JOURNAL OF ADVANCED DISTRIBUTED LEARNING TECHNOLOGY

Volume 2, Number 6, 2014

ISSN 2285-1070

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Chapter II: ADL PAPERS FROM ADL PARTNERSHIP LABS

EDITORIAL

The year 2014 marks the fifteenth anniversary of the Advanced Distributed Learning (ADL) Initiative that was established in the United States (U.S.) under executive order in 1999 by then President William Clinton. As a result of Executive Order 13111, the U.S. Department of Defense (DoD) was directed to lead federal government participation in incorporating emerging technologies to develop standards for training software and associated services. The order further directed DoD to provide guidance to Defense agencies and advise the civilian agencies, as appropriate, on how best to use these standards for large-scale development and implementation of efficient and effective distributed learning technologies.

Since the inception of the ADL Initiative in 1999, and the introduction of the Sharable Content Object Reference Model (SCORM®), ADL programs gained worldwide recognition. As a result, the "ADL Partnership Network" was established. The ADL Partnership Network currently includes fourteen Partnership Co-Labs, with common interests to support cooperative development of ADL capabilities. Current government partners include: Canada, Korea, Latin America and Caribbean Regions, NATO Allied Command Transformation (ACT), New Zealand, Norway, Poland, Romania, Serbia, United Kingdom and the United States of America. Current non-government associates include the Academic Co-Lab (Madison, WI) and the Center for Intelligent Tutoring Systems Research and Development (Memphis, TN). The ADL Partnership Network vision is to provide access to the highest quality education and training, tailored to individual needs, delivered cost effectively, anytime, anywhere. In support of this vision the ADL Partnership Network harnesses the power of distributed learning technologies to include online courseware, training games, virtual worlds, mobile technology and other learning technologies to provide high-quality, easily accessible, adaptable, and cost-effective education and training. Working with international military and government agencies, industry, academia, and various professional organizations, the ADL Partnership Network conducts research, evaluation, and validation of specifications and standards with the goal of advancing education and training.

The Partnership Network and their respective Ministries of Defense (MOD) recognize that successfully implementing the ADL vision can best be achieved through collaboration. To be most effective in today's environment, this collaboration should occur in both a national and international context with participation from military, government, industry, and academia. The ADL Partnership Network provides a collaborative synergy that leverages the best practices from industry, academia, government and our international partners to define common specifications and standards for distributed learning and training content. The Partnership Network research effort is focused for the purpose of developing and assessing common tools, standards, content, and guidelines for ADL. Through this collaborative effort the ADL Partnership Co-Labs serve as the focal points for coordinating ADL activities throughout the world.

Dr. Paula J. DURLACH
Acting Director, ADL Initiative

SPECIAL ISSUE

THE ADL PARTNERSHIP LAB NETWORK

BACKGROUND

For this special issue of the JADLeT, each member of the Advanced Distributed Learning (ADL) Initiative's network of international ADL Partnership Labs was invited to submit a paper and a brief profile of their lab's ongoing research efforts.

Through Memoranda of Understanding with host nations, the ADL Initiative has established a network of international partnership labs that work within their own nation, with other partnership labs, and with the U.S.-based labs and centers. The partner labs share the ADL Initiative's vision *"to maximize each learner's potential to perform and adapt through the use of emerging learning technologies."* By working together, the labs benefit from sharing resources, expertise, and lessons learned. The partnership lab directors meet twice a year to discuss progress, develop common goals, and plan cooperative projects. The special issue has two chapters dedicated to the profiles and labs research activities of the partnership labs.

Chapter I | ADL PARTNERSHIP LABS PROFILES

ADL INITIATIVE CO-LABORATORIES

ALEXANDRIA, VIRGINIA & ORLANDO, FLORIDA, UNITED STATES OF AMERICA

HISTORY

The Advanced Distributed Learning (ADL) Initiative was established in 1999 to standardize and modernize training and education and is part of the U.S. Department of Defense, Office of the Deputy Assistant Secretary of Defense (Readiness). Its research on distributed learning technologies is aimed at advancing the state-of-the-art in individual and collective education, training, performance support, and assessment. Historically, the ADL Initiative is best known for its pioneering work on developing the Sharable Content Object Reference Model (SCORM)®. The ADL Initiative is conducting research and development to provide learning standards, specifications, and applications that can be sustained and extended to incorporate new technologies as they emerge. The aim is to support learners with the information they need, on demand, and in a form suited to their situations and devices.

The ADL Initiative maintains two Collaborative Laboratories (Co-Labs) in the United States where it currently conducts research on personalized and adaptive learning technologies and methodologies.

MISSION

The ADL Initiative mission is to harness the power of information technology to support learning outside of traditional classrooms. SCORM integrated a set of related technical standards, specifications, and guidelines designed to promote reusability and interoperability of learning content across Learning Management Systems (LMSs). SCORM influenced a great deal of infrastructure commitments, and ADL is cognizant of the need to continue to support those commitments, while developing new, more sustainable and extensible options. In 2012, ADL coined the term “Training and Learning Architecture” (TLA) to name the technological thrust to modernize specifications for distributed learning, using a “suite of services” approach rather than an all-in-one solution. This approach will release learning from the confines of a single LMS, and reduce the technical barriers to using custom applications in enterprise learning environments.

The ADL Initiative aims to support personalized learning, driven by an understanding of the learner’s needs, preferences, and context. The vision is for a personal assistant for learning (PAL), that can track each learner’s interests and progress, and can identify the right resources using the learner’s profile. The PAL is not intended to replace interaction with human peers, instructors or mentors, but rather to facilitate and augment such interactions. Several existing technologies provide elements required for a PAL; but, these elements need to be brought together in a cohesive way to support life-long learning. These technologies include, but are not limited to intelligent tutoring systems, recommender systems, wearable devices and sensors, unobtrusive user interfaces, and social networking applications.

PROJECTS and ACTIVITIES

Next Generation Learning Environment

- Training & Learning Architecture (TLA) to support content communication services among various learning delivery platforms (http://www.adlnet.gov/capabilities/tla)
- The Experience API (xAPI) facilitates tracking of learning experiences with simple “I did this” statements (http://www.adlnet.gov/capabilities/tla/experience-api)
- Prototype transmedia learning applications

Personal Assistant for Learning (PAL)

- An unobtrusive, intelligent capability that anticipates learners’ needs and provides information and/or learning at the point of need
- PAL “knows” each learner’s achievements, training gaps, and preferences
- It enhances performance and helps learners adapt to new situations
- A networked “social” capability that utilizes peer-to-peer and expert mentoring

Intelligent Tutoring and Serious Games
- Research on serious games supporting learning of math and programming
- Research on human tutor-student dialogs
- Development of an intelligent tutoring plug-in framework

Search & Retrieval
- Re-Usability Support System for eLearning (RUSSEL): Open-source software for managing and repurposing courses, documents and multimedia assets (http://www.adlnet.gov/re-usability-support-system-for-elearning-russel)
- The 3D Repository: Open-source software and services for managing and repurposing 3D models (http://3dr.adlnet.gov/)
- The Learning Registry: Open-source software and services for exchanging information about learning content and how content is used (http://www.learningregistry.org/)

Mobile Learning
- Best practices and guidance on planning, designing and developing for mobile devices (http://mlhandbook.adlnet.gov/)
- Weekly Mobile Learning Newsletter (http://research.adlnet.gov/newsletter/mobile/)
- Research on Instructional Design for Mobile Learning (http://motif.adlnet.gov)

Find more information about the research project areas listed above at: http://www.adlnet.gov/

DIRECTOR

Paula J. DURLACH, PhD, currently serves as Acting Director of the Advanced Distributed Learning (ADL) Initiative. She had been the Deputy Director since April 2012. Paula is on detail from the U. S. Army Research Institute for the Behavioral and Social Sciences, which she joined in 2001.

Dr. Durlach has worked as a research psychologist in academia, industry, and government. She received her Ph.D. in experimental psychology from Yale University in 1982, and subsequently held fellowship positions at the University of Pennsylvania and the University of Cambridge. From 1987 to 1994, she was an assistant professor of psychology at McMaster University and then went on to lead the exploratory consumer science team at Unilever Research Colworth Laboratory in Great Britain.

Dr. Durlach is a Fellow of the Association for Psychological Science, and member of the Experimental Psychology Society, the Psychonomic Society, and the Society for Artificial Intelligence in Education. With Dr. Alan Lesgold, she co-edited the book, Adaptive Technologies for Training and Education, published in 2012, and has also published research in journals such as International Journal of Artificial Intelligence in Education, Military Psychology, Computers in Human Behavior, and Human-Computer Interaction.

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ADVANCED DISTRIBUTED LEARNING CENTER FOR INTELLIGENT TUTORING SYSTEMS RESEARCH & DEVELOPMENT

MEMPHIS, TENNESSEE, USA

HISTORY

The Advanced Distributed Learning Center for Intelligent Tutoring Systems Research & Development (ADL-CITSRD) was established in 2010. Prior to 2010, ADL-CITSRD was the Workforce ADL Co-Lab (2003–2010). ADL-CITSRD is located in the FedEx Institute of Technology (FIT) on the campus of the University of Memphis in Memphis, Tennessee. Researchers associated with the center include faculty members, postdoctoral fellows, and advanced graduate students in the Institute for Intelligent Systems (IIS). The Center's researchers have extensive experience in research, development, and evaluation of advanced learning environments.

MISSION

The mission of ADL-CITSRD is to advance the science of learning and to develop, apply, and test highly effective complex learning environments. The Center facilitates the research required to address current and future training challenges faced by the military, government, academia, and civilian workforce through the use of learning technologies such as natural dialogue systems and intelligent tutoring systems.

PROJECTS and ACTIVITIES

ADL-CITSRD projects and activities focus on *Advanced Learning Theories*, *Technologies*, *Applications*, and *Impacts* (ALTTAI). ALTTAI at the ADL-CITSRD are demonstrated in the following core capabilities and R&D projects.

Current (selected) ADL-CITSRD Projects

- **JMITSE**[1] is an IES-funded efficacy study. The goal of the study is to find effectiveness of advanced learning technology, such as intelligent tutoring systems (i.e., ALEKS), in out-of-classroom and after-school learning environments.
- **CSAL**[2] is an IES-funded center grant seeking to improve our understanding of how to advance the reading skills of struggling adult learners reading at a 3rd-8th grade level.
- **SKOPE-IT**[3] is funded by the Office of Naval Research (ONR) as part of its *Science, Technology, Engineering and Mathematics (STEM) Grand Challenge*. The primary goal is to produce high-level intelligent tutoring systems at a low-level cost.
- **The OJT**[4] **project** is funded by ONR (with partnership with the Institute for Creative Technology and Arizona State University). The goal of this project is to build and evaluate a computer-based personnel mentor capable of supporting on-the-job training by emulating the duties senior Sailors typically perform.
- **The GIFT**[5] **project** is a multi-year collaborative effort with Army Research Labs (ARL**).** The goals of this collaborative effort are to organize the research community to conduct studies, produce and evaluate working prototypes, and provide design recommendations for Intelligent Tutoring Systems.
- **The TDC-DM**[6] project is funded by ADL. Nearly 250,000 human-human tutorial dialogue transcripts (in Algebra and Physics) accumulated by Tutor.com are being analyzed for insights that will support hybrid human

[1] The Jackson-Madison County School Intelligent Tutoring Systems Evaluation, http://memphis.edu/jmitse/
[2] The Center for the Study of Adult Literacy, http://csal.gsu.edu/content/homepage
[3] Sharable Knowledge Object as Portable Environment for Intelligent Tutoring, http://www.memphis.edu/psychology/onr/
[4] On the Job Training
[5] Generalized Intelligent Framework for Tutoring
[6] TUTOR.COM PAL DATA MINING

and AI tutoring systems compatible with ADL's Personal Assistant for Learning (PAL) architecture.

- **V-CAEST**[7] project is funded by DoD and aims to improve communication between civilian and military personnel during emergency situations. This project enhances efficacy by introducing Intelligent Tutoring Systems (ITS)- style interaction into virtual learning environments.

Core ADL-CITSRD Capabilities

- **Cognitive Studies of Learning Systems** evaluate a learning system's ability to maximize the user's capacities and thus improve the user's learning experience. The randomized, controlled experiments establish the efficacy of learning technology systems and are used to suggest improvements based on current cognitive research.
- **Impact Study of Learning Technology in Applied Settings** conducts real-world tests of learning systems and learning science techniques using controlled randomized classroom studies. The end goal is to provide effective methods for learning that stand up to the stress of real-world environments such as classrooms or e-learning courses.
- **ITS Enhancement of Learning Content** develops dialogue-based intelligent tutoring systems. These systems deliver natural language tutoring conversations that use questions, hints, prompts and summaries in a simulation of a real tutor. These systems can be integrated into existing learning content to provide a just-in-time check for understanding of the material along with scaffolded learning if needed.
- **Usability Analysis for Learning Environments (UALE)** conducts usability studies, using eye-tracking technologies and read-aloud protocols to evaluate learning environments online and offline. The primary goal of UALE is to provide services to organizations such as analyzing learning environments and offering recommendations for making those environments user-friendly in order to enhance learning. Recommendations are based on cognitive theories of learning as well as principles of human-computer interfaces specifically tailored to learning.
- **Text Analysis Using Computational Linguistics Tools** helps organizations and researchers improve the readability and comprehension of written information. Services provided include analyzing written content

[7] Virtual Civilian Aeromedical Evacuation Sustainment Training, http://www.memphis.edu/psychology/vcaest/

such as Web pages, brochures or questionnaires and offering recommendations for making the content more comprehendible to the target audience.

DIRECTOR

Dr. Xiangen HU[8] is a professor of Psychology and Electrical and Computer Engineering at The University of Memphis. Dr. Hu's primary research areas include Mathematical Psychology, Research Design and Statistics, and Cognitive Psychology. His specific research interests range from human learning and memory, computational linguistics and artificial intelligence to mathematical psychology. Dr. Hu was the ADL Workforce Co-Lab director prior to 2010.

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[8] For more information, visit http://www.xiangenhu.info/

CANADA ADL PARTNERSHIP LAB

KINGSTON, ONTARIO, CANADA

HISTORY

The Canada Advanced Distributed Learning (ADL) Partnership Lab, formed in 2003, is a part of the Canadian Defence Academy (CDA) and is co-located in Kingston and Borden, Ontario. The vision of the ADL Lab is to provide access to the highest quality learning and performance aids that can be tailored to individual needs and delivered cost effectively at the right time and at the right place.

