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CONTRACTING DIVISION**

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Maturation, Evaluation, Alignment and Testing of Sero!

CDRL A007

Technical Report- Study/Services;
Ad Hoc Reports and Works (Quarterly)

Option Period of Performance (POP) Final Report

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Executive Summary

This Technical Report-Study/Services, Ad Hoc Reports and Works delivers (Optional) 3.2.4b Optional POP Addendum to Final Report and Deliverable 3.3.5 (Optional) - Results of design checkout - #3. It summarizes the work performed during the Optional POP, including Design Checkout #3, and provides technical data from an analysis of the findings captured during ITD event in August 2018.

All sections follow the format specified in DI-MGMT-80227. This report assumes familiarity with the acronyms and terminology in use under the Total Learning Architecture (TLA) program and by ADL.

An itemized assessment of progress during the Optional POP is included in the body of the report. Appendix A includes Deliverable 3.3.5 (Optional) - Results of design checkout - #3. Appendix B provides findings captured during ITD event in August 2018.

In addition to this report, Perigean Technologies is delivering the final version of open source software – TLA-integrated Sero!. v.1.0 for open source. Appendix C provides technical documentation that enables the configuration of software.

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Section 1. Summary of progress

Based on feedback received from the Government throughout the Optional POP, Perigean’s performance can be characterized as successful in both the technical and managerial aspects. An itemized assessment of progress is included in the next section. To summarize, during the Base year, Perigean achieved the following successes.

Continuation of User Centered Design (UCD). Perigean continued execution of a UCD process through several activities. At the start of the Option Year, Perigean developed wireframes describing functionality, workflows, and Graphical User Interface (GUI) elements to advance the design of Sero!’s two modules, Assessor and Taker. Figures 1 through 4 show sample screenshots of the two modules at the end of the Base and Option Years.

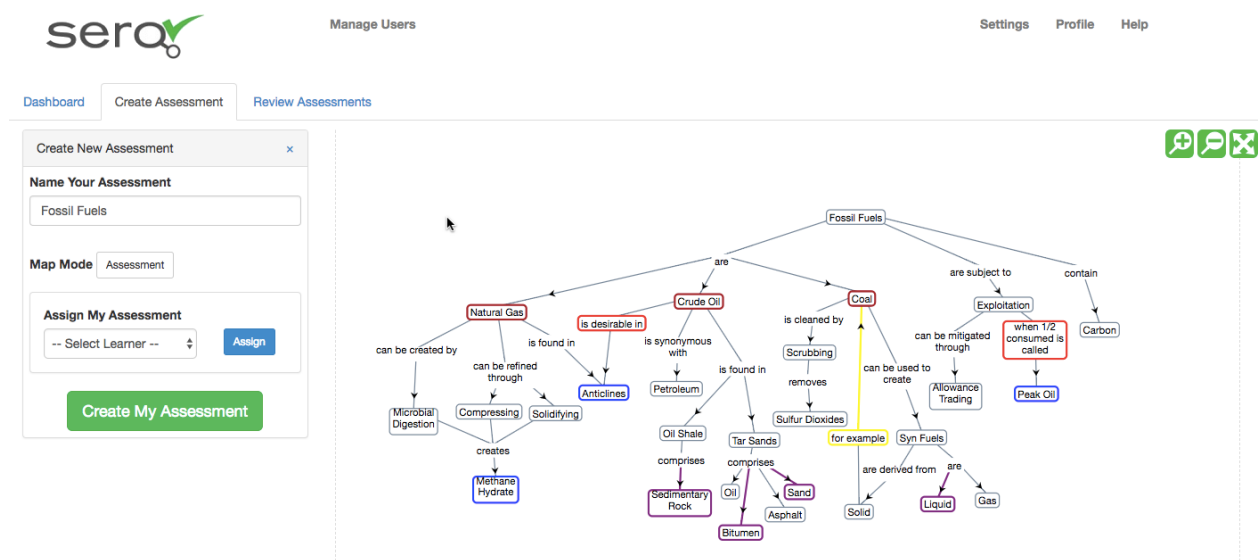


Figure 1: Sero! Assessor GUI, end of Base Year

sero! Dashboard Create Assessment Review Assessments Refresh Instructions Logout

Create New Assessment

Crude Oil	is desirable in	Anticlines	x
Fossil Fuels	always con...	Carbon	x
Exploitation	when 1/2 c...	Peak Oil	x
Syn Fuels	are	Gas	x
Crude Oil	is found in	Tar Sands	x
Natural Gas	can be refi...	Solidifying	x
Tar Sands	comprises	Oil	x
Natural Gas	is found in	Anticlines	x
Coal	can be use...	Syn Fuels	x
Solid	for example	Coal	x
Tar Sands	comprises	Sand	x
Scrubbing	removes	Sulfur Dioxides	x
Tar Sands	comprises	Bitumen	x
Natural Gas	can be refi...	Compressing	x
Solidifying	creates	Methane Hydrate	x
Exploitation	can be miti...	Allowance Tradina	x

Enter propositions by TABBING THROUGH

Concept Relation Concept

Add Takers

Create My Assessment

Name your assessment

Legend

- Fill-In | 3
- MultipleChoice | 4
- Drag&Drop | 5
- ConnectTo | 2
- ErrorCorrect | 2

Fossil Fuels

- include
 - Natural Gas
 - Microbial Digestion
 - Compressing
 - Solidifying
 - creates Methane Hydrate
 - Crude Oil
 - is found in Anticlines
 - is desirable in Petroleum
 - is synonymous with Oil Shale
 - is found in Tar Sands
 - comprises Sedimentary Rock
 - comprises Oil
 - Bitumen
 - Asphalt
 - Sand
 - Coal
 - is cleaned by Scrubbing
 - removes Sulfur Dioxides
 - Carbon
 - always contain Syn Fuels
 - can be used to create Allowance Trading
- are subject to
 - Exploitation
 - can be mitigated through
 - when 1/2 consumed is called Peak Oil
- are derived from
 - Syn Fuels
 - Liquid
 - Gas

Figure 2: Sero! Assessor GUI, End of Option Year

sero! Sero! says: you must select an assessment to take, complete it, then submit.

Submit Map

N11
N11
N11
Secure Researcher Badging Activity

???, concept, connect to, error

Secure Internet browsing

- Hardware
- Point-to-point
- Secure Internet browsing
 - can be enhanced by installing and configuring
 - Browsers
 - have Plugins
 - can be configured using Settings
 - should be set to Secure
 - include
 - Enabled
 - Reduce functionality
 - can Secure
 - can be accessed using Ports
 - are
 - Virtual Private Networks (VPNs)
 - can be implemented using
 - may be
 - can be used to create Tunnels
 - enable Secure transmission
 - is between Two sites via the internet
 - Firewalls
 - can prevent Unwanted connections
 - are prevented by Configuring traffic rules

