1 Interview questions
Scoring: For the organization-level review, two raters reviewed the answers to the following questions. Each rater assigned a score to each of the eight heuristics based on perceived completion. Rater scores were then averaged for a final score.

1. **What does the structure of the educational network look like in your organization?**
   a. Probe questions:
      i. Do they have a structured meeting?
      ii. Is there outreach?
      iii. Do they have clear guidelines?
      iv. Are there leaders, across leadership?

   b. Probe questions: Can you talk about any Internal Network or Initiatives in your organization to facilitate learning expertise?
      i. Professional Training
      ii. internal communication
      iii. establishing guidelines
      iv. building learning networks/community

2. **How does your organization use data to understand/evaluate the needs of all stakeholders (e.g., instructors, instructional designers, SMEs, etc.) or courses?**
      i. Survey/interview and other data-gathering methods
      ii. Technology
      iii. Employee Performance evaluation
      iv. Polit a course and slowly scale-up

3. **What does the organizational support for employees (e.g., instructors) look like in your organization? How does such organizational support affect the employee's effectiveness and engagement?**
      i. the leadership gives the instructors the freedom to try new things and not to be afraid to work outside the box and gives them the resources to be able to do it
      ii. Implementing evidence-based evaluation metrics
      iii. Providing clear and actionable performance feedback
         1. The use of learning analytics dashboards
      iv. Providing adequate technical assistance and course design/development assistance.

      v. Establishing clear workload and compensation models based on metrics and effort.

4. **What do the general support structures your organization have?**
      i. Policies and strategy support from leadership and experts

5. **What does Technological support look like in your organization?**
      i. Technology support from technology specialists
          1. Data collection and data analytics

6. **What does your organization do to ensure consistency and fairness for students?**
      i. Informative and timely feedback
          1. The use of learning analytics dashboards
     ii. The use of external resources
    iii. peer support
    iv. pre-course evaluation
     v. timely support for struggle students

7. **Does your organization have any form of academic and non-academic support services for students? If you do, what are they look like, respectively?**
      i. academic services
          1. advising, library, financial, and admissions
     ii. non-academic services
          1. student organizations, psychological services, placement services, and instructor support, mentoring programs.

8. **How many students on average you have in one class?**
    a. Probe question: How do you decide on the number of students per class? What are the factors that determine the class size?
      i. the content being taught
     ii. the technologies available to support the learning environment
    iii. the instructors' support (e.g., AI (Artificial Intelligence) grading, dashboard…)
    iv. the students support (e.g., peer support)
     v. the teaching support (e.g., mentor, TA, grader, co-teachers)
    vi. the additional resources
    b. Probe question: Is the class size flexible?

7.1.2   Course coding system

Scoring: Each statement was scored 0, .5, or 1 by each rater. Then scores were averaged across raters. Each category was scaled so that the max score was 4.

Recommendation: Fundamental data collection for analytics		
Points for Review	Scoring	Comments
The course regularly uses a standardized approach when capturing the interaction of students in the system (e.g., xAPI) and designs comprehensive visualizations for intended users to interpret and utilize students learning data completely and informatively.		
Visualizations that use user data are transparent to the users synchronously.		
Visualizations are well-designed, aesthetic, and easy to understand including both descriptive information and informative analytic information to help (1) students, (2) stakeholders, (3) instructors (asking students for feedback about the course regularly and revise content as needed), and (4) learning organizations make data-informed decisions strategically		
The course utilizes all three of the best practices in data collection for analytics listed below.		

Recommendation: Support self-regulation		
Points for Review	Scoring	Comments
Phase 1: Students are asked to create a plan for their learning and given the content and information necessary for them to construct a plan. The courses are flexible for learners to make changes based on their own goals and needs (e.g., allow students to withdraw and switch courses with comprehensive justification). Students can plan their learning strategically based on their prior learning experiences.		
Phase 2: Learners must be able to perform tasks and enact their chosen strategies. Students have opportunities to develop and implement their strategies to improve their performance (e.g., they can utilize the feedback)		
Phase 3: Learners must be able to monitor their performance and learning. The feedback that students received is formative and accurate so that it can help students reflect on what they have learned. Whether or not the course structure in a way that students can consistently identify their misconceptions and challenges as well as recognize their achievements.		
Phase 4: Learners must be able to adapt future learning efforts based on their observed results.		

Recommendation: Support motivation

The course includes a great number of effective design features to support student motivation, using four of the five items listed below.		
Scoring	Scoring	Comments
Applicable goals are provided by instructors.		
Goals can be augmented by students.		
The design features enable individuals to obtain personalized and meaningful feedback that is relevant to their own learning goals.		
A clear understanding and realistic external goals are set to motivate students (e.g., earning extra credits/points).		
The course involves motivational pedagogical strategies that collaboratively develop students' soft skills. For example, using problem-based or project-based learning to help students their interpersonal skills, persistence, communication skills, and other "soft" skills aside from academic skills.		

Recommendation: Support interaction with course features		
Scoring	Scoring	Comments
Simulation/virtual world technology use when deemed a useful and reasonable tool.		
Communication platforms are available to students for discussion purposes.		
Formal instruction is given on how to best use the technology available.		
Cooperative learning opportunities between peer students are incorporated throughout the learning process.		
Accommodations are made for students that are unable to engage with supportive technology.		

Recommendation: Fosters a Community of Inquiry		
Scoring	Scoring	Comments
Cognitive presence: The ability for the student to manipulate or alter the content of the course in relation to their interests.		
Instructor presence: The instructor engages with the students in a proactive role, connecting students to extra content outside of the scope of the course, or leading and guiding the community to foster the intellectual growth of its members (e.g., feedback).		
Social presence: The communication outlets are provided for student's discussion and interaction and are regularly monitored to correct misinformation and/or identify any abuse.		

Recommendation: Provides scaffolding, including microlearning and feedback		
Scoring	Scoring	Comments
Guidance is provided for students to move from novice lessons to expert lessons in a structured way.		
Scaffolding is used by taking an individual student's prior knowledge into account for a starting point and supporting students by recommending lessons that they may need based on their performance.		
Microlearning is provided with the content being separated into smaller and logically grouped modules.		
Feedback is provided to students with dynamic timing to promote learning.		

Recommendation: Designed according to human cognitive processes		
Scoring	Scoring	Comments
The lesson's narration is supported with minimal text and the use of relevant imaging materials.		
All materials displayed are used in timing with the narrative to support the cognitive development of the student and reduce cognitive load.		
Cognitive support is used, learning is spaced through the use of supportive materials (i.e., flashcards, comments, examples).		
Highlighting key points in a complex diagram or written text by grouping the information into subtopics and highlighting relevant linking information.		

Recommendation: Provides video content integrates best practices		
Scoring	Scoring	Comments
All course videos are not long recordings of the lectures. These videos are within five to 10 minutes and customized for the course learning objectives and competencies.		
All course videos support human cognitive processes and provide students with modeling on how to apply procedural knowledge.		
All content of course videos is engaging and promotes active learning (for example, asking questions to promote critical thinking and generate interest in acquiring additional knowledge).		
All virtual environments around the instructor are professional yet relatable, and the instructors' "digital" personality is well-expressed.		
All course videos follow ADA accessibility guidelines.		