MISSION

The Canada ADL Lab supports Individual Training, Education and Professional Development activities for the Canadian Armed Forces (CAF). This includes support to other Canadian Government Departments (OGDs), the Federal Security Sector, the e-learning industry, academia and the International ADL Co-Lab network.

The lab is a catalyst for innovation in emergent technologies. Through its whole-of-government approach to partnerships; the lab shapes and guides the development of the Learning Environment by extending the use of collaborative technologies and modern training methodologies.

PROJECTS and ACTIVITIES

The Online Government Advanced Research and Development Environment (ONGARDE), a Canadian ADL product, provides the Federal Security Sector with a common secure online environment to conduct research and development, as well as the evaluation of learning and performance support technologies. ONGARDE aligns with the 3E's (Economy, Efficiency and Effectiveness) by providing a capability that:

- Minimizes the cost of resources through the use of re-usable content and reduction in the duplication of effort – enabling economy.
- Extends anywhere, anytime accessibility to ensure that community members are able to perform tasks in an efficient manner.
- Enables the sharing of standards and best practices to ensure that tasks are completed effectively.

ONGARDE is the platform that connects individuals with common goals to realistic objectives and collaborative solutions.

The other areas of focus include:

- Learning Portals and Web 2.0
- Virtual Worlds
- Simulation
- 3D Modeling
- Mobile Learning
- Standardization, SCORM, S1000D
- Professional Collaborative Business Environments
- Gateway to other Government Learning Initiatives
- Harvest Best Practices and Lessons Learned
- Support Training and Education Communities
- Expand Capability for Collective Research and Technology Demonstrations
- Explore Future Capability Requirements Definition
- Technical Authority for Learning Technology Standing Offers

The most valuable strategic asset the CAF has is its highly training and educated personnel. Through the Canada ADL Partnership Lab, the Learning Technologies section gains access to some of the most current and cutting edge concepts for delivery training and education in a distributed manner. Everything from mobile reference applications, to immersive 3D gaming and simulation environments – all have had their start within the Canadian ADL Partnership Lab.

DIRECTOR

Bill RAILER is a Learning and Technology specialist working within the CDA as part of National Defence. He assumed the Directorship of the Canada ADL Partnership Lab in 2008. Mr. Railer is responsible for promoting innovations in training and education as well as the development and adoption of global e-learning standards within the Department of National Defence (DND) and Canadian federal departments. His team conducts research and development into applications of education and training technologies with a focus on rapid development tools, applied e-learning models, and virtual worlds as well as collaborating on the evolution of sharable content specifications.

Prior to his current appointment, Mr. Railer was responsible for creating the Learning Concepts and Experimentation (LCE) cell and implementing DNDLearn – a Canadian Defence Academy/Department of National Defense (CDA/DND) initiative to support continuous learning and leverage advances in e-learning. He is now responsible for linking Training and Education needs to the Enterprise IM/IT Learning Architecture. The Learning Concepts and Experimentation (LCE) cell will initiate, promote and facilitate the continuing transformation of Canadian Forces professional development through the application of best practices, process automation, and support services, creating an effective learning architecture that adapts to the changing learning requirements of Canada's Armed Forces. The LCE promotes the development and adoption of new learning concepts, methodologies, and solutions. They are also responsible for the implementation of global e-learning standards within the DND.

Bill Railer received a B.A in Political Science and Business Administration from Wilfrid Laurier University and completed a Diploma in Systems Analysis from Humber College.

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NATO ACT ADL PARTNERSHIP LAB

NORFOLK, VIRGINIA, USA

HISTORY

NATO Allied Command Transformation (ACT) joined the ADL multinational partnership Co-Labs in November, 2010 establishing a collaborative effort between NATO and the ADL Co-Labs. The collaboration is comprised of military, government, industry and academic professionals who share a common interest in e-learning and are committed to work with emerging technologies to develop, support and deliver state-of-the-art online education. The partnership enables the sharing of experiences in implementing innovative e-learning solutions as well as providing unique opportunities to learn about the latest research and events shaping e-learning.

MISSION

The ACT Partnership Lab's mission is to develop its e-learning capability by supporting NATO and its partner nations in raising educational standards and supporting institutions in their transition to knowledge-based organizations. The ACT Partnership Lab conducts applied research in the field of e-learning for the benefit of all. It also serves to raise awareness in the use of education and training technologies to support learning in its many forms.

PROJECTS and ACTIVITIES

The NATO e-Learning Programme and responsibility of the Education & Training Technologies section is to investigate and promote the use of technology in support of NATO and its partner nation's education and training objectives. To this end, we have three major areas of work.

1. E-Learning Course Delivery - Using the NATO tested and approved open source software LMS, Ilias we run two servers on the NATO unclassified and

classified networks. These servers support over 2,000 users per month and cover a wide range of topics using courses developed by NATO as well as nations.

2. Course Development - The lab has a small team of instructional and multimedia designers on staff that produce new courses in support of NATO requests. These courses support the International Security Assistance Force (ISAF) (and future ISAF transition to the new mission), NATO doctrine and policy as well as a wide range of topics from energy security to counter-terrorism. These courses are produced using Adobe Captivate and we strive to develop at level two e-learning standards.

3. Education and Training Technology - The incredible pace of development in technology, including mobile devices and simulation, means our capabilities to ensure excellent electronic learning constantly grow. By keeping fully abreast of technological developments and national programmes, we can ensure NATO remains at the leading edge and fully interoperable with our nations.

DIRECTOR

Paul THURKETTLE is a British NATO civilian working at one of the two NATO strategic commands, Allied Command Transformation, based in Norfolk, Virginia. His 23-year NATO career and 12-year Royal Air Force service has covered telecommunications, command and control systems, technology and training. Now in his role as the lead for NATO in adopting technology for education and training, he is introducing e-Learning into NATO covering all aspects of this field from serious games to mobile learning. Paul lives in Hampton, Virginia with his two children and as many boats as he can afford.

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NEW ZEALAND ADL PARTNERSHIP LAB

AUCKLAND, NEW ZEALAND

HISTORY

The Training Technology Unit (TTU) was formed as part of a New Zealand Defence Force (NZDF) restructure that took place in 2011. At this time a new organisation was created, the New Zealand Defence College, with the aim of centralising, amongst other things, NZDF Training Development. TTU was formed from the Royal New Zealand Navy Technology Based Training Unit and the Royal New Zealand Air Force Training Technology Cell.

TTU is responsible for creating multimedia content for individual training and education (IT&E) and investigating new technologies to support the delivery of training and education in the NZDF. This involves creating multimedia learning aids, e-learning content and proofs of concept. In July 2014 the TTU took on the additional role as the NZDF ADL Partnership Lab.

MISSION

Provide support to NZDF Training Establishments wishing to use technology to deliver training and education.

Collaborate with other ADL labs on the creation of e-learning standards and frameworks.

PROJECTS and ACTIVITIES

The day-to-day work of TTU involves the creation of multimedia learning aids – such as training videos and interactive 2D/3D animations – and the development of e-learning courses to be hosted on the NZDF Learning Management System.

The unit is also involved in research into the use of new technologies for training and education. TTU recently completed an investigation into how mobile devices could be best used to support learning within the NZDF. Recommendations have been made to the organisation and are now under review.

TTU also develops proof of concept content such as mobile compatible courses and learning aids.

DIRECTOR

Lee GRAHAM is the Team Leader of the Training Technology Unit and the main point of contact for the NZDF Partnership Lab. Lee is a former Royal New Zealand Navy Education Officer who has held the civilian position of Team Leader Training Technology since 2011. He has been working in the field of Advanced Distributed Learning for the NZDF since 2008. Lee is particularly interested in the use of mobile devices to augment learning and enable learners to access content at any time and place.

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Volume 2, Number 6, 2014
JADLET Journal of Advanced Distributed Learning Technology

NORWAY ADL PARTNERSHIP LAB

OSLO, NORWAY

HISTORY

The Norway ADL Partnership Laboratory (Norway ADL Partnership Lab), established in 2008, is part of the Norwegian Defence University College and is located at Akerhus Fortress in Oslo, Norway. The Partnership Lab is a collaborative project between ADL and the Norwegian Ministry of Defence with the Norwegian Defence (NoD) University College directing the work. The NoD University College consists of units such as the NoD Staff College, Institute for Defence Studies, and NoD School for Military Sports. About 169 people work at the NoD University College, with 6 of them at the ADL office.

MISSION

The Norwegian Defence ADL Office (NoD-ADL-O) is responsible for the development, procurement, implementation, and evaluation of ADL products in Norwegian Armed Forces. Since 2001, the ADL office has coordinated the development of approximately 25 e-learning courses. The NoD-ADL-O seeks to enhance the armed forces' ADL capability and quality through national and international cooperation with governmental organisations, the ADL Initiative, the ADL Partnership Labs and Co-Labs, and North Atlantic Treaty Organization (NATO) Training Group (NTG), NATO Allied Command Transformation (ACT), and International Defence ADL counterparts.

PROJECTS and ACTIVITIES

The Norwegian ADL Partnership Lab concentrates on these areas:

- Methodology for development and procurement of e-learning
- Pedagogy in all areas of ADL (e-learning, online learning, net-based courses)
- Relevant tools for development and use of ADL

- Learning portals and Web 2.0 technology
- Mobile learning solutions and development tools
- Virtual worlds
- Standardization, SCORM®, S1000D
- Evaluation of ADL
- ADL support to the Norwegian Armed Forces

The NoD University College co-hosts the annual Nordic NORDECO ADL Conference in May, a conference that is open to all national and international partners.

DIRECTOR

Commander Geir ISAKEN has more than 10 years in the field of ADL. He has been responsible for more than 15 e-learning projects and various R&D projects in the field of e-learning, m-learning, online learning and emerging technologies. CDR Isaksen has a master's degree in Information Computer Technology & Learning from the University of Aalborg and a bachelor's degree in electrical engineering, from Vestfold University College. In addition, he has completed different university courses in pedagogies, learning styles, and crew resource management.

CDR Isaksen is an ADL Staff Officer at the Norwegian Defense University College (NoDUC)/ADL office, where he is responsible for leading and coordinating procurement, development and implementation of ADL projects. His military background is from the Navy, serving on submarines for 6 years as an electro engineer. CDR Isaksen spent 2 years as the head instructor in the technical simulator at the Royal Norwegian Submarine School before he started to work at the NoDUC/ADL office in 2002. He was a member of the NATO Training Group Task Group IT/ED from 2005 to 2012, where he was the ADL subgroup chairman until May 2011. As the Norwegian ADL Partnership director and a member of the Nordic ADL forum of experts, he is also responsible for international cooperation.

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POLAND ADL PARTNERSHIP LAB

WARSAW, POLAND

HISTORY

The Poland ADL Partnership Laboratory, formed in 2012, is part of the National Defence University located in Warsaw (district: Rembertow), Poland. The Poland Partnership lab is a collaborative project between ADL and the Polish Ministry of National Defence with the National Defence University (NDU) directing the work.

MISSION

The Poland NDU-ADL Team is responsible for the development, procurement, implementation, and evaluation of ADL products in the Polish Armed Forces.

The Poland ADL Partnership Lab focuses its activities on the following areas:

- Methodology for development and procurement of ADL,
- Pedagogy in all areas of ADL,
- Learning Management Systems,
- Learning Record Store,
- Mobile learning,
- Serious games,
- Machinima,
- Relevant tools for development and use of ADL,
- SCORM, xAPI,
- Evaluation of ADL,
- ADL support for the education and training activities of the NDU and the Polish Armed Forces.

PROJECTS and ACTIVITIES

- Individual Training and Education Development NATO Training Group Task Group - IT&ED NTG TG:

- Introduction to Cultural Awareness ADL Course
- ADL Handbook (participation)
- ADL Glossary (participation)

- CAMELOT project (**C**re**A**ting **M**achinima **E**mpowers **L**ive **O**nline language **T**eaching and learning) funded by the European Union, 2013-2015, 9 partners.
- Laboratory-provided expertise in the development of distance training concepts for the Polish Armed Forces needs.

DIRECTOR

Lt. Col. Dariusz POCZEKALEWICZ is a PhD candidate (NDU Warsaw). Lt. Col. Poczekalewicz graduated from the Military University of Technology (1997) and completed postgraduate studies in IT Infrastructure management and network administration of UNIX (2003). In 1998-2000, he served as a member of the didactical team at the Institute for the Missile Technology of the Military University of Technology where he contributed to the mathematical modeling, simulation, and optimization of anti-air missile guidance systems.

For the next several years he was assigned to the Ministry of Defense in positions related to IT. He authored the relational database for planning expenditures on military infrastructure used by the Polish General Staff.

Since 2009, Lt. Col Poczekalewicz has served at NDU where he leads the distance learning team (ADL). He is also the co-organizer for the distance learning system at the NDU Warsaw. He serves as administrator of the ADL system and is an expert for the Learning Management System ILIAS (he is responsible for the Polish interface of ILIAS). He participates in many military and civilian workshops and conferences related to multimedia and instructional designer aspects. He handles numerous ADL authoring tools and has designed and co-authored many ADL materials.

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ROMANIA ADL PARTNERSHIP LAB

BUCHAREST, ROMANIA

HISTORY

Since 2004 when Romania joined the NATO community, the Romanian Armed Forces have been focused on the process of reaching full interoperability with the other NATO nations' armed forces.

One of the most important domains for modernizations of armed forces is the new technology in training and education. Romania started to build a capability for e-learning in 2005 within the National Defence University.

Step by step, year after year, through its own efforts and learning from others' experiences, the Romania Advanced Distributed Learning Department (RoADL-D) started to develop its own technical infrastructure, human resources capabilities, and to deliver educational content conformant with SCORM standard.

In January 2009, The "Carol l" National Defence University of the Ministry of Defence of Romania established an Advanced Distributed Learning Partnership Lab in Bucharest, Romania, to develop ADL capabilities in cooperation with the U.S. Department of Defense. Professor Dr. Ion Roceanu, Director at that time of the RoADL-D of the "Carol l" National Defence University, and Dr. Robert Wisher, Director of the ADL Initiative, Office of the Deputy Under Secretary of Defense for Readiness of the Department of Defense of the United States of America, were the principal signatories.