Figure 3: Sero! Taker GUI, End of Base Year

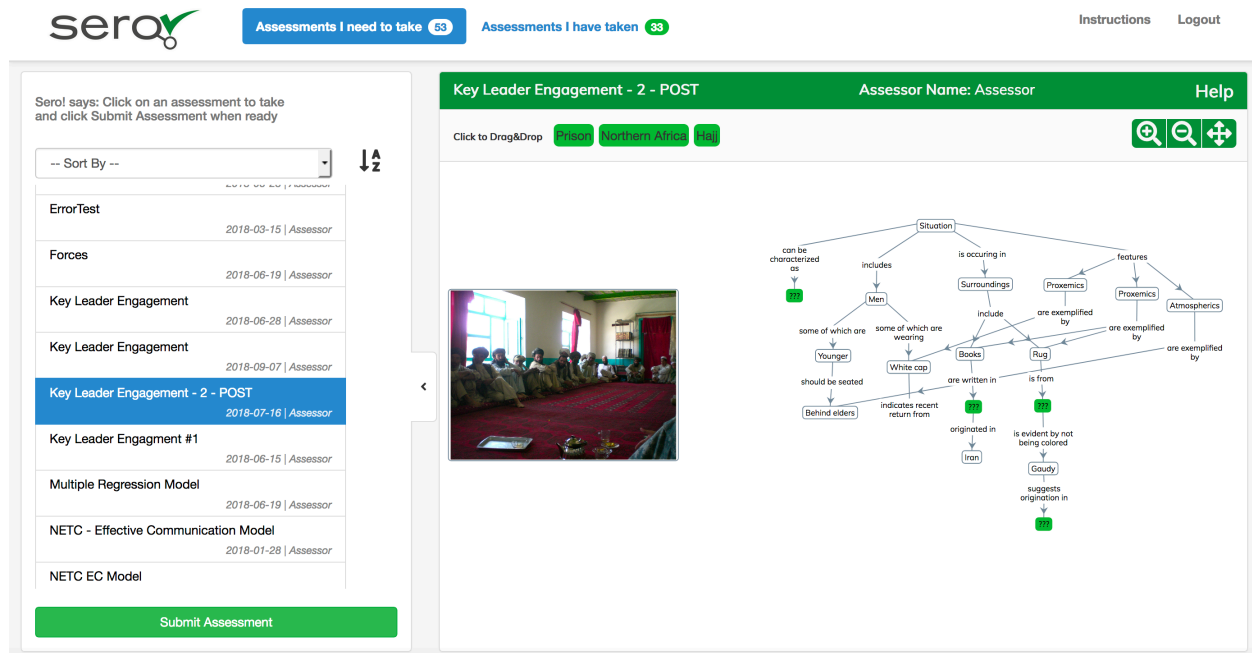


Figure 4: Sero! Taker GUI, End of Option Year

Design Checkout. Perigean conducted a Design Checkout at the NETC General Skills Training, Course Supervisor/CCC Schoolhouse in Norfolk, Virginia. Results of the Design Checkout are reported in Appendix A.

Content Development. Perigean executed one content development activity focused on developing Concept Maps for use in the August 2018 ITD event. The activity produced 12 AssessmentMaps targeting CODIAC-based scenarios provided by UCF’s Institute for Institute for Simulation and Training.

August 2018 ITD planning, engagement and analysis. Perigean participated in several activities focused on planning for the ITD event, including:

- Two onsite planning meetings at ADL Orlando
- Planning activities conducted during the ADL PI Meeting
- Weekly development telecons
- Multiple experiment design and content telecons.

Perigean also provided on-site support during the event and conducted an analysis of user performances with Sero! (provided in Appendix B).

Reporting. Perigean provided monthly reports, a kickoff presentation and three IPR presentations. Perigean submitted and produced a poster for iFest and published the following:

Moon, B., Johnston, C., & Moon, S. (2018). A Case for the Superiority of Concept Mapping-Based Assessments for Assessing Mental Models. Proc. of the Eighth Int. Conference on Concept Mapping. Medellín, Colombia.

Appendix C contains all Technical Documentation for software, including:

- a listing and detailed explanation of algorithms, coding schemes, software, and empirical results;
- a user manual explaining how to run the delivered software; and
- a programmer's manual which includes documentation (READ ME files) for the delivered software.

Recognitions. In recognition of its innovation, Sero! was also selected as:

- Finalist, Innovation Lab, Innovations in Testing Conference, Association of Test Publishers
- Selectee, Startup Pavilion, International Society for Technology in Education Conference.

Section 2. Solved technical problems / Itemized assessment of progress

Perigean made significant progress toward solving numerous technical problems during the Optional POP. This section details progress in accordance to the corresponding tasks.

(Optional) 2.2.5 The Contractor shall use the results from Task 2.5.3 (analysis of the ITD results) to revise the design of relevant Sero! features and functions.

Perigean made significant progress in the design and development of Sero! features and functions within a UCD process.

Specific overall design advancements include:

- Introduction of resizable sub-windows
- Introduction of sorting throughout
- Streamlining of functions into organized icons with mouseovers
- Extensive refactoring of action modals
- Improvements to readability
- Streamlining instructional components
- Aesthetic refinements.

A sampling of specific design advancements for the Assessor module includes:

- Introduction of interactive reporting and management widgets in Dashboard
- Introduction of ErrorCorrect item type
- Extensive refactoring of Create, including showing propositions and legend for assessment items
- Extensive refactoring of Review, including showing overall results across all items and Takers.

A sampling of specific design advancements for the Taker module includes:

- Refactoring Drag&Drop into concept bank
- Introduction of MasterMap review
- Introduction of pictures.

Key development efforts included:

In architecture:

- Account and login management
- AWS/Cloudant streamlining
- Refresh functions
- Implementing xAPI extensions, e.g.,
 - connect & disconnect: source + target; update: value; where the source and target are the text values for the link and value is the text that is updated in the update statements.

In functionality for the Assessor module:

- Taker account management
- Assessment and Map management
- Assignment functions
- Extensive graph editing and rendering improvements
- Assessment item revisions, including adding alternative acceptable answers to Fill-In
- Assessment level reporting and visualization
- Scoring algorithm refinement.

In functionality for the Taker module:

- MasterMap review
- Mixed media concept maps displaying images
- Built-in tutorial with interactive exemplar maps.

Regarding xAPI, Table 1 shows the statements that were developed and integrated to the basic set implemented during the Base Year.

Table 1: Implemented xAPI statements

Initialized	Sent when an activity is loaded in Sero!
Terminated	Sent when a user closes tab or navigates away from open assessment
Completed	Sent when user submits assessment
Passed	Sent when assessment is scored 60+
Failed	Send when assessment is scored 59-
Connected	Sent when a connection is made between linking phrase and concept
Disconnected	Sent when a connection is made between linking phrase and concept
Updated	Sent when a node in the graph is updated by the user
Selected	Sent when the user selects an item from the word bank

Discarded	Sent when the user removes a word bank item from the graph
Answered	Sent when Sero! scores the assessment, the timestamp correlating to the last appropriate user action for that item (ie: update, connect)

(Optional) 2.2.6 The Contractor shall conduct a design checkout / usability review of Sero!.

Perigean conducted one design checkout at the April 27 through May 11 at the NETC General Skills Training, Course Supervisor/CCC Schoolhouse in Norfolk, Virginia. A total of 11 Takers participated. Results of the Design Checkout are reported in Appendix A.

The Design Checkout tested an offline version of Sero!, and was managed outside the control of Perigean due to computer network restrictions. No Perigean personnel were present during the introduction of or interaction with Sero!.

In addition to this executed Design Checkout, Perigean attempted to plan Design Checkouts and other review activities and/or experimentation with the following organizations, all of whom expressed interest in piloting Sero!:

- USMA at West Point
- National Park Service
- Uniformed Services University of the Health Sciences
- HQ Air Force Personnel Center
- U.S. Army Combined Arms Center.

Perigean will continue engagement with USUHS and HQ AFPC following the conclusion of the Option Year.

2.3.4 The Contractor shall extend Sero! to enable more complex, semi-automated analysis.

Progress on this technical problem was achieved through updates to the scoring algorithm reported in the Base Year POP Final Report.

For the AssessmentMaps used during the ITD event, some items were given a weighted score, counting for 33% of the total grade. Specifically, the weighted item required Takers to characterize the nature of a scenario shown in an included image. The adjustment was introduced within code; future versions of Sero! can enable setting the weighting during the authoring process.

ConnectTo assessment items more adjusted to be more accurate by calculating the score based on the total number of correct links for a single assessment item with each given an equal percent of the score. If a Taker adds incorrect links to an assessment item, these are not counted in the score but marked incorrect on the Taker's display of the completed map.

In addition to these adjustments, scores and correct/incorrect items were linked to the submitted versions of Takers' maps to enable visualization in support of (Optional) 2.3.12 and (Optional) 2.3.13.

2.3.5 The Contractor shall equip Sero! to enable assessors to provide assessor feedback.

While not an Option Year task, this technical problem was deprioritized in the Base Year and thus continued during the Option Year. Progress on this technical problem was achieved in architectural refactoring. Given that the Design Checkout and ITD events did not exercise a use cases for assessor feedback, GUI elements to enable assessor feedback were not introduced. However, architectural advances such as event sourcing graph changes with websocket allows two-way communication between an Assessor and Takers to allow additional instruction.