Since 2009, the Romania ADL Partnership Lab has collaborated with ADL on developing technical frameworks and standards in national and international contexts, with participation from government, industry and academia.

Beginning in October 2010, the "Romania ADL Association" was formed for the purpose of expanding ADL benefits to academies and corporate organizations, and to promote information technologies in education, continuous training through research and development of systems, solutions and eLearning Standards.

In April 2013, the U.S. Department of Defense and the "Carol I" National Defence University of the Ministry of National Defence of Romania, and the Romania ADL Partnership Laboratory respectively, signed a new Intent to Cooperate, thereby reinforcing the commitment to support cooperative development of ADL capabilities.

MISSION

The RoADL-D vision is focused on a "Network Based Education – Student Oriented" concept as part of its core mission to develop and manage multi-level, standardized, online learning curricula according to ADL principles.

The RoADL-D promotes e-learning and e-training for civilian and military personnel for lifelong learning and military education. The department is involved in research projects developed at the national, European Union (EU), and NATO levels, and offers expertise on creating SCORM 2004-conformant educational content, authoring tools, and integrated systems for education and training.

PROJECTS and ACTIVITIES

Main activities

- Provide educational online services support for E-education domain: master degree and doctoral studies
- Deliver a dedicated offer for military training
- Provide short professional online courses in the framework of lifelong learning
- Training for nominated persons to use the ADL technologies
- Developing SCORM conformant courses
- Scientific research in domain of eLearning and related fields

Main projects

- Provide a dedicated Learning management system and technical support for European Security and Defense College Internet based distance learning system
- Support for implementation an ADL system to other Romanian military educational institutions
- Support the Human Resource Management Directorate (2 projects) for improving the efficiency of the programs for learning a foreign language:

– The first project aims at providing an instrument to assess the preliminary level of English skills necessary to join the language training programs that are organized in language centers following the training needs of the personnel selected by the MOD benefiting structures or other beneficiaries. The actual assessment consists of a multi-level online test implemented on RoArmy e-learning platform organized on 4 sections, one for each language skill, namely listening, speaking, reading, and writing.

– The second project aims to develop five distinct online tutoring modules of online English courses. These courses are especially intended for those who have graduated foreign languages courses and want to maintain their abilities or even to perfect them through individual study under the guidance of a teacher.

Scientific research projects developed

eLearning pilot center for the development and distribution of digital content in the field of national security and crisis management, national level, 2005-2006, national research program, coordinator.

“Advanced research for creating a pilot educational system within the virtual space in order to simulate scenarios regarding natural disasters and citizens’ and institutions’ way of action in crises situations,” 2007-2010, national research program, coordinator.

Research regarding the design of an experimental model of a mobile learning-type virtual network with real time access to knowledge and learning, using communication technologies and wireless terminal devices” 2008-2011, national research program, coordinator.

Optimized educational process in view of competences within a knowledge-based society multi-touch technology in training and education national research program, partner. This project have received Excellence Award in Project Management.

Multinational Virtual Learning Environment, 2007-2008, international initiative, partner nation.

MoLE, Mobile Learning Environment, 2011-2012, international initiative, partner nation.

Games and Learning Alliance: Network of Excellence, (European Union, 7th Framework Programme, partner

DIRECTOR

Professor Ion ROCEANU, PhD, has served as the Director of the RoADL-D of the "Carol l" National Defence University since its founding in 2005, and assumed responsibilities for the Romania ADL Partnership Lab in 2009. He was responsible for developing ADL capabilities for the university and the Ministry of National Defence of Romania in close cooperation with national and international partners. As Director of the Romania ADL Partnership Lab he works to further the goals of the ADL Initiative through partnership activities and projects that advance SCORM, and other related learning technologies. Dr. Roceanu is a member of the NATO and PfP Consortium Advanced Distributed Learning working groups, is the President of the eLearning and Software for Education International Scientific Conference (eLSE), President of the Advanced Distributed Learning Romanian Association, Member in the scientific committee of the International conference on Virtual Learning, Romanian Agency for Quality Assurance in Higher Education evaluator, Member of the National Council for Titles, Diplomas and Certificates. He has published widely in domains of elearning, advanced distributed learning, mobile learning, and serious games.

Prof. Roceanu has vast experience in leading different research and development projects, at national, international, and NATO levels. In the last 6 years he managed 3 national research projects as director and another 3 projects as a contributing partner.

Dr. Roceanu is a graduate of the Signal Military School. After completing doctoral studies in 2000, he has taught Computer Science applied in the Military sciences, including Command and Control, Communications, Computers and Intelligence, and Network Centric Warfare. He has completed advanced coursework in project management, Chief Information Officer, and Joint Operations Planning.

He is currently Deputy Commandant (vice rector) of science at "Carol I" National Defence University. He has been nominated in this position since 2012.

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CENTER FOR SIMULATIONS AND DISTANCE LEARNING AT SERBIAN MINISTRY OF DEFENSE

BELGRADE, SERBIA

HISTORY

The Ministry of Defense (MoD) of the Republic of Serbia established the Center for Simulations and Distance Learning (CS&DL) in 2010. The implementation of distance learning has been conducted with significant support of our Norwegian colleagues through equipment procurement and experience transfer. A distance learning platform was implemented and became fully operational in 2011.

MISSION

In order to accomplish the vision and role of the military educational system and meet the needs of the MoD and the Army, it is necessary to support the reform of military education in accordance with the requirements imposed by contemporary world trends. The mission of this Lab is to support development of the members of the MoD and the Serbian Army throughout their careers by means of applying modern technologies, primarily informatics.

PROJECTS and ACTIVITIES

1. Implementation of distance learning as a part of Serbian military education reform (2010-2011):

- Equipment procurement
- Distance learning platform implementation
- Digital library software development
- Developing e-courses.

2. Development of e-courses and mobile learning within Serbian military education (2012-2013):

- Development of e-courses
- Mobile equipment procurement

- Mobile learning application development
- Mobile courses development
- E-learning promotion within Serbian MoD and Serbian Army.

3. Mainstreaming distance learning in the Serbian MoD (2014-2016):

- Development of TNA system
- Development of competence repository system
- Development of e-courses
- Equipment procurement
- Making bilingual courses.

DIRECTOR

Colonel Goran Šimić (Shimich) is the Head of the Center for Simulations and Distance Learning at the Serbian MoD and Serbian Army. He has been the main point of contact for the Serbian MoD ADL Partnership Lab since its establishment in 2010. Col. Šimić received his B.S. degree in Electronic Warfare (EW) from the Military Academy, Belgrade, Serbia; M.S. degree in informatics from the Department of Information Systems, FON – School of Business Administration, University of Belgrade, Serbia; and PhD degree in Computer science, FIM – Faculty of Informatics and Management, Singidunum University Belgrade, Serbia. He is a lecturer for several courses on Java and C Programming, Algorithms and Data Structures at the Military Academy, Belgrade, Serbia. He also teaches courses on Intelligent Computer Technologies and Software Engineering in the School of Electrical and Computer Engineering of Applied Studies, Belgrade, Serbia. His current research interests are in the area of Web-based e-learning, interoperability between different learning resources & systems, and integration between intelligent tutoring systems and learning management systems. So far, he has authored/co-authored more than 10 research papers and has contributed to three books. Col. Šimić is a member of the GoodOldAI (Group for Object Oriented Design Objective Languages Development and Artificial Intelligence) research network (http://goodoldai.org/).

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UK ADL PARTNERSHIP LAB

SHRIVENHAM (near Swindon), ENGLAND

HISTORY

The Defence Academy of the United Kingdom is part of Joint Forces Command and is responsible for post-graduate education and the majority of command, staff, leadership, defence management, acquisition and technology training for members of the UK Armed Forces and Ministry of Defence (MoD) Civil Servants. Its main site is in Shrivenham, England, and it is the current home of the United Kingdom ADL Partnership Lab formed in 2011. The activity of the Partnership Lab is embedded within the Defence Technology Enhanced Learning (DTEL) team.

MISSION

The DTEL team provides the MoD with a centralized resource for managing support and consultancy on existing and emerging learning technologies and on their exploitation for learning.

PROJECTS and ACTIVITIES

The DTEL team administers the current Learning Management System (LMS) for the MoD and is developing its replacement based on a Moodle Virtual Learning Environment (VLE). This includes running courses on e-learning development and on exploiting VLEs for learning. The team is also responsible for writing policy, guidance and support documentation on the use of learning technologies within MoD.

The DTEL team provides a MoD focus for the coherence of learning technologies exploitation across the single Services and acts as a Joint sponsor for research related to Technology Enhanced Learning (TEL). It works closely with the Defence Training and Education Capability that currently focuses on exploiting modelling and simulation in support of capability acquisition but, with DTEL, is expanding its scope to cover learning technologies in support of training and education.

DIRECTOR

Jim POTTS is the TEL Assistant Head based in the HQ of the Defence Academy of the UK and is the current Director of the UK ADL Partnership Lab. He served in the Army as a Royal Engineer from 1980 till 2009. After attending Staff College he specialised in Defence Acquisition in ground manoeuvre, though his last two roles were in: the Development, Concepts and Doctrine Centre working on concepts development, NATO doctrine, and science and technology research including Global Strategic Trends; and in the Defence Capability Centre focusing on education on defence technologies. In 2009 he left the Army and joined the Civil Service in his current post as an OF5 (NATO grading), though its responsibilities have grown from an initial internal Defence Academy focus, to the current pan-MOD and international focus.

He graduated with a BSc (Hons) in Civil Engineering from Manchester University, and has a MSc in Defence Technology from Cranfield University and a PG Cert in Online and Distance Education from the UK Open University.

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Chapter II PAPERS FROM ADL PARTNERSHIP LABS

ADVANCED DISTRIBUTED LEARNING INITIATIVES 2014

Paula J. DURLACH*, **Andy JOHNSON****

Abstract: *The Advanced Distributed Learning (ADL) Initiative's) current focus is to develop new specifications and standards, suited to the current technology environment, capable of adapting both in the face of future technological innovation, and to learners' needs, devices, and contexts. In order to accomplish this, ADL is developing the Training and Learning Architecture (TLA). The TLA will enable those who currently create and deploy distributed learning content to take advantage of a cloud computing environment. This will be accomplished by developing four functional areas: Experience Tracking, Content Brokering, Competency Framework, and Learner Profiles. ADL is also conducting research and development on technologies to support a Personal Assistant for Learning (PAL). A PAL will guide and support lifelong learning, anticipate learner needs, recommend learning resources and partners, while taking into account the current context and device affordances. As this work progresses, the PAL research can inform needed functionality for the TLA, and the TLA can support needed architectures, standards, and specifications for the PAL.*

Keywords: *Competency; Intelligent Tutoring; Recommender System; SCORM; Personalized learning; xAPI*

I. INTRODUCTION

In 2011, seven years after Google started to digitize books, the revenue from eBooks overtook the revenue from physical books [1]. In 2004, Forbes magazine predicted that laptop sales would outnumber sales of desktop computers [2]. Ten years on, in 2014, it is expected that tablets will overtake laptops [3]. In the current technology environment of mobile devices, cloud

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computing, wearable devices, and personal assistants, we are on the cusp of being able to develop technology-mediated learning, anytime, anywhere. Learners will have information at their finger tips, tailored to their needs, and synchronized and synthesized across devices. The Advanced Distributed Learning (ADL) Initiative was started in 1999 to harness the power of information technology to support learning outside of traditional classrooms, and it did so successfully by promoting the development of standards and specifications. In particular, the Sharable Content Object Reference Model (SCORM®) integrated a set of related technical standards, specifications, and guidelines designed to promote reusability and interoperability of learning content across Learning Management Systems (LMSs). SCORM® produced economic benefits for both the supplying industry and the customers by reducing costs and risks, and increasing quality and compatibility [4]. ADL's current focus is to develop new specifications and standards, suited to the current technology environment, and capable of adapting in the face of future technological innovation, as well as adapting to the learners' current needs and context. In order to accomplish this, ADL is taking a two-pronged approach.

The first approach is aimed at supporting modernization of learning today, by enabling those who currently create and deploy distributed learning content to take advantage of the current technological environment in ways that SCORM® cannot. One limitation of SCORM®-based learning applications is that they only work inside LMS's, which traditionally do not share data with other software systems. That limitation prevents them from interoperating with other sources of learner data, such as data about learning using a mobile device. Web services allow different software systems to exchange data over the web. This approach will supplement SCORM®, and will encompass SCORM®, as well as most any type of content, with new specifications and standards based on web services. We refer to the envisioned web service architecture as the Training and Learning Architecture (TLA).

The second approach looks further into the future, and supports research and development that will enable personalized, ubiquitous learning. The long term vision is for a personal assistant for learning (PAL), which will guide and support lifelong learning. PAL will anticipate learner needs and recommend learning resources and/or collaborators, taking into account the current context and device affordances. The PAL will necessarily depend on interoperable systems, and thus will require specifications and standards. The software applications currently being developed under the PAL initiative will help determine what those need to be. Thus, there is a feedback relation between the TLA and PAL. The PAL research can inform needed functionality for the TLA, and the TLA can support needed architectures for the PAL, as well as expand the capabilities of current distributed learning in the near term.

II. TLA

Over the past few years, ADL analyzed how SCORM® was being used in the government, academia, and industry, where improvements could be made, and which technological barriers couldn't be overcome. This led to ideas for the next generation of distributed learning specifications as an architecture, rather than a single specification. In 2012, ADL coined the TLA is the technological thrust to modernize specifications for distributed learning. The TLA consists of four conceptual components: Experience Tracking, Content Brokering, Competency Framework, and Learner Profiles. These components will support distributed learning requirements using a "suite of services" approach rather than an all-in-one solution. This approach releases learning from the confines of a single LMS, and reduces the technical barriers to using custom applications in enterprise learning environments.

The TLA is a work in progress, committed to the "ilities" – reusability, interoperability and durability. Another "ility" is also a key component – practicality. SCORM® influenced a great deal of infrastructure commitments, and ADL is cognizant of the need to continue to support those commitments. This section will discuss each of the four conceptual components of the TLA, the evolution path of SCORM® to TLA, and ways both can be utilized together.

2.1. Experience tracking

Experience Tracking collects, stores, and provides access to learner data. This includes traditional data such as scores or completions; but, it can also include more granular data such as time spent on an item or page, or performance data from training applications not traditionally captured by an LMS, such as simulations, and even instrumented live training. The TLA component that enables this is called the Experience API (xAPI). The xAPI, initially referred to as "Project Tin Can," is the official name of the specification for the .95, 1.0, and 1.01 releases (see http://www.adlnet.org/tla/experience-api/). The basic structure of xAPI mimics human language; but, is also machine readable, which means that either a human or computer can look at the data and decipher it. The data structure is called a Statement and consists of at least three parts – an actor (e.g., Andy), a verb (e.g., wrote), and an activity (e.g., an article on xAPI). There are other parts of a Statement that allow any type of meaning to be captured, including context. The technology used, JavaScript Object Notation (JSON), doesn't require a specific order to the elements comprising it. That means the Statement can be displayed differently to a human without impacting the machine's ability to process it. That feature should facilitate its use by speakers of different languages.

When SCORM® was created, it was used to condense a series of learner interactions and inputs into a smaller and coarser set of tracked learner data. Since that time, data transfer has become faster and memory has become cheaper. Many institutions and applications would like to remove the SCORM® filter, and restore the ability to track finer-grained data. For better or worse, SCORM® used a Data Model with a limited number of fields. When used in the way intended, the Data Model promoted interoperability. xAPI was designed to allow the tracking of finer-grained data, with the idea that Communities of Practice would establish their own "profiles," in order to establish interoperability. These profiles will consist of conventions on verbs to use, activities to track, sequencing rules, and how to use context. There will be a learning curve for communities of practice, but it will pay off in the long run. ADL recognizes this learning curve, and is creating an "ADL profile" to aid xAPI adoption.

SCORM® is still extremely effective at what it does, and will not be completely phased out. xAPI and SCORM® can both be used for the same content. The addition of xAPI won't impact or interfere with the use of SCORM® in any way. To facilitate SCORM® users adding xAPI, ADL will release wrappers, content examples, and prototypes that will show use of the xAPI with existing SCORM® content.

2.2. Content brokering

The Content Brokering component of the TLA concerns content management, discovery, and delivery. The idea of PAL – personalized, just-in-time, right-sized, and contextualized instruction delivered at the perfect moment – is the holy grail of e-learning. The TLA seeks to create interface points which could make this possible with the right systems plugged in. These systems include repositories and registries, along with metadata and paradata associated with the repository or registry content. In order to determine what content to find, the broker also needs to know something about learner needs (see sections 2.3 and 2.4 below), and select from among the relevant content discovered to recommend to the student. Thus it also entails recommendation (see section 3.2 below). Finally, once content is selected by a learner, content brokering services must know how to launch it, in a manner appropriate for the learner's device, track resulting user data, and send it to the appropriate storage location. xAPI offers a storage area, the Learning Record Store (LRS), that can be used for tracking at run-time. The LRS works with the xAPI to collect and return statements. It can be integrated into a larger system like an LMS, or it can stand alone as a separate system and allow other systems to add and retrieve statements (see http://www.adlnet.gov/tla/lrs/ for more details).

ADL has been engaged in several efforts to make content more easily discoverable. Of note, The Learning Registry (http://learningregistry.org/; http://free.ed.gov/) is a new approach to capturing, connecting, and sharing data about learning resources available online. The goal is to make it easier for educators and students to access the rich content available in our ever-expanding digital universe. It isn't a portal, it isn't owned by one organization or reliant on a single organization, it is a framework that allows the repositories of different organizations to share resources and metadata about those resources. The framework connects the back ends of different organizations' repositories, to share information about resources and how they are used in different contexts. Globally, there have been several initiatives to make "open educational resources," (e.g., digitized materials offered freely and openly for educators, students, and self-learners) to use, adapt, and share. ADL's view is that standardized content brokering services will be necessary to discover and deliver these resources. With respect to SCORM®, a constraint in delivering the next logical piece of content is that the content needs to be internal to the SCORM® package, both in terms of space and recognition. The TLA, through the idea of "suite of services" – discovery, recommendation, and delivery – will enable a broader range of sequencing logic than afforded by SCORM®.

2.3. Competency framework

Experience tracking serves not only training management, but also assessment of competency. It can provide data that demonstrate that "this person knows what he or she is doing." Several industries promote an understanding of the skills and abilities needed to train their workforce through the use of competency models (e.g., see http://www.careeronestop.org/CompetencyModel/). In education, Europeans are likely familiar with the Bologna Process, a part of which lays out the requirements for Associate's, Bachelor's, Master's, and doctoral degrees and outlines the different levels of competence students earning those degrees should exhibit. Those in the United States are likely familiar with the Common Core State Standards Initiative for Math and Literacy, that lays out standards for what competencies students should be able to demonstrate at each grade level in elementary and high school education. OER Commons (https://www.oercommons.org/), an open educational resource initiative, provides tools to support educators in associating or "aligning" open educational resources to Common Core State Standards. Such alignment is useful not only for supporting educators looking for resources, but also for automated recommendation of learning resources. By comparing a learner profile (See section 2.4) with a competency model, a recommender system can identify the gaps and, consequently, the domain of content to discover. This requires that content be associated with metadata concerning its targeted competencies. An assumption required to make this work is that data in the learner profile can be aligned with data in the competency model. Thus, the need for specifications and standards once again arises.

ADL is currently examining the usefulness of a competency framework developed by MedBiquitous, a leader in specifications for distributed learning in the domain of medicine (http://www.medbiq.org/). The MedBiquitous Competency Framework is a technical standard for representing competency models in XML. Using this standard format, ADL has been able to map competencies to xAPI Statements, demonstrating that the two can work together to help learners visualize their progress, and to find new resources in the Learning Registry matched to yet-to-be-mastered competencies. Work exploring this standard is ongoing.

2.4. Learner profile

The main purpose of having a learner profile – information about the learner – is to personalize learning. It is believed that learners respond better to, and learn more effectively with, personalized content. In particular, adapting both the sequencing and content of learning materials to a student's current level of mastery is a proven and desirable method of increasing learning effectiveness [5]. Consequently, at minimum, a learner profile should represent learner mastery of competencies. As per the above discussion these need to be capable of alignment with content metadata and a competency framework. The goal of the TLA is to foster such interoperability. No longer imprisoned inside individual applications or LMSs, the ability to share learner data across TLA services should foster personalization of learning. The learner profile would persist in time and could exist independent of any specific application. Alternatively, it might exist distributed across applications. As discussed by [6], there are many technical challenges associated with persistent learner profiles, including ownership of the data, the learner's ability to inspect and challenge the data, and protection of the learner's privacy. The learner will need control over which applications are allowed to use and contribute data, including not just learning applications, but also other types, such as enterprise personnel or training management systems.

With respect to interoperability, there have been some attempts to standardize learner profiles, most notably IEEE Personal and Private Information (PAPI, http://edutool.com/papi/) and IMS Learner Information Package (LIP, http://xml.apache.org/xindice/index.html). However, these standards do not suit the needs of the most advanced adaptive learning applications, such as intelligent tutors, which tend to use their own idiosyncratic models. The challenges of learner model interoperability are discussed further in section 3.1.

2.5. TLA in action

When all of the components of the TLA are in place, we envision them supporting learning in the following ways. Recommendation services act on learner goals and needs from the learner profile. These goals and needs may be personal, or may be set by instructors or organizations. They may be explicitly represented in the learner profile (e.g., required organizational or institutional courses), or inferred by comparing the learner profile against competencies the learner has identified as goals. If explicitly assigned content is not scheduled, the content broker will find learning content aligned with those missing competencies. If available, the content broker may use additional information in the learner profile (e.g., media preferences), to down-select among the identified relevant content. In addition, discovered content may be vetted by examining other data about it, such as how it is ranked by others or whether it is considered an authoritative source. The content brokering services will then recommend one or more options to the user, and deliver or launch on the user's device. Experience tracking will collect data about the learner's activities, including performance and learner feedback. These data will be sent to the LRS for retrieval by the learner profile. Some processing of the data might occur before updating the learner profile by a learner modeling service or certification service. For example, a certification service may determine that the learner has accomplished a particular milestone and award a badge (see https://wiki.mozilla.org/Badges and [7] for more information on badges). The appropriate filtered data can be sent to other applications, such as those accessed by instructors, managers, or personnel systems. All of these components are modular, so that different services can be swapped, or possibly a subset of these activities can be integrated with enterprise LMSs, as suits the needs of the learners and/or their associated organization.

III. PAL

Cloud computing has freed learning from the classroom and desk, and blurred the lines between learning and performance support. Ongoing development in device and environmental sensors, as well as augmented reality, offer the possibility that digital applications will eventually interpret user context and determine what information a user might need at any given time, as well as the nature of that information (e.g., formal or informal learning material, practice opportunities, or performance support). ADL's vision for the PAL is to do just that: provide ubiquitous, relevant, tailored, and timely access to learning content, advice, and performance support, based on knowledge of the user and the user's current context. The PAL is not intended to replace interaction with human peers, instructors or mentors, but rather to facilitate and augment such interactions. Several existing technologies provide elements required for a PAL; but, these elements need to be brought together in a cohesive way to support life-long learning. These technologies include, but are not limited to intelligent tutoring systems (ITSs), recommender systems, wearable devices and sensors, unobtrusive user interfaces, and social networking applications. ADL has been exploring all of these technologies, but this discussion will focus on ITSs and recommender systems in their relation to the PAL vision.

3.1. Intelligent tutoring systems (ITSs) as a model for PAL

ITSs are a technological analog of one-on-one human tutoring. ITSs encode knowledge about the student, domain, tutoring strategies, and assessment into different models. These models include: the student model (which stores information about the student and maintains an estimate of the student's knowledge, skills, and abilities); the expert model (which contains information about the domain and how experts solve problems within the domain); the domain model (which contains information about topic relations in the domain, and potentially common misunderstandings); and the pedagogical model (which uses information from the student, domain, and expert model to determine how and when to provide coaching, feedback, hints and examples, or what content or problem to present next). In this context, the student model is analogous to the learner profile of the TLA, and the domain model is analogous to a competency model of the TLA. The pedagogical model is analogous to a recommender system, except that in an ITS, the recommendations can include feedback and hints, and curated content confined to a single domain.

ITSs have been used in a variety of real-world settings, and their effectiveness has been empirically documented in several different domains. For example, the Algebra I Cognitive Tutor, which is currently maintained by Carnegie Learning (www.carnegielearning.com), is a widely used ITS for teaching introductory algebra. Other notable ITSs include Andes, a physics tutor that has been effectively used at the United States Naval Academy to teach students Newtonian physics [8]; SHERLOCK, an avionics tutor; and the LISP tutor, which was developed at Carnegie Mellon University for teaching LISP programming language to college students. Research has shown that these tutors are quite effective. For instance, [9] found that 20-25 hours of training with SHERLOCK produced performance that was judged equivalent to four years of on-the-job-experience. Corbett [10] reported that the LISP tutor cut instruction time by two-thirds while still improving scores – compared to practice problems alone. Based on this record of success, a portion of the PAL project is devoted to ITS research and development [11, 12].

Much analysis has been done on naturally occurring one-on-one human tutoring sessions to determine what tutoring tactics to incorporate into ITSs [e.g., 13, 14, 15, 16, 17]. Yet, there is still no clear consensus on how to use the findings to influence ITS design. Reaching a consensus is hampered by the fact that each research team has worked with a relatively small data set, and has used its own idiosyncratic coding scheme [17]. ADL is supporting an effort to apply a new coding scheme to a very large archive of tutoring dialogs. These sessions are being coded through a combination of human tagging and machine learning [18]. After coding, data mining will be applied to determine prevalent and important tutoring patterns, which will yield recommendations for the design of ITSs.

While ITSs pose a potential model for the PAL, the model has limitations. ITSs are domain-specific, and (like an LMS) they don't share their data. Even if ITSs did make their data available to other applications, each ITS (currently) uses idiosyncratic data models designed for the goals and purposes of that ITS (e.g., mastery of algebra). Even two ITSs created to tutor in the same domain, may use different data domain structures. In addition, ITSs are designed to guide students while they are learning a particular topic (e.g., algebra); however, they are not responsible for decisions about whether the student should learn that topic in the first place. Moreover, if the student lacks the prerequisite knowledge for algebra, there is nothing a traditional ITS can do to help him or her gain it. To overcome the first issue (lack interoperability), PAL could be designed as one monolithic ITS, using internally consistent models; but, that solution would require one ITS to have domain and expert models about everything, as well as appropriate interfaces to support student interaction with the ITS about anything. In addition, a monolithic ITS would require a method to select (from its large knowledge base) what the user should focus on during any given learning episode. By expanding the scope of knowledge an ITS could help teach, it would introduce a new need: decision algorithms to determine what to teach and when to teach it.

3.2. Recommender systems as a model for PAL

Recommender systems have proliferated over the web, especially in e-commerce and social networking sites. Recommender systems assist consumers in finding the right movie, vacuum cleaner, book, or social group. Perhaps they can also be used to provide learners with advice on the most appropriate experience or content to meet their current learning and performance goals [19, 20, 21]. Two common recommender approaches are collaborative filtering and content-based filtering (which can be combined). Collaborative filtering records the online behavior of users (say at a shopping website), tracking what pages they view. The similarity of a current user to other past users is computed in order to group users into clusters. Then, any differences between the current user and their reference cluster are used to generate recommendations. For example, a user may fall into a cluster that purchases mysteries and thriller books. Most of the people in that cluster have purchased a particular ebook, say, *The Girl with the Dragon Tattoo;* but, the current user has not. Therefore, a good recommendation for them is *The Girl with the Dragon Tattoo*. Content-based filtering makes use of attribute information about items to be recommended. Using past selections or rankings, content-based filtering attempts to identify items that match a person's preferences across attributes (without social comparison to others). Pandora Radio is a well-known music provider that uses content-based filtering, by considering hundreds of song and artist attributes. When it comes to applying content-based filtering to learning content, one important question is what attributes are most beneficial to use? Some standards already exist for characterizing learning content (such as Learning Object Metadata [LOM] and the Learning Resource Meta Data Initiative [LRMI]); but, these may not be sufficient for providing truly personalized learning.