2.3.7 The Contractor shall extend Sero! to enable learners to access embedded assessment task instruction.

While not an Option Year task, this technical problem was deprioritized in the Base Year and thus continued during the Option Year. Progress on this technical problem was achieved through three pathways. First, instructional videos that demonstrate how to create ConceptMaps and AssessmentMaps were developed and linked to the Sero! app. Second, the workflow for creating ConceptMaps and AssessmentMaps was refactored such that Assessors must proceed through stages in order to complete the design (authoring) process. The stages are:

- Initialize concept map, which can be created by Scratch by entering propositions, by Import of .csv, .txt or cxi files, or by reuse of Existing Maps,
- Refinement of concept map, which is achieved in the positioning mode
<ITERATIVE WITH>
- Introduction of AssesmentItems, which is achieved in the Assessment Items mode
- Name Assessment
- Assign to Takers
- Create.

Lastly, the workflow process is aided by set of icons and modals that embed additional guidance and process awareness, for example, mouseover icons.

(Optional) 2.3.11 The Contractor shall explore information assurance (IA) requirements for transition of Sero! into DoD learning environments.

This task was cancelled.

(Optional) 2.3.12 The Contractor shall equip Sero! to enable assessors to access advanced reporting of learners' performances.

Significant progress on this technical problem was achieved during the Option Year. At the conclusion of the Base Year, learner (Taker) performance was not visible in the Assessor module, being available only in xAPI statements. The Assessor Review Assessment tab now provides access to each Taker's performance, including score, duration and performance on each item, and a meta-view across all Takers and Items, as shown in Figure 5. Results are presented statistically and visually, in the context of the AssessmentMaps. Additional architectural

refactoring, including xAPI integration, will allow for additional reporting of and assertions about performance in future versions, to include showing outlier performances and sequence pathways.

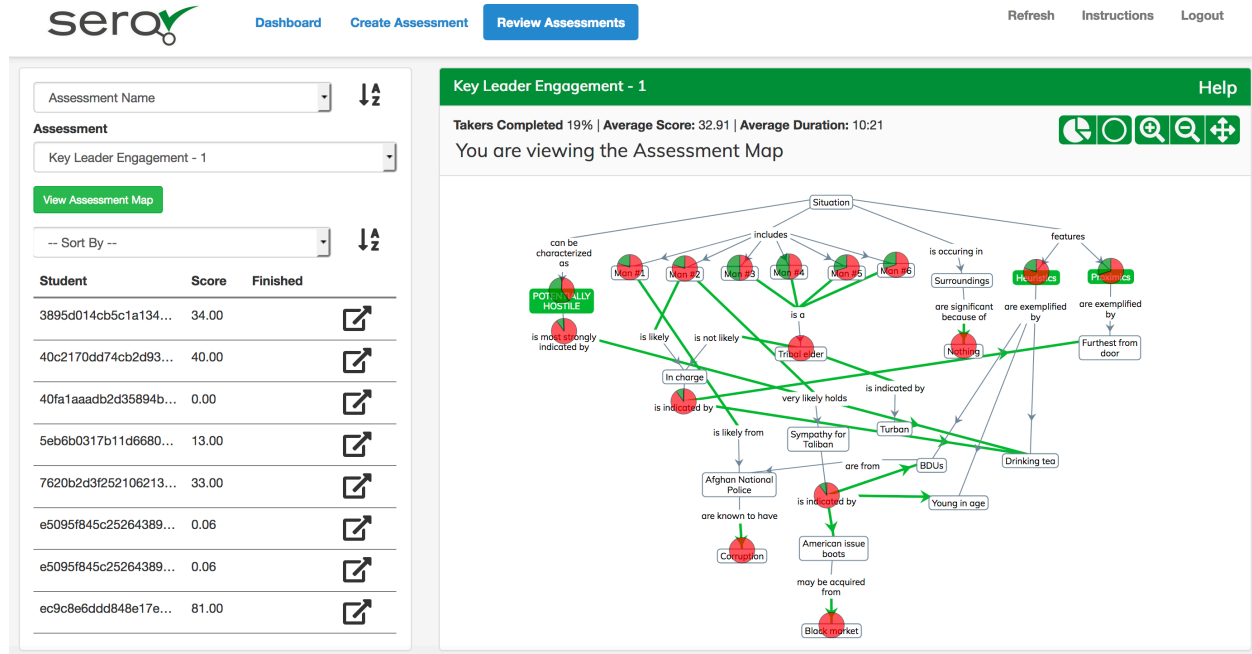


Figure 5: Assessor Review Assessments tab

(Optional) 2.3.13 The Contractor shall extend Sero! to enable learners to access enhanced assessment feedback reporting.

Significant progress was also achieved on this technical problem during the Option Year. At the conclusion of the Base Year, learner (Taker) performance was only visible to Takers through a modal that reported scoring. The Taker “Assessments I have taken” tab now displays Taker performance, including score, duration and correct/incorrect items, as shown in Figure 6.

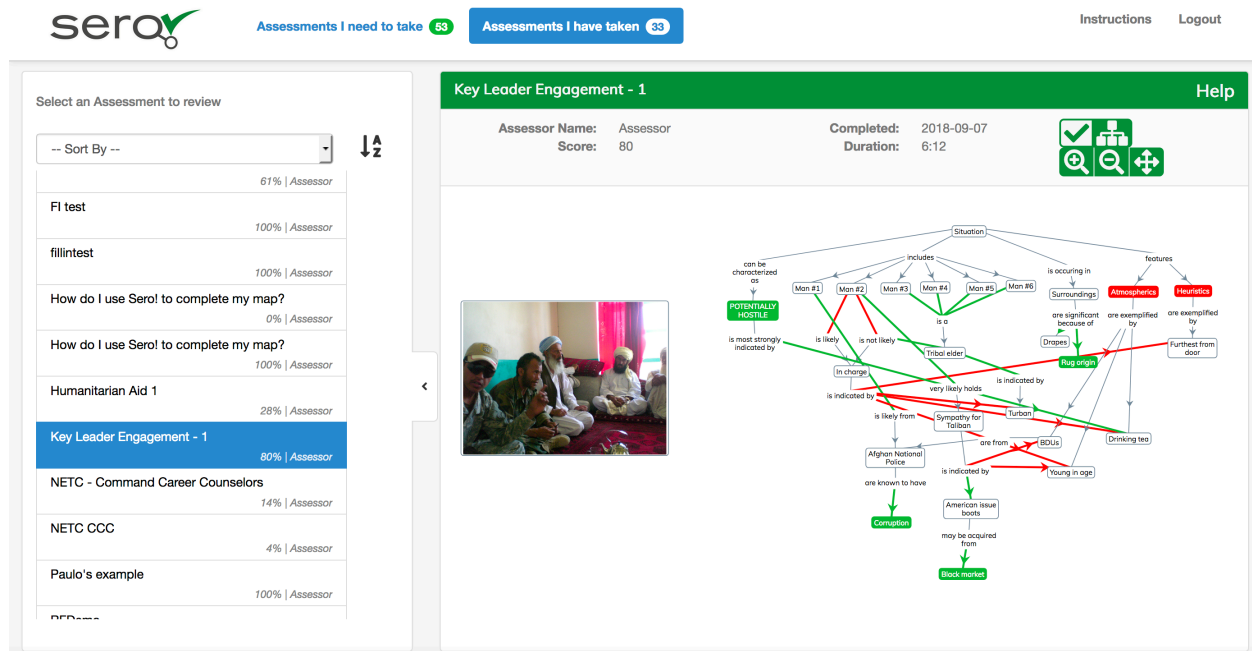


Figure 6: Taker "Assessments I have taken" tab – performance view

In addition, Takers can also toggle between their performance and the MasterMap, as shown in Figure 7, to compare their performance and receive learning benefit.