If we were to fully delineate the set of attributes we need for personalizing content, another obstacle would still need to be overcome: How to create the metadata about the attributes of the content? Would this require monk-like manual annotation of every piece of content, or can annotation be automated or semi-automated? One of ADL's PAL projects is examining this issue, by using a combination of natural language processing, computational linguistics, and artificial intelligence to automatically create metadata about content attributes in a machine readable form, so that it can be used by recommendation algorithms.

In an effort to select learning content based on user goals and needs, one of ADL's PAL recommendation projects distinguishes three types of content: Explore, Study, and Stay Sharp [22]. Study is similar to traditional formal learning, and requires content to be delivered in a logical sequence, and the learner to put in sustained effort over time to build domain competence. Explore, on the other hand, is a brief introduction to some domain, intended to create passing familiarity, to build interest, and to be relatively easy. The third type, Stay Sharp, is content that is intended to maintain expertise and keep the learner abreast of new developments in a domain. PAL projects are also developing ways to take context into account when recommending content. Context includes characteristics such as current activity (e.g., riding on a train), proximity to sources (e.g., a knowledgeable peer or useful QR code), device (e.g., screen size, bandwidth), and amount of time available. These contextual factors can be used to recommend context-appropriate content, such as audio-only resources if a person is driving, or a short "Explore" resource if a person has a few spare minutes till their next scheduled activity.

Enabling the PAL to interoperate with multiple applications, like calendars, location services, and wearable physiological sensors should help to automate understanding of context.

The need to take into account learner motivations, knowledge, and context suggests that collaborative filtering and content-based filtering may not be sufficient for good learning recommendations. An attribute model of the learner – the learner profile – is also necessary. A lifelong learner profile would need to update as new learning (or forgetting) occurs, and as motivations and interests change due to changes in priorities, roles, and context. In this sense, a recommender can use a learner profile and a competency model like an ITS. The difference is that an ITS uses its student and domain models to assist the learner *while* they are learning, while a recommender uses learner profile and competency models to assist the learner with *what* they are learning. Selection of an appropriate ITS for a learner could be the role of a recommender. One of the research issues is how to align an ITS student model and a lifelong learner profile so that they can exchange data. The two applications may store learner data at different levels of granularity, and translation services will be needed to align data models from different applications, for example [23].

IV. CONCLUSION

It should be apparent from the foregoing discussion that PAL will need to function on top of APIs and services like those envisioned by the TLA. Those services may be unique to any particular instantiation of the PAL, as in our current prototypes; however, to the extent we can create specifications and standards, a PAL can be more modularized and open. Experience tracking is currently the most mature component of the TLA, while the other components are relatively more nascent. Once standards and specifications are established for all components, we can envision that a PAL user may be able to select among content brokering services according to their preferences, similar to how users now can select from multiple mobile apps with similar functions. One of the unanswered issues for the PAL is whether it should be a closed, curated system with content resources vetted and systematically catalogued and added to the domain model by PAL "librarians." The alternative is to have an open system that can discover content from any connected source, be it an open, curated educational resource, such as OER Commons or the Learning Registry, or even totally uncurated resources, using semantic web technologies and artificial intelligence techniques to align uncurated content with competencies. Of course, it is possible that eventually, all these various forms may coexist. Ultimately, learning applications will need to broker the right resource for learners according to their need. The TLA and PAL focus on enabling learning applications to understand learning needs and how best to address them.

References

[1] Fowler, N. (2012). Hello, future – Siri inventor Adam Cheyer's top 15 tech predictions. Available at http://venturevillage.eu/adam-cheyer-15-predictions-future-tech.

[2] Fortt, J. (2004). 2004's Top Technology Trends. *Forbes Investment Newsletter*. Available at http://www.forbes.com/2004/01/02/ 102techtrendspinnacor_ii.html

[3] Hardy, E. (2013). Tablet Sales Surge as Laptop/PC Sales Decline. Tablet PC Review. Available at http://www.tabletpcreview.com/news/tablet-sales-surge-as-laptoppc-sales-decline/.

[4] WSC Newsletter (2011). The Benefits of Standards for National Economies. Available at http://www.worldstandardscooperation.org/ newsletters/003/newsletter03.html

[5] Durlach, P.J. and Ray, J.M. (2011). Designing Adaptive Instructional Environments: Insights from Empirical Evidence. U. S. Army Research Institute Technical Report 1297, Arlington, VA.

[6] Kay, J. and Kummerfeld, B. (2012). Lifelong learner modeling. In P. Durlach & A. Lesgold (Eds.), *Adaptive Technologies for Training and Education* (pp. 140-164). New York: Cambridge University Press.

[7] Regan, D., Raybourn, E. M., & Durlach, P. J. (2013). Learner modeling considerations for a personal assistant for learning (PAL). In Sottilare, R., Hu, X., Graesser, A. and Holden, H. (Eds.) *Design Recommendations for Intelligent Tutoring Systems: Learner Modeling, Volume I* (pp. 223 – 231). Orlando, FL: U.S. Army Research Laboratory.

[8] VanLehn, K., Lynch, C., Schulze, K., Shapiro, J. A., Shelby, R., Taylor, L., Treacy, D., Weinstein, A., & Wintersgill, M. (2005). The Andes physics tutoring system: Lessons Learned. In *International Journal of Artificial Intelligence and Education*, 15 (3), 1 - 47.

[9] Lesgold, A. M., Lajoie, S. P., Bunzo, M., & Eggan, G. (1992). SHERLOCK: A coached practice environment for an electronics troubleshooting job. In J. Larkin & R. Chabay (Eds.), *Computer assisted instruction and intelligent tutoring systems: Shared issues and complementary approaches* (pp. 201-238). Hillsdale, NJ: Lawrence Erlbaum Associates.

[10] Corbett, A. (2001). Cognitive computer tutors: solving the two-sigma problem. In M. Bauer, P. J. Gmytrasiewicz, & J. Vassileva (Eds.), *Proceedings of the 2001 International Conference on User Modeling* (pp. 137–147). Berlin: Springer.

[11] Lenat, D. B. & Durlach, P. J. (2014). Reinforcing Math Knowledge by Immersing Students in a Simulated Learning-by-teaching Experience. *International Journal of Artificial Intelligence in Education, 24,* 216 – 250. Available at: http://download.springer.com/static/ pdf/372/art%253A10.1007%252Fs40593-014-0016-x.pdf?auth66=1405865572_ 9128c6c589e55875890c08877cb64d45&ext=.pdf.

[12] Ritter, S., Sinatra, A. M., & Fancsali, S. E. (2014). Personalized content in intelligent tutoring systems. In Sottilare, R., Graesser, A., Hu, X., and Goldberg, B. (Eds.). *Design Recommendations for Intelligent Tutoring Systems: Volume 2 - Instructional Management*. Orlando, FL: U.S. Army Research Laboratory. ISBN 978-0-9893923-3-4. Available at: https://gifttutoring.org/documents/

[13] De Grave, W. S., Dolmans, D. H. J. M., & van der Vleuten, C. P. M. (1999). Profiles of effective tutors in problem-based learning: Scaffolding student learning. *Medical Education*, *33*, 901–906.

[14] Graesser, A. C., Bowers, C. A., Hacker, D. J., & Person, N. K. (1997). An anatomy of naturalistic tutoring. In K. Hogan, & M. Pressley (Eds.), *Scaffolding student learning: Instructional approaches and issues* (pp. 145-184). Cambridge, MA: Brookline Books.

[15] Graesser, A. C., Person, N. K., & Magliano, J. P. (1995). Collaborative dialogue patterns in naturalistic one-to-one tutoring. *Applied Cognitive Psychology, 9*(6), 495-522.

[16] Lepper, M. R., Drake, M. F., & O'Donnell-Johnson, T. (1997). Scaffolding techniques of expert human tutors. In K. Hogan & M. Pressley (Eds.), *Scaffolding student learning: Instructional approaches and issues* (pp. 108-144). Cambridge, MA: Brookline Books.

[17] Ohlsson, S., Di Eugenio, B., Chow, B., Fossati, D., Lu, X., & Kershaw, T. (2007). Beyond the code-and-count analysis of tutoring dialogues. In AIED 2007, the *13th International Conference on Artificial Intelligence in Education*.

[18] Morrison, D. M., Nye, B., Samei, B., Datla, V. V., Kelly, C., & Rus, V. (2014). Building an intelligent pal from the tutor.com session database-phase 1: data mining. In Stamper, J., Pardos, Z., Mavrikis, M., McLaren, B.M. (Eds.) Proceedings of the 7th International Conference on Educational Data Mining, 335-336. Available at: http://educationaldatamining.org/EDM2014/index.php?page=proceedings.

[19] Drachsler, H. Hummel, H. G. K. , Koper, R. (2007) Recommendations for learners are different: Applying memory-based recommender system techniques to lifelong learning. *Information Systems Journal*, *235*, 18-26. Available at http://infolab-dev.aua.gr/sirtel2007/papers/Drachsler_et_al.pdf

[20] Manouselis, N., Drachsler, H., Vuorikari, R., Hummel, H., Koper, R. (2011). Recommender systems in technology enhanced learning. Kantor, P., Ricci, R. Rokach, L., Shapira, B. (Eds.). *Recommender Systems Handbook* (pp 387 – 409). Springer: New York. Available at http://dspace.ou.nl/bitstream/1820/3086/1/RecSys_Handbook-preliminary_version.pdf.

[21] Verbert, K., Manouselis, N., Ochoa, X., Wolpers, M., Drachsler, H., Bosnic, I., & Duval, E. (2012). Context-aware recommender systems for learning: a survey and future challenges. *IEEE Transactions in Learning Technologies*, *5*, 318 – 335). Available at https://lirias.kuleuven.be/bitstream/123456789/338644/3/.

[22] Freed, M., Yarnell, L., Dinger, J., Gervasio, M., Overholtzer, A., Perez-Sanagustin, Roschell, J., & Spaulding, A. (2014). PERLS: An approach to pervasive personal assistance in adult learning. *Proceedings of the Interservice/Industry Training,Simulation, and Education Conference (I/ITSEC)*.Orlando, FL.

[23] Van Der Sluijs, K. & Houben, G. (2006). A generic component for exchanging user models between web-based systems. *International Journal of Continuing Engineering Education and Lifelong Learning*, *16*, 64 – 76.

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AUTOTUTOR IN THE CLOUD: A SERVICE-ORIENTED PARADIGM FOR AN INTEROPERABLE NATURAL-LANGUAGE ITS

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***Abstract**: Artificial intelligence has been used to power conversational tutoring systems since the early days of the field. Despite this longstanding research focus, scalable conversational intelligent tutoring systems have encountered significant challenges for both tutoring delivery and developing conversational tutors. AutoTutor, a longstanding intelligent tutoring system (ITS) project for natural language tutoring, has approached these challenges. This paper describes three facets of AutoTutor services: the AutoTutor Conversation Engine (ACE), AutoTutor Authoring Tools (ASAT), and the Sharable Knowledge Objects (SKO) framework. This framework combines intelligent tutoring, semantic analysis, and service-oriented patterns to provide natural language computer tutoring. Compared to existing natural language tutoring systems, this design pushes the bounds for delivering conversational tutoring as a service, authoring natural-language tutoring scripts, service-oriented semantic messaging with roots in the Experience API (xAPI) and Foundations for Intelligent Physical Agents (FIPA) standards, and integrating with other systems such as virtual worlds and web clients. Innovations in each of these areas will be reviewed briefly. Integration and scalability challenges are also discussed.*

***Keywords:** Intelligent Tutoring Systems; Natural Language Processing; Authoring Tools; Service Oriented Architectures; Semantic Messaging; Scalability*

I. INTRODUCTION

Research on conversational intelligent tutoring systems (ITSs) has been ongoing since at least the SCHOLAR system [1]. There have been successes for this area over the last decade: AutoTutor [2], WHY2/Atlas [3], Oscar [4], and others have shown substantial learning gains for students. Overall, learning gains for ITSs have averaged about 0.76σ compared to controls [5]. However, despite these successes, few ITSs have made the jump to wider adoption and commercial ITSs seldom use natural language conversation. As Massively Open

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Online Courses (MOOC's) grow rapidly and learning management systems like Moodle expand beyond 60 million users [6], there are clear opportunities for ITSs in the new educational environment. These large scale web-based systems cause student-to-teacher ratios to jump by orders of magnitude, creating a pressing need for intelligent systems that provide individualized adaptation and tutoring.

ITSs can add great value as online learning technologies: they can provide automated assessment, personalized and adaptive content sequencing, and individual one-on-one computer tutoring for a learner working on a learning activity. Unfortunately, tutoring systems were not originally designed to be embedded into a MOOC like a YouTube video or to wrap existing web content like a mashup. More than a decade ago, the monolithic design patterns for ITSs were referred to as "application islands," and the majority of ITSs still fall into this mold [7]. Tutoring systems need to transition away from self-contained applications and toward interoperable services that can enhance and consume a variety of other educational technologies.

Interoperability is necessary for long-term scalability and sustainability. Interoperability impacts scalability from two directions: 1) Research and development and 2) Optimizing and distributing processing. First, lack of interoperability centralizes research and hinders development. A recent review of literature found that one-third of a systematically-collected set of 815 ITS papers covering 2009-2012 were developed by just 12 groups [8]. Developing an effective ITS requires different types of expertise (computer scientists, cognitive scientists, education researchers, content specialists, etc.), so the inability to share "parts" of an ITS creates a barrier to innovation by smaller groups and individual researchers. At a high level, researchers largely agree about the functionality of an ITS. VanLehn [9] described a common set of functionality for ITSs, which outlines a de-facto ontology for the behaviors of an intelligent tutor. The roadblock for interoperability often lies in how the modules are carved up: one system may combine hint-selection and hint-generation in a single module, while a second system combines hint-selection and affect-modeling instead. Researchers agree what an ITS does, but not where or how. This hinders traditional service composition patterns.

Second, distinct and interoperable modules facilitate computational scalability. The capability to easily substitute web services allows developers to design domain-specific or application-optimized variants. This also facilitates load-balancing and other essential capabilities for an intelligent system intended to interact meaningfully with a large number of users. Particularly for conversational tutoring, scaling up is non-trivial. A computer tutor that can productively talk with one student will not necessarily survive a MOOC with 10,000 active students. For large-scale applications, the ability of an intelligent tutoring agent to do more with less natural language processing becomes important. There are empirical questions about how shallowly an agent can process learner text, while still making effective pedagogical decisions. This is particularly important for large-scale ITSs and mobile applications, which are limited by CPU cycles, battery life, and network bandwidth.

This paper describes how AutoTutor has approached interoperability and scalability issues, moving from a traditional ITS model (e.g., standalone applications) toward a service-oriented model for natural language tutoring. Three components of the AutoTutor environment are discussed: the AutoTutor Conversation Engine (ACE), the AutoTutor Authoring Tools (ASAT), and the Sharable Knowledge Objects (SKO) framework for cloud-based storage, delivery, and message-passing for tutoring. The AutoTutor Conversation Engine implements the core dialog engine for AutoTutor, which has been under development for over a decade [2,10]. This engine is domain-independent and ITSs using this system have produced an average learning gain of about 0.8σ (e.g., nearly one letter-grade improvement) across domains such as computer literacy, physics, and research methods. ASAT refers to the authoring tools used to create *tutoring scripts* and other supporting data (SKOs), which are consumed by the conversation engine. Finally, the Sharable Knowledge Object framework refers to both a service-oriented system for coordinating tutoring using real-time semantic messaging and also a repository of portable tutoring objects (SKOs) created using ASAT.

While earlier papers on AutoTutor have focused primarily on the conversation engine and its applications, this paper highlights the underlying technologies, platforms, and standards. Key developments in these areas include a web service for the AutoTutor Conversation Engine, cloud-based and collaborative authoring tools, and a SKO semantic messaging framework which incorporates elements of the xAPI (Experience API) and FIPA (Foundation for Intelligent Physical Agents) standards [11,12]. The goal of each advance has been communication. Tutoring systems cannot be islands. They need to share services (interoperability), share tutoring scripts (collaborative authoring), and share learning data (contribute to cross-system learning record stores).

AutoTutor Conversation Engine (ACE)

The AutoTutor Conversation Engine (ACE) manages natural language tutoring sessions. ACE implements a customizable production rule system for dialog transitions, a speech act classifier, and a semantic inference evaluator that computes the quality of individual student statements and also compares the accumulated language contributions (e.g., all assertions about a topic so far) to ideal answers from experts. An AutoTutor intelligent tutor is formed when ACE is integrated with a user interface and with a set of tutoring script SKOs that drive the tutoring interactions. Using different production rule sets, AutoTutor can implement a variety of tutoring strategies, often focused on helping students explain the answers to deep reasoning questions [2]. A core learning principle behind AutoTutor is explanation, which has been shown to improve learning gains and result in deeper learning [2,10,13]. AutoTutor provides highly-effective tutoring and has passed a bystander Turing test [2], where observers reading human tutor and AutoTutor tutoring turns could not reliably tell the difference.

AutoTutor is reviewed in detail by prior papers (e.g., [10]), which the reader can refer to for extensive details on the learning principles and pedagogy behind the system. Because ACE can run arbitrary rule-sets, it is not limited to a finite set of tutoring styles. However, three commonly-used tutoring strategies will be explained as examples: expectation-misconception tailored dialog, self-reflection questions, and vicarious tutoring. Expectation-misconception tailored dialogs start with a deep reasoning question by the tutor and scaffold the learner to cover all the main ideas of an ideal complete answer [2,10]. The full answer is broken down into expectations and misconceptions. Expectations each represent a main idea the student must state and misconceptions represent archetypal bad answer types that indicate particular misunderstandings. If the student cannot complete the full explanation for the main question, AutoTutor focuses on each incomplete expectation and asks hints (leading questions) and prompts (fill-in-the-blank type questions) to help them, while providing positive and negative feedback based on the quality of the learner's response. If a misconception is detected, AutoTutor can correct it using short feedback and also ask hints that help remedy the misconception. Expectation-misconception tailored tutoring is a primary strategy for AutoTutor, so script rules have special conditions available that make it easier to implement.

A second strategy is self-reflection, where the students are asked to summarize material they recently learned. Depending on how many of the concepts they cover in their summary, AutoTutor can provide pumps (e.g., "Anything else?") or hints to help them recall more. A third strategy is vicarious tutoring: multiple agents talking with each other. Vicarious tutoring follows patterns similar to another tutoring style (e.g., deep reasoning questions), but the computer student answers questions that the human student would have answered. Vicarious tutoring is particularly effective for low-knowledge students, who need to establish basic knowledge [14]. Other strategies are also used with significant frequency, ranging from collaborative lectures (explanations by the tutor, punctuated by short explanations) to teachable agents (computer students who ask the learner to explain concepts).

Figure 1: Examples of AutoTutor User Interfaces for Learners Supported by ACE (Left to right: AutoTutor for CSAL, Operation ARIES, V-CAEST)

ACE supports a single learner with an arbitrary number of computer agents whose utterances are selected by a single conversation script. Recent versions of AutoTutor typically use trialogs, where a computer tutor and a computer student play different roles to help the human student learn the material [15]. Using multiple agent roles is important for presenting feedback (e.g., student agents can be less formal), inducing productive confusion (e.g., two computer agents can disagree), and presenting narratives (e.g., a backstory built-in to the tutoring). The presentation and number of agents is not handled by ACE, but by clients such as HTML5 interfaces, Flash talking heads, or virtual worlds. Representative user interfaces are shown in Figure 1. The left image shows the Center for the Study of Adult Literacy (CSAL) tutor, which uses an HTML5 client and Flash talking heads. In the middle, Operation ARIES shows a desktop-based interface [15]. On the right, V-CAEST (Virtual Civilian Aeromedical Evacuation Sustainment Training) is a Unity virtual world for training medical triage and evacuation [16]. V-CAEST uses a Flash-based interface (www.skoonline.org) called AutoTutor Lite [17] that originally used a simplified ACE engine, but that now can use the full ACE engine as well.

While the dialog content and expected answers for tutoring scripts are domain-specific, the rules for strategies are based on domain-independent speech acts (e.g., good answers, bad answers) and speech act classifications (e.g., detecting metacognitive statements, such as “I don’t know”). The semantic processing in ACE implements pattern matching (e.g., regular expressions) and semantic similarity (latent semantic analysis [18], nearest-neighbor semantic match scores, and others), which can calculate measures of similarity between any two statements [2,10]. Rather than treating all words equally for similarity, ACE also applies inverse frequency weighting: matching uncommon words (e.g., “semantic”) carries more weight than matching common words (e.g., “the”). This approach for comparing student answers against ideal answers has shown high reliability with human raters across multiple domains [2,10]. ACE uses this semantic analysis to interpret student responses, such as their coverage of expectations (ideal answers) or specific misconceptions they have expressed. After the tutoring interpreter decides what (if anything) the agents should say, a message is sent to a client service, which talks to the student through either an animated agent and/or a chat window. The basic input-output functionality of ACE allows loading/ending a tutoring script, sending input to the system from the learner, and sending utterances for a particular agent to say to the learner. When a tutoring script is loaded, a unique session id is returned, which is used by all communication until the script is complete (which terminates the session) or the session times out. Human input is captured using text input or, less commonly, voice-to-text input [19]. While output utterances are mostly text, they may also include markup to produce non-verbal cues (e.g., smiles, waves) or utterances (e.g., throat-clearing, laughter) to present using animated agents. In addition to natural-language discourse as input and output, ACE can also receive and transmit named world events to the client's learning environment (e.g., a web page or a virtual world). An example of this functionality is seen in AutoTutor for the ongoing Center for Adult Literacy (CSAL) project, where learners may be unable to type certain answers due to their low level of literacy. In that case, HTML buttons and interactive images trigger events that are sent to ACE (e.g., "Please click which part of the medicine label talks about how much to use"). In return, ACE can send world events that trigger changes in the environment (e.g., highlighting a correct choice). In all interactions, ACE is mixed-initiative. That is, it can respond to human input or initiate interaction with a user based on events or timers. The latter case is frequently used by scripts designed to handle inattentive learners: if the human says nothing for too long, the tutor will pump for information (e.g., "Please try to answer and we'll work from there").

For web-based clients, an implementation of ACE called AutoTutor Web Services (ATWS) has been developed. This service has both a REST (Representational State Transfer) endpoint and a SOAP (Simple Object Access Protocol) endpoint based on WSDL (Web Services Definition Language). This service currently runs behind multiple AutoTutor-based tutors. In addition to the web-service, ACE has been bundled into desktop-based tutors. ACE has also been integrated as a service into the recent releases of the Army Research Lab's Generalized Intelligent Framework for Tutoring (GIFT) system [20,21]. In general, the move toward a service-oriented framework has made this type of integration straightforward and vastly simpler than earlier desktop-centric versions.

II. AUTOTUTOR AUTHORING TOOLS (ASAT)

AutoTutor Authoring Tools (ASAT) are the collection of authoring tools used to create AutoTutor tutoring scripts and other data stored as Sharable Knowledge Objects (SKOs), which will be discussed later. For much of

AutoTutor's development, a desktop-based authoring tool was used to design tutoring scripts [2]. This single tool was referred to as ASAT. However, this paper deviates from that naming convention because new authoring needs have resulted in tools that address different authoring use-cases.

The original ASAT desktop authoring tool discussed in prior papers will be referred to as ASAT-Desktop (ASAT-D), to prevent confusion. Three newer authoring tools complement ASAT-D and are being actively developed: 1) A web-based authoring tool (ASAT-W) developed for the Flash-based AutoTutor interface, 2) a visual authoring tool (ASAT-V) for authoring tutoring script production rules using a flow-chart interface, and 3) a form-based (ASAT-FB) tool for authoring dialog content but not production rules.

Figure 2 shows a screenshot for each of these tools. Due to space limitations, it is impossible to describe all the functionalities of each tool in detail. Instead, this section will focus on the role of each authoring tool in the authoring process. ASAT-D remains the primary AutoTutor authoring tool and provides powerful authoring functionality for creating all parts of a tutoring script for AutoTutor. ASAT-D can author conversational rules that guide the tutoring, domain-specific pedagogical dialog (e.g., questions, expectations, hints, prompts), representative good/bad answers, speech-act classifiers based on pattern matching, canned speech acts for common response types (e.g., a dozen ways to give positive feedback), and agent descriptions (e.g., names, roles) for the tutoring agents in a dialog. ASAT-D also provides analytics such as visualizing the state transition network created by the conversation rule logic.

While ASAT-D simplifies the authoring process so that non-programmers can quickly produce tutoring scripts, authoring high-quality and reusable scripts often requires experienced authors. A recent paper describes the functionality of ASAT-D in detail [22]. The output of ASAT-D is either an AutoTutor tutoring script or template.

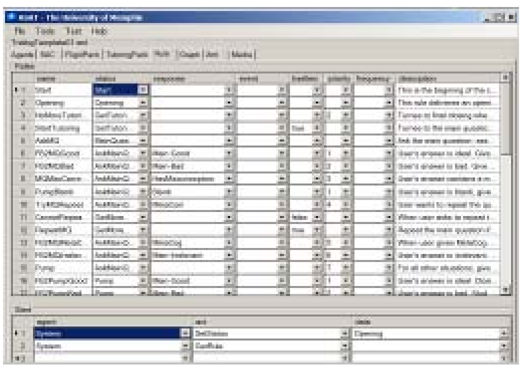

Figure 2.A.: ASAT-D (Desktop)

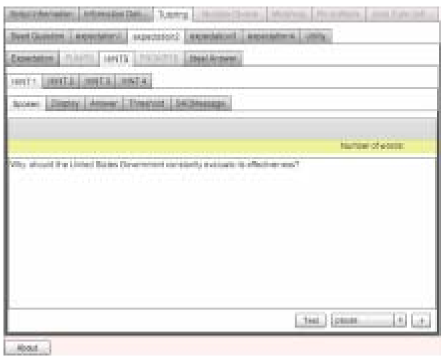

Figure 2.B.: ASAT-W (Web-Based)

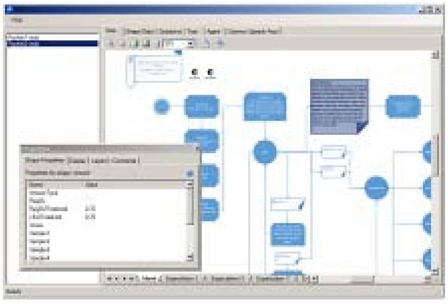

Figure 2.A.: ASAT-D (Desktop) **Figure 2.B.:** ASAT-W (Web-Based)

Figure 2: Interfaces for ASAT Tools

ASAT-W (Web-based) was designed to enable collaborative web-based authoring. While ASAT-D saves scripts to a computer file system, ASAT-W is accessed through a browser and saves Sharable Knowledge Objects (SKOs) to a repository designated by the configuration of the ASAT-W interface. Logins are handled using open authentication and each user has specific ownership and editing rights for given SKOs in the repository. ASAT-W SKOs cover a wider range of content than just tutoring scripts. Different types of content, such as multiple-choice questions, can be authored. Additionally, each SKO can contain additional metadata related to a tutoring script, such as which animated agents should be displayed by the interface and sequencing information (e.g., which SKO should be loaded when the current one finishes). However, ASAT-W is currently less user-friendly than ASAT-D for authoring advanced tutoring script features, such as production rules that determine dialog transitions.

Finally, two new authoring tools are being developed and tested. ASAT-FB (Form-Based) is a tool suite for integrating tutoring into existing web-based content [23, 24]. While previous tools have focused mainly on a single-author process, ASAT-FB considers the authoring process as a workflow, where authors with different expertise (e.g., programmers, domain experts) use different authoring tools. As such, ASAT-FB provides a user-friendly interface for authoring tutoring script content (e.g., questions, expectations, hints) only, which can be integrated into rule templates designed in ASAT-D or ASAT-W. The second emerging tool, ASAT-V (Visual), makes the rule-authoring process easier by visualizing conversational transitions as an editable flow-chart. ASAT-V is a plug-in that lets authors create tutoring strategies and rule-based transitions that are displayed as shapes and directed links. Currently ASAT-V is implemented as a

Microsoft Visio plug-in, but additional plug-ins (e.g., for open-source equivalents to Visio) are being considered.