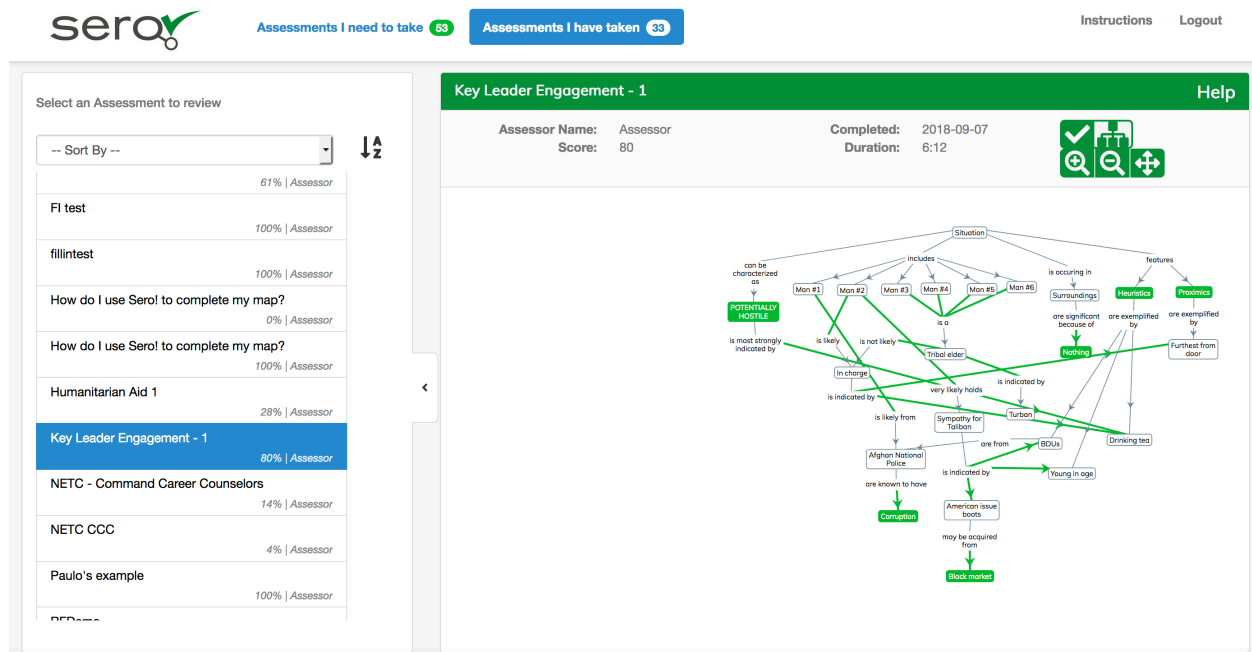


Figure 7: Taker "Assessments I have taken" tab - MasterMap view

In addition, the architectural advances noted under Task 2.3.5 will also enable Takers to review assessor feedback in future versions.

Appendix A. Report of findings from the Design Checkout #3

Section 1. Description of the Design Checkout

During April and May 2018, Perigean Technologies conducted a Design Checkout of Sero! While the original intent of Design Checkout #3 was to conduct a usability evaluation, Perigean determined that such an event was not feasible due to network limitations. Thus, the goals of the Design Checkout were to:

- to conduct a live-demonstration event using Sero! *independent of the development team*,
- capture user data via xAPI – offline – to support post-event analysis, including inferences about learners/Takers.

Research partner

Personnel at the Naval Education and Training Command, General Skills Training, provided the content, participants, facilities and instruction to facilitate the Design Checkout.

Protocols

Protocols followed the Classroom Evaluation procedures as described in the Institutional Review Board application.

Setting and equipment

Participants took part in the Design Checkout at NETC CCC Schoolhouse [Navy College BLDG IE, Room 15, 1680 Gilbert St., Norfolk, VA 23511]. Two laptop computers – one with a large screen and one with a smaller screen – with the following programs and files were used in a typical learning/training environment:

- Offline version of Sero!,
- Taker instructional video.

Facilitator

Participants were directed by the General Skills Training course to the Sero!-enabled, Perigean-provided laptop to voluntarily participate in the evaluation event. All facilitation of Participants' tasks was self-managed by the Participants.

Instructions

Participants were directed to review the following instructions:

TAKER INSTRUCTIONS

Thank you for agreeing to help with this exercise. The purpose is to pilot test an assessment format called concept mapping.

IMPORTANT: The results of your performance on this exercise have no bearing on any of your performance records for this course or the Navy. You may quit this exercise at any time with absolutely no repercussions.

There are two exercise sessions. The first will be toward the end of Week 1; the second toward the end of Week 3 or beginning of Week 4. Completing one assessment may take between 8 and 15 minutes. Please complete as many assessments as you have time for.

Exercise Session #1:

Steps 1 through 8 should be completed toward the end of Week 1.

Step 1. Review the roster below and take the next roster number available. PRINT YOUR INITIALS + LAST DIGIT OF YOUR SOCIAL IN THE INITIALS COLUMN. This will be your roster number for both exercise sessions – refer back to the roster if you forget your roster number.

Step 2. Click on the file on the desktop titled “Introduction to Sero!” and watch the video.

Step 3. If a browser is not already open to Sero!, click on Google Chrome browser and type in the URL - localhost:8080. (You can also open the "sero_closed" folder on the desktop, and use "Sero! Assessments" bookmark to launch Chrome browser.

Step 4. Login to Sero! using your roster number and the password – ‘sero’.

Step 5. Select one of the three assessments titled:

Week 1 – Communications

Week 1 – CPD

Week 1 – OPNAV INSTRUCTION

You are advised to complete the assessments with which are you most familiar, given the content you have covered in Week 1.

Step 5. Complete the assessment to the best of your ability and click Submit when you are finished.

Step 6. (Optional) You may review your results under the tab “Assessments I have taken”.

Step 7. Complete the other assessments as time allows.

Step 8. Once you have completed the assessments, click on the Sero! logo, which will return the browser to the login page.

Exercise Session #2:

Steps 9 through 15 should be completed toward the end of Week 3 or beginning of Week 4.

Step 9. If a browser is not already open to Sero!, click on Google Chrome browser and type in the URL - localhost:8080. (You can also open the "sero_closed" folder on the desktop, and use "Sero! Assessments" bookmark to launch Chrome browser.

Step 10. Login to Sero! using your roster number and the password – 'sero'.

Step 11. Select one of the three assessments titled:

Week 3 – Communications

Week 3 – CPD

Week 3 – OPNAV INSTRUCTION

You are advised to complete any assessments that you did not complete during Exercise Session #1. You may also complete assessments that you did complete in Exercise Session #1. The goal is to have all Takers complete all assessments.

Step 12. Complete the assessment to the best of your ability and click Submit when you are finished.

Step 13. (Optional) You may review your results under the tab "Assessments I have taken".

Step 14. Complete the other assessments as time allows.

Step 15. Once you have completed the assessments, click on the Sero! logo, which will return the browser to the login page.

Participants

A total of eleven (11) Taker Participants participated during Week One. A total of five (5) participated during Week Three. No demographic information was made available.

Taker Tasks

As described in the Taker Instructions, Takers were required to:

- Watch the Introduction to Sero! video, which demonstrated the features in Sero! that were available for their use,
- Launch Sero!,
- Select an AssessmentMap,
- Complete and submit the AssessmentMap,
- Complete other AssessmentMaps, as time allows.