III. SHARABLE KNOWLEDGE OBJECTS (SKOs)

SKOs are portable data containers describing tutoring script data and associated resources required to run the script. The design of SKOs has conceptual underpinnings in Sharable Content Objects (SCOs) from the SCORM® standard [25]. More recently, a framework for SKOs has extended this concept to a service-oriented paradigm. In this perspective, the object contains data that a specific service (i.e., the client session) consumes and communicates to other services to deliver interactive tutoring. This object contains domain knowledge relevant to its tutoring focus, which may include messages sent to or received from available services. Essentially, each SKO is a micro-domain for tutoring. These objects are sharable in that they can be authored in the cloud, shared by reference (i.e., permissions-based sharing for both tutoring and authoring), or explicitly copied to a separate repository.

The SKO framework has three core pieces: the SKOs themselves (e.g., data related to a tutoring session), the SKO storage repository (e.g., where SKOs are stored), and the SKO semantic messaging system (e.g., how SKOs communicate with other services). The SKOs carry data related to a tutoring dialog in a serialized form (either XML or JSON). The contents of a SKO typically include an ASAT-compatible tutoring script, which may be a complete script (e.g., ready to send to ACE) or a reference to a script template with accompanying data in the SKO that can complete that template. While SKOs tend to contain tutoring script information, they can also store information about other interfaces such as multiple choice questions. In general, a SKO contains sufficient information for a client with appropriate services to present a given task. SKOs are stored in cloud-based repositories (currently Google App Engine or Amazon EC2) where they can be accessed for display or editing. Depending on the repository, the SKOs may also be versioned (e.g., prior versions can be restored).

The SKO framework is designed for modular services communicating through semantic messages. The structure of messages was based on two established specifications: the FIPA (Foundation for Intelligent Physical Agents) agent message and speech act standards [12] and the Advanced Distributed Learning xAPI (Experience API) learning record store (LRS) messages [11]. Table 1 notes the fields for the SKO message structure, with their origin and meaning noted. These two formats are complementary: FIPA offers generic, content-agnostic agent communication (e.g., for coordinating distributed web agents), while xAPI messages specifically broadcast and track learning experiences (e.g., "John completed Test1 and the result was 86"). Unifying these formats makes sense for ITS services, which direct, interact with, interpret, and record learning experiences. Ad-hoc optional context data may also be added to each message. While SKO services communicate using semantic messages like an agent communication language, no hard assumptions are made about service behavior or internal structures, such as goals or beliefs (i.e., those parts of the FIPA standard are not assumed to constrain messaging).

Table 1: SKO Message Structure

Parameter	Description
id	Message GUID (xAPI)
actor (content)	Actor described (xAPI)
verb (content)	Verb actor did/does (xAPI)
obj (content)	Target of action (xAPI)
result (content)	Result of action (xAPI)
timestamp	Time message created (xAPI)
context	Key-value map for extra data (xAPI)
speechAct	Purpose of message (FIPA)
conversation-id	GUID for conversation (FIPA)
reply-with	Message template for reply (FIPA)
in-reply-to	Message template replied to (FIPA)
reply-by	Latest time a reply is needed (FIPA)
language	Representation for content (FIPA)
ontology	Ontology for content (FIPA)

SKO messages are a subset of FIPA and a superset of xAPI (which effectively only considers "Inform"/HTTP PUT and "Request"/HTTP GET speech acts). In practice, the semantic content used to interpret most SKO messages is contained in the *speech act* (performative), *actor*, *verb*, *object*, and *result*, while the remaining fields provide context (e.g., a conversation session id). These messages can be used to record learning experiences (e.g., Inform: John, Answered, Question1, Wrong) or trigger actions by services (e.g., Request: Question1, Present, John, null). Most FIPA fields are retained, except that fields about message participants (i.e., *sender*, *receiver*, and *reply-to*) and the generic *content* field are removed. Sender and intended receiver information can still be included, but are not treated specially compared to any other fields sent in the context parameter. xAPI content parameters replace the generic *content* field, facilitating communication with learning record stores. For example, most SKO "Inform" and "Request" messages can easily be translated to and from the xAPI format by moving any FIPA-based fields into the xAPI *context* field. SKO messages were created for two reasons. First, the FIPA fields are good for run-time coordination: messages have *conversation-id* values, to group messages about a distributed event, and have *speech acts* about why a message was sent ("Not Understood", "Inform", "Disconfirm", etc.). Second, xAPI fields reflect learning activities more effectively than an unstructured *content* field.

Semantic messages enable the design of anonymous services. This means they do not need knowledge of the state, functions, or even the existence of any other *specific* service or class of service. This is accomplished by connecting services to generic gateways that connect to a network of services. Individual services are effectively "secret" (i.e., have no address for a direct message). This network of services may include web-services, services in the same process, services in cross-domain browser frames, or elsewhere. The guiding principle for this design was arbitrary composition of services: services require no awareness of the topography or internal structure of the services that consume the messages it produces. Services only know that they have produced messages and, in turn, received messages with certain content (or received no response, alternatively). Combined with semantic messaging, the constraint that services remain anonymous allows developing services that exclusively focus on the content of the messages that they send and receive. This paradigm decouples the design of a service from the network topography and granularity of other services. Services can send and receive messages from a gateway in the same process. Gateways form an undirected acyclic graph and propagate messages through this graph, mediating communication and establishing the service topography. For low-volume applications, gateways can dispatch messages using a fan-out policy, letting individual services ignore irrelevant messages. For larger scale systems, each service can submit necessary conditions to its gateway for receiving a message, enabling the gateways to relay messages based on their semantic content. This is similar to publish-and-subscribe, except distribution is based on each message's semantic content, rather than requiring the creation of a separate set of topics to determine message subscriptions. This approach solves much of the problems underlying ITS interoperability, by decoupling where services exist (gateways) from what services do (messages processed and generated). While not all implementations of the SKO framework use anonymous services yet, this design is incrementally replacing direct service-to-service messaging.

Related Work and Future Directions

AutoTutor's move toward standards-based service-oriented computing is one effort within a larger push toward ITS interoperability. The Generalized Intelligent Framework for Tutoring (GIFT) architecture is a parallel effort by the Army Research Lab, which uses point-to-point message passing between services [20]. A collaboration to improve communication between SKO and GIFT services is currently underway [21]. An additional unrelated effort is combining the functionality of the ASSISTments system and Wayang Outpost [26], two other well-established ITS. Since all three projects seek to increase interoperability, each line of research is inherently complementary.

A continuing direction of this work has focused on optimizing natural language tutoring to address scalability issues. Natural language tutoring adds two bottlenecks compared to other ITS: semantic processing and speech synthesis. In many ways, speech synthesis is significantly harder. While synthesizing low-quality speech is fairly trivial, synthesizing and streaming high-quality speech is computationally taxing. While this project has found workarounds, such as caching pre-generated speech, speech synthesis has inherent tradeoffs between quality, scale, and cost. On the other hand, semantic processing for tutoring systems appears to be readily optimized, at least for a system such as AutoTutor. Recent related work identified an effective technique for using nearest neighbors to evaluate the similarity between semantic spaces, across a variety of encodings [16]. This approach can be used to automate the creation of sparse semantic spaces that provide near-equivalent inferences to the original spaces. As noted earlier, each SKO module contains the domain knowledge (e.g., expectations, misconceptions, answers to hints) for that particular tutoring dialog. As such, semantic processing only needs sufficient depth to evaluate student responses compared to that highly constrained micro-domain and associated terms. These techniques should be able to reduce semantic spaces for a SKO to a sufficiently small size that they might be directly bundled with the SKO, which could allow semantic processing to occur entirely in the client (e.g., web-browser or mobile phone). Lightweight, domain-specific natural language processing that can be evaluated client-side would resolve one of the major challenges for scaling up natural-language understanding.

Continuing research directions include developing and comparing the effectiveness of different tutoring strategies in AutoTutor, with respect to learner outcomes (e.g., learning gains, affect, attitudes toward future learning). The AutoTutor framework has acted as a testbed for this type of research for over fifteen years and the ability to compare different tutoring script templates is a new direction for this research. Finally, research on authoring workflows and collaborative authoring is continuing. Due to the complexity of authoring tool research and relative lack of maturity as a topic, many fundamental theoretical questions (e.g., "How do we operationalize a 'good' authoring tool?") and pragmatic questions (e.g., "What features do specific author types want in a tool?") remain unanswered. By focusing on communication and sharing of services and tools, insights should be gained into how this new generation of service-based ITS can be developed and maintained.

Acknowledgements

Research related AutoTutor and Shareable Knowledge Objects has been supported by numerous sponsor grants, including the Office of Naval Research (N00014-12-C-0643), Army Research Lab (N00014-12-C-0643), National Science Foundation (0325428, 633918, 0834847, 0918409, 1108845, 0834847, 0904909, 0918409, 1108845), Educational Testing Service, Institute of Education Sciences (R305A080594, R305G020018, R305C120001), and the Advanced Distributed Learning Initiative. The statements and views in this paper are the views of the authors alone.

References

[1] Carbonell, J. R., 1970. AI in CAI: An artificial-intelligence approach to computer-assisted instruction. *IEEE Transactions on Man-Machine Systems, 11*(4), 190–202.

[2] Graesser, A., Chipman, P., Haynes, B., Olney, A., 2005. AutoTutor: An intelligent tutoring system with mixed-initiative dialogue. *IEEE Transactions on Education* 48(4):612–618.

[3] Vanlehn, K., Graesser, A. C., Jackson, G. T., Jordan, P., Olney, A., Rosé, C. P., 2007. When are tutorial dialogues more effective than reading? *Cognitive Science* 31(1):3–62.

[4] Latham, A., Crockett, K., McLean, D. 2014. An adaptation algorithm for an intelligent natural language tutoring system. *Computers & Education* 71:97–110.

[5] VanLehn, K. 2011. The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist* 46(4):197–221.

[6] Moodle. 2013. Moodle statistics. moodle.org/stats/. Retrieved March 25, 2014.

[7] Roschelle, J., Kaput, J., 1996. Educational software architecture and systemic impact: The promise of component software. *Journal of Educational Computing Research* 14(3):217–228.

[8] Nye, B. D., 2013. ITS and the digital divide: Trends, challenges, and opportunities. In Lane, H. C., Yacef, K., Mostow, J., & Pavlik, P., eds., *Proceedings of Artificial Intelligence in Education 2013*. Springer, Berlin. 503–511.

[9] VanLehn, K. 2006. The behavior of tutoring systems. *International Journal of Artificial Intelligence in Education* 16(3):227–265.

[10] Graesser, A. C., D'Mello, S. K., Hu, X., Cai, Z., Olney, A., and Morgan, B., 2012. AutoTutor. In McCarthy, P. M., and Boonthum, C., eds., *Applied natural language processing and content analysis: Identification, investigation and resolution*. IGI Global, Hershey, PA. 169–187.

[11] Advanced Distributed Learning, 2013. xAPI technical specification. www.adlnet.gov/tla/experience-api/technical-specification/.

[12] FIPA, 2013. FIPA ACL message structure specification. www.fipa.org/specs/fipa00061/SC00061G.html.

[13] Chi, M. T., De Leeuw, N., Chiu, M. H., LaVancher, C., 1994. Eliciting self-explanations improves understanding. *Cognitive Science*, 18(3), 439-477.

[14] Craig, S. D., Gholson, B., Brittingham, J. K., Williams, J. L., Shubeck, K. T. 2012. Promoting vicarious learning of physics using deep questions with explanations. *Computers &. Education, 58*(4):1042–1048.

[15] Millis, K., Forsyth, C., Butler, H. A., Wallace, P., Graesser, A. C., and Halpern, D. F., 2011. Operation ARIES! a serious game for teaching scientific inquiry. In Ma, M., Oikonomou, A., and Lakhmi, J., eds., *Serious Games and Edutainment Applications*. Springer, London, UK. 169–195.

[16] Hu, X., Nye, B. D., Gao, C., Huang, X., Xie, J., Shubeck, K. (In Press). Semantic representation analysis: A general framework for individualized, domain-specific and context-sensitive semantic processing. In *Proceedings of Human-Computer Interaction International 2014.*

[17] Hu, X., Cai, Z., Han, L., Craig, S. D., Wang, T., Graesser, A. C., 2009. AutoTutor Lite. In *Proceedings of Artificial Intelligence in Education 2009*. IOS Press, Amsterdam, 802.

[18] Landauer, T. K., Foltz, P. W., and Laham, D., 1998. An introduction to latent semantic analysis. *Discourse Processes* 25(2-3):259–284.

[19] D'Mello, S. K., Dowell, N., & Graesser, A. C.. 2011. Does it really matter whether students' contributions are spoken versus typed in an intelligent tutoring system with natural language? *Journal of Experimental Psychology: Applied, 17*(1), 1-17.

[20] Sottilare, R. A., Goldberg, B. S., Brawner, K. W., Holden, H. K., 2012. A modular framework to support the authoring and assessment of adaptive computer-based tutoring systems (CBTS). In *Proceedings of I/ITSEC* 2012.

[21] Nye, B. D. 2013. Integrating GIFT and AutoTutor with Sharable Knowledge Objects (SKO). In Sottilare, R. A., and Holden, H. K., eds., *AIED 2013 Workshop on GIFT*. CEUR, 54–61.

[22] Cai, Z., Li, H., Nye, B. D., Hu, X., Graesser, A. C., In Press. ASAT: An AutoTutor script authoring tool for intelligent tutoring conversations. In *Intelligent Tutoring Systems 2014 Workshop on Authoring Tools*.

[23] Nye, B. D., Rahman, M. F., Yang, M., Hays, P., Cai, Z., Graesser, A., Hu, X., In Press. A tutoring page markup suite for integrating shareable knowledge objects (SKO) with HTML. In *Intelligent Tutoring Systems 2014 Workshop on Authoring Tools*.

[24] Nye, B. D., Yang, M., Hays, P., Silva-Lugo, R., Cai, Z., Rahman, M. F., Hu, X., Graesser, A. C., In Press. Rapid, form-based authoring of natural language tutoring trialogs. In *The Second GIFT Symposium (GIFTSym2)*.

[25] Advanced Distributed Learning, 2004. SCORM. scorm.com/scorm-explained.

[26] Worcester Polytechnic Institute, 2013. Collaborating to build a better online math tutor. *Research at Worcester Polytechnic Institute - Fall 2013* 42.