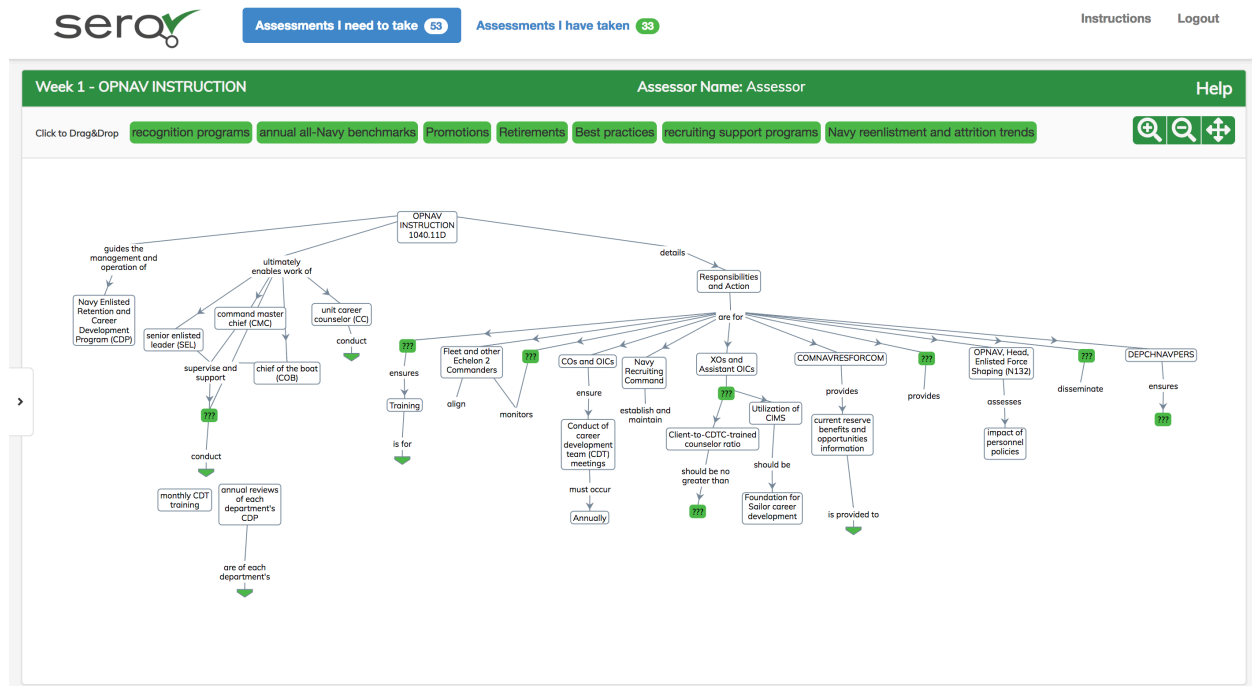


Figure 10: OPNAV INSTRUCTION (AKA: NAV01, NAV03)

- Number of propositions = 49
- Total Assessment Items = 19
- Fill-In = 0
- MultipleChoice = 8
- Drag&Drop = 5
- ConnectTo = 5
- ErrorCorrect = 1

Section 2. Results

Results of the Design Checkout were limited to the xAPI facilitated-data captured on the laptop, including: number of actions taken, score, duration. Table 2 shows all data.

Table 2: All Data from Design Checkout #3

TAKER ID	MAP NAME	SCORE	DURATION	NUMBER OF ACTIONS
LARGE LAPTOP				
USN01	CDP01	15	4:49	8
USN02	CDP03	68	9:35	29
USN02	COM01	8	6:08	22
USN02	COM1	0	0	1
USN03	CDP01	0	2:34	3
USN04	CDP01	26	3:52	19
USN04	CDP03	10	2:15	15
USN04	COM01	20	4:06	24
USN04	COM03	12	1:25	25
USN04	NAV01	10	2:00	22
USN04	NAV03	10	1:15	25
USN05	CDP01	26	6:49	17
USN07	CDP01	28	11:14	24
USN07	CDP03	0	1:17	4
USN07	COM01	4	3:21	19
USN07	COM03	0	0:03	1
USN07	NAV01	0	0:46	9
USN07	NAV03	0	0:39	9
USN08	CDP03	39	5:20	20
USN08	COM01	33	1:46	14
USN09	CDP03	44	5:00	16
USN10	CDP03	39	3:58	17
USN11	CDP01	36	6:25	18
USN11	COM03	20	8:48	10
USN11	NAV01	28	7:09	14
USN12	CDP01	39	7:22	11
USN12	COM03	20	3:39	13
SMALL LAPTOP				
USN101	CDP01	31	16:28	12
USN102	COM01	37	5:53	15
USN103	CDP01	26	5:00	16
USN103	COM01	33	12:55	31
USN104	CDP01	28	5:23	19
USN105	COM01	0	4:52	10

Tables 3 through 10 shows summaries of the data.

Table 3: Average Score, All Assessments

ALL ASSESSMENTS	
Average Score	21
Average Score, w/o 0 scores	27

Table 4: Average Number of Actions, All Assessments

ALL ASSESSMENTS	
Average Actions	16
Average Actions, w/o 0 scores	18
Average Actions of 0 scores	5

Table 5: Average Duration, All Assessments

ALL ASSESSMENTS	
Average Duration	4:54
Average Duration, w/o 0 scores	5:50
Average Duration of 0 scores	1:27

Table 6: Score, Duration, Actions - COM maps

COM01	
Attempts	8
Average Score	17
Duration	3:32
Number of actions	17
COM03	
Attempts	4
Average Score	13
Duration	3:00
Number of actions	12

Table 7: Score, Duration, Actions - CDP maps

CPD01	
Attempts	10
Average Score	26
Duration	7:28
Number of actions	15
CDP03	
Attempts	6
Average Score	33
Duration	6:34
Number of actions	17

Table 8: Score, Duration, Actions - NAV maps

NAV01	
Attempts	3
Average Score	13
Duration	0:54
Number of actions	15
NAV03	
Attempts	2
Average Score	5
Duration	2:27
Number of actions	17

Table 9: Number of Assessments, Score, Duration, Actions - By Laptop

LARGE SCREEN LAPTOP	
Number of Assessments	27
Average Score	20
Duration	4:07
Number of actions	15
SMALL SCREEN LAPTOP	
Number of Assessments	6
Average Score	26
Duration	8:25
Number of actions	17

Table 10: Number of Attempts, Average Score, Average Duration, Average Actions - By Taker

	ATTEMPTS	SCORE	DURATION	ACTION
USN01	1	15	4:49	8
USN02	3	25	5:14	17
USN03	1	0	2:34	3
USN04	6	15	2:28	22
USN05	1	26	6:49	17
USN07	6	5	2:53	11
USN08	2	36	3:33	17
USN09	1	44	5:00	16
USN10	1	39	3:58	17
USN11	3	28	7:27	14
USN12	2	30	5:30	12
USN101	1	31	16:28	12
USN102	1	37	5:53	15
USN103	2	30	8:57	24
USN104	1	28	5:23	19
USN105	1	0	4:52	10

Section 3. Discussion

The goals of the Design Checkout were met:

- ✓ to conduct a live-demonstration event using Sero! *independent of the development team*,
- ✓ capture user data via xAPI – offline – to support post-event analysis, including inferences about learners/Takers.

The primary limitation of the Design Checkout was the number of and available information about Participants. All statistical findings should be considered qualified by this limitation. Inferencing about Participants' performance is limited by the lack of knowledge about:

- Participants' level of engagement with learning material,
- Participants' review of the instructional video,
- Participants' available time to complete the tasks.

A secondary limitation of the Design Checkout was the number of attempts to complete the AssessmentMaps.

- 21 attempts in Week One,
- 12 attempts in Week Two,
- 9 attempts were of 2:00 or less in duration.

With these caveats in mind, some inferences about learner/Taker performance can be made.

Takers were challenged by the assessment

The Average Durations were reasonable and within range of previous Design Checkout findings. Yet Average Scores were generally low – no scores were above 50%. These findings suggest that the majority of the Participants' attempts were legitimate. Because it is not clear the extent to which Participants reviewed the instructional video nor the extent to which they engaged in the learning content, it is difficult to parse whether the lower scores were usability related.

Takers engaged some exploratory actions

Given that several maps were opened and some actions were taken against them that resulted in very low scores, it is reasonable to conclude that Participants engaged in exploratory actions with respect to Sero!, some of which were seemingly done without interest/concern for the assessment. There were weak correlations between Scores and the Durations, Actions and Scores, and even weaker correlations between Actions and Durations. The correlations suggest that the attempts that were undertaken with respect to assessment (vice exploration) were legitimate attempts.

Table 11: Correlations

Score / Duration	0.59
Action / Score	0.51
Action / Duration	0.39

AssessmentMap differences in difficulty affected scores

The AssessmentMaps differed by the number of propositions and number of types of items. The middle sized map in terms of Propositions (CDP), which had the same number of and similar percentage of AssessmentItems as OPNAV (19; CDP = 35%, OPNAV = 39%), resulted in the highest average scores. COM include a much higher percentage of Drag&Drop items and resulted in second the lowest Average Scores. It is difficult to determine the effect of Item types and map size on the difficulty of the Assessment given these results.

Difficult to determine the nature of the challenge: usability or content or assessment task

Laptop size suggests screen size is not a differentiating factor in usability. Participants were not observed engaging with Sero!. It is not feasible to determine the nature of the difficulty that resulted in low scores.

Appendix B. Findings captured during ITD event in August 2018

Section 1. Introduction

Perigean conducted an analysis of the available user performance data from the ITD event. The analysis assumes some familiarity with the ITD event and its structure.

Sero! was included as an activity; specifically, an assessment activity comprising 12 AssessmentMaps targeting CODIAC-based scenarios provided by UCF’s Institute for Institute for Simulation and Training. Figure 4 in this report shows an exemplar map (Key Leader Engagement - 2 – POST). All maps followed the same structure. Table 11 summarizes the maps.

Table 12: Summary of ITD event AssessmentMaps

ASSESSMENTMAP	PROPOSITION COUNTS	ASSESSMENT ITEMS
Clinic	23	Total Assessment Items = 10 Fill-In = 0 MultipleChoice = 5 Drag&Drop = 2 ConnectTo = 0 ErrorCorrect = 3
Humanitarian Aid 1	23	Total Assessment Items = 11 Fill-In = 0 MultipleChoice = 4 Drag&Drop = 3 ConnectTo = 0 ErrorCorrect = 4
Key Leader Engagement - 1	33	Total Assessment Items = 10 Fill-In = 0 MultipleChoice = 1 Drag&Drop = 3 ConnectTo = 10 ErrorCorrect = 2
Key Leader Engagement - 2 - POST	21	Total Assessment Items = 8 Fill-In = 1 MultipleChoice = 3 Drag&Drop = 1 ConnectTo = 0 ErrorCorrect = 4
School - 1	21	Total Assessment Items = 7 Fill-In = 0 MultipleChoice = 4 Drag&Drop = 3 ConnectTo = 0 ErrorCorrect = 0
School - 2	22	Total Assessment Items = 7 Fill-In = 0 MultipleChoice = 3 Drag&Drop = 1 ConnectTo = 3 ErrorCorrect = 0
School - 3	16	Total Assessment Items = 9 Fill-In = 0 MultipleChoice = 8 Drag&Drop = 0 ConnectTo = 0 ErrorCorrect = 1
Street Shura	25	Total Assessment Items = 8 Fill-In = 0 MultipleChoice = 2 Drag&Drop = 2 ConnectTo = 3 ErrorCorrect = 1
Village Scene 1 - PRE	29	Total Assessment Items = 12 Fill-In = 0 MultipleChoice = 3 Drag&Drop = 4 ConnectTo = 3 ErrorCorrect = 2
Village Scene 2	20	Total Assessment Items = 12 Fill-In = 0 MultipleChoice = 4 Drag&Drop = 3 ConnectTo = 2 ErrorCorrect = 3
Village Scene 3	29	Total Assessment Items = 8 Fill-In = 0 MultipleChoice = 2 Drag&Drop = 3 ConnectTo = 3 ErrorCorrect = 0
Village Scene 4	23	Total Assessment Items = 10 Fill-In = 0 MultipleChoice = 2 Drag&Drop = 0 ConnectTo = 7 ErrorCorrect = 1

Participants (N=16) were briefly, verbally introduced to Sero! on the first day of their participation after being directed to Sero! from the TLA dashboard.

Upon first opening Sero! – which happened at different times during the ITD event – Participants were presented with the introductory video that described the features that enable taking a Sero! assessment. Participants were not required to watch the video to proceed. Participants also able to review and interact with practice maps that further instructed on Sero!’s features and allowed non-scored practicing. AssessmentMaps were also presented to Participants in accordance to the recommendations from the TLA.

Section 2. Dataset

Tables 13 through 15 provide the summary data describing Participant performance.

Table 13: Attempts, Average Score and Duration, by AssessmentMap

	ATTEMPTS	AVERAGE DURATION	AVERAGE SCORE
Clinic	16	2:39	60
Humanitarian Aid 1	22	4:01	36
Key Leader Engagement - 1	7	13:58	47
Key Leader Engagement - 2 - POST	4	2:47	25
School - 1	6	3:00	78
School - 2	5	2:21	58
School - 3	5	3:00	44
Street Shura	6	2:27	63
Village Scene 1 - PRE	4	3:21	44
Village Scene 2	1	2:08	23
Village Scene 3	1	1:47	13
Village Scene 4	3	1:16	66
	80	4:00	49

Participants attempted AssessmentMaps across three days.

Table 14: Assessments across days

DATE	DURATION	SCORE
8/15/18	3:10	36
8/16/18	4:31	53
8/17/18	2:42	53

A total of 80 attempts at AssessmentMaps were made by 16 Participants.

Table 15: Attempts by Participant

PARTICIPANT ID	ATTEMPTS
101526	1
159504	20
194644	3
280790	1
347822	1
424590	1
432523	14
459670	4
471061	10
516799	3
530128	1
630786	13
858947	3
887278	2
902666	1
940938	2

Importantly, of the 80 attempts, 37 were repeat attempts of the same AssessmentMap by the same Taker.

Tables 16 - 19 present results from the four most active Participants.

Table 16: Results from Participant 432523

DATE / TIME	ASSESSMENTMAP	DURATION	SCORE
8/15/18 14:58	Clinic	1:28	42
8/15/18 15:03	Humanitarian Aid 1	3:13	0
8/15/18 15:18	Clinic	3:44	50
8/15/18 15:26	Humanitarian Aid 1	8:17	6
8/15/18 15:34	Key Leader Engagement - 1	6:49	33
8/15/18 15:37	Key Leader Engagement - 2 - POST	2:07	50
8/15/18 15:40	School - 1	3:15	56
8/15/18 15:43	School - 2	2:19	50
8/15/18 15:46	School - 3	2:41	9
8/15/18 15:48	Street Shura	2:11	71
8/15/18 15:51	Village Scene 1 - PRE	2:16	58

8/15/18 15:53	Village Scene 2	2:08	23
8/15/18 15:55	Village Scene 3	1:47	13
8/15/18 15:57	Village Scene 4	1:22	91
Total Attempts = 14		AVG = 3:06	AVG = 39.43
Average Score for First Attempts			41

Table 17: Results from Participant 159504

DATE / TIME	ASSESSMENTMAP	DURATION	SCORE
8/16/18 8:53	Clinic	5:37	41
8/16/18 9:02	Humanitarian Aid 1	8:03	6
8/16/18 9:07	Humanitarian Aid 1	4:09	33
8/16/18 9:30	Key Leader Engagement - 1	21:16	56
8/16/18 9:40	School - 1	8:18	70
8/16/18 9:45	School - 1	2:03	89
8/16/18 10:21	Clinic	6:09	75
8/16/18 10:35	Key Leader Engagement - 1	13:24	72
8/16/18 10:43	Humanitarian Aid 1	3:08	60
8/16/18 10:48	Key Leader Engagement - 1	5:06	81
8/16/18 10:55	Key Leader Engagement - 2 - POST	3:47	33
8/16/18 10:59	School - 2	3:09	61
8/16/18 11:02	School - 2	1:40	83
8/16/18 11:13	School - 2	1:18	72
8/16/18 11:19	School - 3	4:35	54
8/16/18 11:21	School - 3	1:33	81
8/16/18 11:25	Street Shura	2:59	47
8/16/18 11:28	Street Shura	2:17	66
8/16/18 11:30	Street Shura	1:20	59
8/16/18 11:32	Street Shura	1:03	93
Total Attempts = 20		AVG = 5:02	AVG = 61.60
Average Score for First Attempts			46

Table 18: Results from Participant 471061

DATE / TIME	ASSESSMENTMAP	DURATION	SCORE
8/16/18 13:02	Clinic	3:48	25
8/16/18 13:26	Clinic	0:58	50
8/16/18 13:31	Clinic	4:06	91
8/16/18 13:34	Clinic	2:04	91
8/16/18 13:36	Clinic	1:32	91

8/16/18 13:38	Clinic	1:24	100
8/16/18 13:47	Humanitarian Aid 1	8:21	13
8/16/18 14:22	Humanitarian Aid 1	6:45	26
8/16/18 14:32	Humanitarian Aid 1	8:49	73
8/16/18 14:35	Humanitarian Aid 1	2:44	86
Total Attempts = 10		AVG = 4:03	AVG = 64.60
Average Score for First Attempts			19

Table 19: Results from Participant 630786

DATE / TIME	ASSESSMENTMAP	DURATION	SCORE
8/16/18 9:17	Humanitarian Aid 1	3:49	26
8/17/18 8:51	Humanitarian Aid 1	2:26	26
8/17/18 8:55	Humanitarian Aid 1	3:17	26
8/17/18 8:58	Humanitarian Aid 1	1:53	80
8/17/18 9:01	Humanitarian Aid 1	1:13	86
8/17/18 9:03	Key Leader Engagement - 1	1:04	34
8/17/18 9:27	Clinic	1:29	0
8/17/18 9:29	Clinic	0:59	83
8/17/18 9:33	School - 1	2:22	68
8/17/18 9:34	School - 1	1:05	85
8/17/18 9:53	Clinic	1:11	83
8/17/18 9:55	Clinic	1:02	100
8/17/18 9:57	School - 1	1:02	100
Total Attempts = 13		AVG = 1:45	AVG = 61.31
Average Score for First Attempts			32

Focus group comments

Requested but not available at the time of reporting.

xAPI statements

Across all activities, 2073 statements were generated. Table 20 shows an exemplar of the data from Participant 159504:

8/16/18 10:48	Key Leader Engagement - 1	5:06	81
---------------	---------------------------	------	----

Table 20: Exemplar xAPI statements

2018-08-16T14:44:04.732Z	{"id":"http://adlnet.gov/expapi/verbs/initialized","display":{"en-US":"initialized","es-ES":"inicializÃ³n"}}	{}		
2018-08-16T14:44:10.660Z	{"id":"http://activitystrea.ms/schema/1.0/update","display":{"en-US":"updated"}}	{}		
2018-08-16T14:44:14.941Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is most strongly indicated by	Man #1
2018-08-16T14:44:22.368Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #1	is not likely
2018-08-16T14:44:25.035Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #2	is likely
2018-08-16T14:44:28.167Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #2	very likely holds
2018-08-16T14:44:32.713Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #3	is a
2018-08-16T14:44:34.372Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #4	is a
2018-08-16T14:44:36.205Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #5	is a
2018-08-16T14:44:39.201Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Man #6	is a
2018-08-16T14:44:43.567Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Tribal elder	is indicated by
2018-08-16T14:44:49.449Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is indicated by	Drinking tea
2018-08-16T14:44:57.928Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/disconnected","display":{"en-US":"disconnected"}}	{}	is most strongly indicated by	Man #1
2018-08-16T14:45:04.797Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is most strongly indicated by	Drinking tea
2018-08-16T14:45:13.941Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is indicated by	Young in age
2018-08-16T14:45:22.394Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is indicated by	BDUs
2018-08-16T14:45:24.393Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is indicated by	American issue boots
2018-08-16T14:45:29.925Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	may be acquired from	Black Market
2018-08-16T14:45:37.794Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	are known to have	Corruption
2018-08-16T14:45:45.756Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	are exemplified by	Nothing
2018-08-16T14:45:57.580Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	is indicated by	Furthest from door
2018-08-16T14:46:46.875Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	are significant because of	Nothing
2018-08-16T14:46:55.618Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	are significant because of	Nothing
2018-08-16T14:47:01.775Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	are exemplified by	Nothing
2018-08-16T14:48:23.269Z	{"id":"https://w3id.org/xapi/dod-isd/v1.0/connected","display":{"en-US":"connected"}}	{}	Tribal elder	are significant because
2018-08-16T14:48:47.604Z	{"id":"http://activitystrea.ms/schema/1.0/update","display":{"en-US":"updated"}}	{}		
2018-08-16T14:49:03.141Z	{"id":"http://activitystrea.ms/schema/1.0/update","display":{"en-US":"updated"}}	{}		
2018-08-16T14:49:17.938Z	{"id":"http://adlnet.gov/expapi/verbs/passed","display":{"en-US":"passed","es-ES":"aprobÃ³n"}}	{}		
2018-08-16T14:49:18.262Z	{"id":"http://adlnet.gov/expapi/verbs/completed","display":{"en-US":"completed","es-ES":"completÃ³n"} ("score":{"scaled":0.71})	{}		

Section 3. Discussion

The ITD Event offered an opportunity to exercise Sero! in the context of a multiday learning event. The findings about Sero!’s use were limited by:

- the overall number of attempts at Sero! AssessmentMaps,
- the percentage of attempts that were repeat attempts conducted by the same Participants against the same AssessmentMaps,
- uncertainty about whether or when Participants reviewed instructional materials,
- uncertainty about Participants’ level of engagement with learning material prior to engaging with the AssessmentMap (not including Village Scene 1 – PRE),
- the majority of use was limited to four Participants.

Key Learnings

Sero! reliability

Scores between attempts yet within AssessmentMaps offer insight into the reliability of Sero!. In most cases, Participants improved scores between attempts at the same AssessmentMaps. However, their first attempts at subsequent AssessmentMaps were nearly always lower than the score of their last attempt at the previous AssessmentMap. Given that the structure of the maps were all very similar, this finding suggests that Sero! reliability – i.e., the degree to which an assessment tool produces stable and consistent results – is promising.

Duration

Average Durations were reasonable and within range of previous Duration findings. The Average size of the maps – 24 propositions – was smaller in comparison to the maps used during Design Checkout #3 – 60 propositions. The Average Duration – 4:00 minutes – was less than the

Average Duration of the Design Checkout #3, for attempts that did not result in a score of 0, was 5:50. Importantly, the AssessmentMaps were all similarly structured maps. These findings, as well as the reliability finding, suggest that small, similarly structured AssessmentMaps can reliably enable rapid assessment, perhaps as “knowledge checks.”

xAPI data will be useful for future development

The xAPI data gathered during the ITD Event offer detailed reviews of the sequencing of Participant actions through an AssessmentMap. Perigean’s poster presented at iFest 2018, shown in a thumbnail view in Figure 11, suggests potential for visualizing such sequencing and the duration between actions may provide views that are useful for determining deep insight – i.e., microgranularity – into learner knowledge. Perigean intends to develop such views in future versions.

The Benefits of Granularity
 Brian Moon & Charles Johnston
 Perigean Technologies
 Advanced Distributed Learning (ADL) Initiative (Contract W911QY-16-C-0081)

State of the art
 Discreet item knowledge assessments, typically comprising multiple choice, true/false items.
 Provides macro-level granularity:
 - Correct/incorrect
 Could provide, but rarely does:
 - Total duration
 - Time between answers
 - Changed answers (typically only captures final answer)
 - Sequence of answers (questions rarely provided at once)

Question
 Could micro-granularity into assessment? Takers' actions provide a more meaningful assessment of knowledge and understanding?

serol
 Concept mapping-based knowledge assessment platform
 Holistic assessment using interdependent items applied to organized propositions that describe a domain or challenge problem
 Five item types
 -Multiple Choice
 -Fill-In
 -Drag&Drop
 -ConnectTo
 -ErrorCorrect
 Difficulty varies by content of map, number and type of item types. Current version allows for weighting of individual items.

Key Leader Engagement - 1
 Learner view and task: Given the image, determine the nature of discernable cues, state of the scene and (in some cases) COA. Characterizing scene and selecting COA are weighted in score.
 xAPI statements generated for every action a Learner takes, including inputting answers, changing of, sequence of and duration between answers.

Context for Results: Serol Activities demonstrated during 2018 live prototype test and demonstration (ITD)
 All Warfighters presented video tutorial and practice assessments
 16 Warfighters attempted Serol assessments
 4 Warfighters attempted more than 4 assessments
 Many repeated assessments as a function of recommended activities
 Macro-level results:
 Average time: 4:00 mins
 Average score: 49%
 Additional exemplars:
 serol

Lessons Learned
 Micro-granular view of learner actions within a concept map-based assessment offer additional insight into learner knowledge and understanding, including the potential to reveal learner insights and discoveries and revisions of misconceptions.

Future Directions
 Validation will require controlled experimentation
 Analysis and visualization of results requires additional work to show:
 - Sequencing and timing pathways
 - Correct actions taken | Incorrect actions taken | Actions NOT taken

Figure 11: iFest 2018 poster showing sequencing

Appendix C. Technical Documentation

Perigeon Technologies is delivering the final version of open source software – TLA-integrated Sero!. v.1.0 for open source. The following provides technical documentation that enables the configuration of software.

Installing/Configuring Sero!

Sero! is an online platform for creating and administering concept map (cmap) assessments. This version of Sero! for the TLA uses a CouchDB database to store cmaps and query result metrics; it integrates with keycloak for user authentication and learning locker as an LRS.

These steps will show how to stand up the Sero! server and integration steps to communicate with a TLA.

Architecture

Sero! is an angular.js application that uses d3.js to render cmaps natively in the browser as SVG. These graph components reference javascript event handlers to send xapi data and update the internal state of the cmap. As the user makes actions on the graph, the graph UI updates the display.

When the user is finished they submit the concept map it is graded by the application; sent as xapi and stored in CouchDB.

Maps in the database that have ids tied to the activity in the activity index can be assigned via the launch url:
www.hostedlocation.example/adl?activityId=_____ _

Prerequisites

Before you can launch Sero! as an application, you must have these available on your machine:

- Keycloak
- Learning Locker
- CouchDB 2.0+

Sero System Directory

The build directory available in this deliverable contains the packaged angular logic to run the app. The code endpoints that need to be updated are marked in this documentation.

```
build/  
  \=- assets  
  \=- vendor  
  \=- src/  
    \= \=- app/  
    \= \=- learner/  
    \= \=- learner.js  
    \= \=- teacher/  
    \= \=- teacher.js  
    \= \=- app.js  
    \= \=- common/  
    \= \=- db/  
    \= \=- db.js  
    \= \=- graph/  
    \= \=- graph.js  
    \= \=- xapi/  
    \= \=- statement-generator.js
```

The **vendor** folder contains the compiled javascript files available from open source projects. This includes the logic for angular, jquery, d3, bootstrap, ramda.js. The assets folder holds local resources: the keycloak logic, specific css and javascript files.

The **src** folder holds the app logic. App.js defines routing and responses for http requests.

Learner defines the logic for the Taker account, including the UI actions and xapi statements regarding session information.

Teacher defines the Assessor UI and logic for creating assessments and reviewing completed maps.

The **common** folder holds the utility directives.

Db.js holds the logic to communicate with a CouchDB endpoint and exchange Sero! data objects.

Graph.js holds the extensive logic for rendering and manipulating the concept maps based on user input.

Xapi.js holds the logic for formatting xapi statements and the endpoint for learning locker.

There are other components that are not necessary to cover in the scope of the TLA but more documentation can be provided.

Installing Sero!

These are the steps to configure Sero! from the source code in this directory.

1. Configure a CouchDB server
(<http://docs.couchdb.org/en/stable/install/index.html>)
2. Access the COUCHDB futon ui via url (default:
http://localhost:5984/_utils/)
3. Add new database (Security is out of scope, but permissions are available here and will be marked in the api references)
4. Save the contents of sero_design_doc.json into db
5. Update the example file: example_assessor.json
 1. Replace the username with the designated keycloak user's username to use as an Assessor
6. Save the contents in the db
7. Update the api endpoints in Sero! code:
 1. In /build/src/common/db/db.js
 1. Line *3* – Authentication key for database
 2. Line *4* – Authentication secret for database
 3. Line *12* – update the url of cloudant with your hosted version.
 4. line *16* update the variable dbName with the correct name of your database.
 2. In /build/src/common/xapi/statement-generator.js
 1. Line *9* – update LRS_ENDPOINT with the hosted learning locker
 2. Line *13* – update auth with the Client authentication string
8. Host the build directory with a web server
9. Go to url for the application and with keycloak.

Sero! Web Server

The browser portion of Sero is an angular app that needs to be hosted on a web server. In the delivery directory there is a folder “build”. This folder can be hosted locally or placed on a web server. Once it is available, navigate to the url in your browser. This should begin the keycloak login process. Once authenticated, Sero! will redirect to your main application page.

If the user is an Assessor, this will bring up the Assessor dashboard. Information on how to use the Sero! interface as an assessor can be found here under **Using Sero! as Assessor**.

If the user is a Taker, any assigned assessments will load on the left and completed assessments can be viewed from the “Assessments I have taken” tab. More information on the Taker interface is available here **Using Sero! as Taker**.

Sero! CouchDB

CouchDB is JSON record store that provides storage for the data objects Sero uses as well as providing some logic on views that Sero uses when querying data. The CouchDB instance will have to be configured with a design document and root user before the application can be launched.

To align cmaps with the TLA, a user must have access to the CouchDB server and be able to update documents. More information on CouchDB installation here (<http://docs.couchdb.org/en/stable/>).

Data Objects in CouchDB

****User object**** – Represents a user in Sero!. The field “permission” determines the user’s role in that application; it can be either “teacher” for Assessor or “student” for Taker. Taker accounts are created automatically when that use first logs in to the application via keycloak.

```
> {
> "type": "user",
> "username": "280790",
> "name": "Pilot User",
> "permissions": "student"
> }
```

****Assessment object**** – This document contains information on the map structure and assessment items. For the TLA demonstration, the map _id must match the activity id for the assessment. The assessment table is a list of json objects; each object has an id correlating to a node id in the map and an assessment type that can be “multi-choice”, “fill-in”, “error-detection”, “SAFI” and “partial-prop”.

```
> {
```

```

> "type": "assessment",
> "name": "Clinic",
> "triples": [{"subject", "predicate", "object"}],
> "nodes": [{id, type, node_type, value}],
> "links": [{id, type, link_type, source, target}],
> "assessment_table": [{assessment_type, weighted, correct_answer, choices}],
> "assessor_id": "8324a42d7hd825c5a8c75cde1478872a"
> }

```

****Assignment object**** – Connects a single assessment object to one-to-many Taker accounts. Whenever a user enters a new activity through the TLA and is redirected to Sero!, the application will generate an assignment for the logged-in user.

```

> {
> "type": "assignment",
> "assessor_id": "df048fd409ca1cdce979e305033e4797",
> "grouping": "Village Scene 1 - PRE",
> "assessment_id": "5b4ce0ca3892005213519cc9",
> "students": [
> {
> "login": "0276bf10f71b432559c76fe8720ee397",
> "assigned": "2018-07-24T23:31:09.904Z"
> }
> ]
> }

```

****Student Map object**** – A completed, graded concept map. It mirrors the assessment object and stores additional information on the score and user_answer on each assessment item.

```

> {
> "type": "student_map",
> "name": "Clinic",
> "assessment_table": [{user_answer}],
> "start_time": "Wed Aug 12 2018 15:50:04 GMT-0400 (Eastern Daylight Time)",
> "end_time": "Wed Aug 12 2018 15:51:00 GMT-0400 (Eastern Daylight Time)",
> "score": 85
> }

```

CouchDB Views

Sero! makes use of CouchDB's Views to quickly query bulk data on assessments or users. Each View is a collection of javascript logic that executed on each document in the database in map-reduce fashion. The reduced list is then cached for performance and queried via REST calls. These functions must exist in the **sero** design document in the database.

Using Sero! as Assessor

Once the application is running and the database is populated with the design document, you must designate one of the keycloak users as the Assessor user in Sero!. The Assessor is responsible for creating the concept maps, assigning assessment items in the map, applying the activity id to the map. The Assessor account also has access to all user entered maps with some additional metrics and visualizations. Assessor Information (<<https://www.serolearn.com/instructions-assessor>>)

****Note:**** In order for a concept map to align with the TLA Activity Index, the _id of the assessment object in the database must match the activity object. The admin user will have to update the assessment object in CouchDB.

Using Sero! as Taker

A Taker account may log in as soon as Sero! is hosted and communicating to keycloak. However, they will not be able to access any activities until those activities are given the correct _id and added to the activity json.

Taker Information (<<https://www.serolearn.com/instructions-taker/>>).