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Volume 2, Number 6, 2014
JADLET Journal of Advanced Distributed Learning Technology

REDISCOVERING THE EIGHTFOLD PATH: SOME OBSERVATIONS ON PLANNING AND DELIVERING TECHNOLOGY-BASED TRAINING IN AFGHANISTAN

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***Abstract**: In developed countries, content delivery and selection of simulation technologies is based on intended use, planned content and resources available. In these settings, choices of simulation for training or competency assessment are usually only limited by time, expertise and resource availability. However, in failed state settings such as Afghanistan the use of specific technologies, the availability of support infrastructure, and cultural considerations (including baseline educational skills) are a factor in selection and use, as the available approaches to the delivery of content and use of simulation for training, education and assessment may be limited by the circumstances of place. This situation results in unique challenges to the provision of education and the rebuilding of training and educational institutions, with occasional novel solutions to defined obstacles to effective training and competency assessment. Examples discussed range from purely cultural (such as Dari having one word and related concept for the English equivalents of Task, Job and Occupation), a consideration which has significant impact on initial training and subsequent assessment of individual capability, to more technically complex issues. This paper will discuss a sample of the lessons learned in training delivery and assessment of student capabilities for the Afghan National Police. The information included is drawn from a combination of onsite personal observation in Afghanistan by the author between July 2013 and March 2014, Training Assessment Team reports for training conduct before and after handover to local authorities by the NATO Training Mission – Afghanistan (NTM-A) for the 13 enduring Provincial Training Centers, interviews with staff from NTM-A, the European Union Police Mission in Afghanistan (EUPOL), German Police Project Team (GPPT), the International Police Coordination Board (IPCB), and relevant findings from the NATO lessons learned repository for that same period. This information was collected during the final nine months of the Canadian contribution to the International Security Assistance Force (ISAF).*

***Keywords:** Individual Training; Content Delivery; Competency Assessment.*

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I. INTRODUCTION AND HISTORICAL BACKGROUND – PROFILE OF THE STUDENT AUDIENCE FOR POTENTIAL TRAINING AND EDUCATION PROGRAMS

The people of Afghanistan have endured political and economic instability since 1973, compounded by severe repression, open warfare, occupation and insurgency since 1979 [1]. As a result, a significant percentage of two living generations of adult Afghans are functionally illiterate and innumerate, circumstances compounded by the majority of Afghan society being largely village based and ethnically oriented on the basis of language, religion and tribal culture. This situation adversely impacts creation and maintenance of a sustainable, appropriately educated workforce. It was made worse by the loss or maiming of fighting aged males (in their late teens to early 30s) during the Soviet occupation and the later conflict between NATO and the Taliban from 2001 to approximately 2011. These conditions resulted in significant gaps in the working population, as until recently, the Taliban-imposed, predominantly conservative culture restricted the socially acceptable roles of women in Afghanistan. The combined impact of a traditional isolationist attitude and a shortage of able-bodied workers acceptable to a conservative society have resulted in Afghanistan's slow economic and societal recovery. Further, aside from providing a measure of stability, the presence of NATO and various Non-Government Aid Agencies (NGOs) during the last 14 years has changed the expectations of the most recent generation of working-age Afghans by providing access to modern communications technology and to the internet, particularly in major centers such as Mazar al Sharif, Herat, Kandahar and Kabul. This latest generation has been exposed to a blend of cultures and values that conflict with those of their more traditional elders, adding an element of friction within family groups. Further, although this generation is somewhat westernized, most members of Afghan society possesses only a limited ability to compare aspects of other cultures favorably against its own due to the barriers of religiously and culturally isolated frames of reference. The lack of a common language with and understanding of cultural values originating outside of Afghanistan restricts the ability of individual Afghans to interpret the personal impact of world events for themselves and learn about the world outside of their immediate social environment, further contributing to isolation of the Afghan people.

Educating the local population in planning and delivering instruction (including the ability to deliver forms of content-appropriate simulation to support needed skills training and education) is an important factor in rebuilding such societies. Developing this capacity was a critical consideration in the planning for stability operations by the NATO Training Mission - Afghanistan (NTMA) [2].

Promotion and support of the education and training of citizens of failed states in a process of economic and social recovery allows such societies to begin to address their own needs. Demonstration and use of effective, content and culturally appropriate methods to deliver training and educational content to the population as, where and when required promotes re-creating the set of social, economic and intellectual institutions required to support a stable and thriving society [2]. Provision of effective education and evaluation for needed job-related skills and knowledge from outside the affected society leads to formal, common benchmarks for accreditation, and creation of self-sustaining Communities of Practice. These Communities of Practice in turn promote use of effective, efficient delivery for relevant educational content. This process assists the citizens of the recovering state to create an island of stability for themselves in an uncertain geopolitical environment. Further, supporting this activity permits the stable cultures of the contributing developed nations[1] to significantly reduce potential threats to national security by supporting these states to become functional members of a world community.

Education of the current generation is a priority for Afghans and for the international community. The question of how to train members of two generations who missed the opportunity to have a basic education and who compose the majority of the existing indigenous work force remains. It is that audience, from whom the recruits for the Afghan National police are drawn, that is addressed in this paper.

The Afghan National Police (ANP) is a combination of functionally separate elements as shown in Table 1 below.

Table 1: Pillars of the ANP

Official Name	**Function**
Afghan Uniform Police (AUP)	General Duty Policing
Afghan Civil Order Police (ANCOP)	Special Weapons and Tactics (crisis response and riot control) in urban settings
Afghan Border Police (ABP)	Border security, Customs and Immigration Functions at airports and land entries
Afghan Anti Crime Police (AACP)	Counter Narcotics, counter terrorism and Criminal Investigations
General Directorate Police Special Unit (GDPSU)	High risk arrests, cordon and search oeprtions, quick reaction force, armed reconnaisance, vehicle interdiction and cache recovery.

The lessons learned discussed here address specific challenges to teaching adult learners (many of whom are illiterate and innumerate) in this environment.

[1] As of FY 2013/2014, Japan has provided funding for the International Police Coordination Board of Afghanistan (IPCB) to the end of 2014.

Each lessons learned will be examined in the context of the Continuum of interaction in learning environments for Distributed Learning [3] and the Eightfold Path Simulation model [4]. They will also be examined against the three rules for successful technology application [3]; those of technology availability, supportability, and cultural influence to see how they address the circumstances of place for the design user population.

Figure 1: Continuum of interaction in learning environments

The Eightfold Path model [3] describes a set of categories of simulation in terms of human activity, as opposed to focusing on specific technologies. The approaches used in training ANP personnel will be discussed throughout the balance of this paper using labels drawn from this classification system.

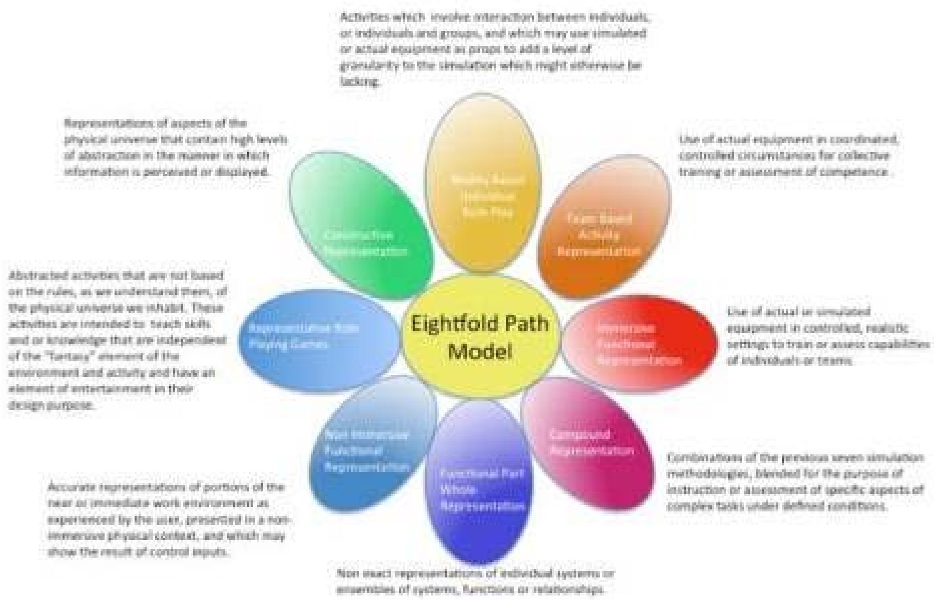

Figure 2: Eightfold Path model of simulation

The observations made in this paper should be considered generalizable to other, similar situations in which technology-dependent and high-risk occupations must be effectively trained in the absence of existing and capable educational institutions. This example represents a worst-case setting, in which infrastructure is effectively non-existent, the economy is not self-sustaining, social institutions which normally guarantee the function of the society in question are compromised or non-existent and there is a presence in the population who are opposed to the efforts of the involved agencies.

In this paper, the term technology refers to any human innovation that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities [4]. This includes application of knowledge to develop tools, materials, techniques, and systems to help people meet and fulfill their needs [5] and all forms of mass and communications media [6]. It also includes any specific information and know-how that is required for the development, production, or use of a production item, but not the actual product [7]. In this context, educational technology refers to manufactured tools or concepts that include the imposition of structured change in the capability of an intended audience to perform specific tasks or functions in a predetermined manner [8]. The technologies discussed in this setting are those that support organized activity for teaching, learning and assessing individual or group capability. Successful use of these technologies involves three basic requirements: A specified technology must exist in a developed form; the infrastructure to support use must be present in the environment intended for its use; and the target audience had to accept the use of the technology for that identified purpose (or something else that was functionally related) in order for it to be acceptable [3].

II. FINDINGS

The ANP have a maximum authorized strength of 152,000 (including 1,700 women) and make up slightly less than half of the Afghan National Security Forces (ANSF), [the balance being made up of the Afghan National Army (189,000) and Afghan Air Force (6,800)[2] [9]. Due to their role in Afghan society, the ANP have both the most contact with the public within Afghanistan and the highest casualty rate from the ongoing insurgency. As a result of staff turnover based on retirements, trained ANP leaving on completion of their contracted term of service, or casualties, the ANP are constantly recruiting and training personnel through the locations shown at Figure 3 below.

[2] Information gleaned from www.NATO.int/cps/en/natolive/topics_92726.htm downloaded 19 April 2014.

Figure 3: Locations of 13 ANP enduring Training Sites in Afghanistan

2.1. Forms of Distributed Learning Observed

The approaches and technologies observed to be used in training ANP members between July 2013 and March 2014 ranged from applications of Face-to-Face (IPCB Funded), Face-to-Face Off-Campus "Satellite" training, Face-to-Face with Technology Mediated interaction, to Technology Mediated interaction between teacher and students. Formal individual and follow-on collective, small group training for ANP members within Afghanistan is conducted at each of the 13 training centers, using a satellite training form of delivery. In all cases the content delivered was from a centrally issued common curriculum for individual qualification courses. The scope of courses available at each training center depends on the housing capacity for the student population (which varies between the Training Centers), and the specific facilities available for training at each location. In most instances, inability to train on a specific function at an identified site is based on resource availability, priority of use for high demand resources (such as vehicles), or due to policy guidance on where and when a specific course might be taught.

2.2. Forms of Simulation Observed

It was observed that the most successful forms of simulation used in ANP training for any content were those that allowed instructional designers and the mentors involved in the conduct and subsequent supervision of training to use a building block approach to isolate ideas and relationships in specific contexts, and build progressively.

In each instance, the form of simulation and the level of technology selected within it reflected specific operational needs at the place and time of training, a consideration of which approaches would be the least complex to promote understanding, the least resource and support intensive, and lastly, the format of simulation most logical and acceptable to the student audience.

Of the eight approaches identified for use in instructional simulation or for simulation-based assessment within the Eightfold Path model, five were noted as in common and documented use in ANP training. The best example of this use of instructional simulation was the Afghan Uniformed Police (AUP) Initial Police Training Course (IPTC), as shown at Table 2 below.

Table 2: Forms of simulation used during AUP IPT

Course	Simulation Classification	Specific Purpose	Specific Application
Initial Police Training Course	Non-Immersive Functional Representation (NIFR)	Personal weapons handling and maintenance	Stripping and assembling of weapons for servicing, dry rehearsal of Immediate Actions for weapons stop-pages or malfunctions
		Baton drills	Use of police baton on either a dummy or appropriately padded opponent
		Restraining arrested individuals	Practicing holds and restrains Application of Handcuffs Application of Plastic Restraints
	Constructive Representation (CoR)	Developing Map Reading Skills	Teaching navigation, route planning, and ability to pinpoint locations
	Reality Based Individual Role Play (Role Play)	Teaching and conforming appropriate interactions with the public	Teaching and reinforcing positive image, appropriate responses to circumstances, and positive relationship building in the community

		Arrest procedures	Scenario-based application of knowledge and above skills to successfully take custody of an arrested individual using individually issued police equipment
		Individual Search Procedures	Scenario-based search of arrested individuals, using “blue gun” and other props
		Vehicle Search Procedures	Scenario based search of vehicles, using “blue gun” and other props
		Checkpoint Procedures	Teaching and assessing individual competence in operating a vehicle or foot traffic checkpoint
		Use of Police Radio	User operation and voice procedure for the issued types of police radio
	Immersive Functional Representation (IFR)	Individual Weapons handling	Use of known distance ranges with specific scenarios, use of combat lanes with scenarios, or shoot house site with live ammunition
	Team-Based Activity Representation	Small Group tactical training	Scenario-based search of individuals or vehicles (high risk activity) training, initially dry, later with blank and finally using live ammunition
		Pairs / Small group tactics training	Use of Combat lanes, Shoot House or Urban Assault course to teach and assess skills and knowledge required.

The most effective approaches to content delivery were relatively inexpensive, culturally supported group activities that could be directly related to task performance. Where the relationship between the content being taught and the real world was not obvious, the use of simulation became less effective. Approaches that supported multi-use were popular and effective as the concepts taught were directly relatable and with exposure to the content in question, individual confidence increased for the students. Two examples of this were the processes of qualifying ANP members in vehicle operation and maintenance (using an actual vehicle under close supervision to do basic tasks like check fluids or change a tire), and female ANP in individual personal search procedures (Figures 4, 5 and 6 below).

Figures 4, 5 & 6: Female ANP conducting individual Search of person procedures (Courtesy T. Tyler, Dyncorps) [13]

The literacy level of the students was a major complication in the learning process. Individual students who were not literate or numerate struggled with abstraction and preferred concrete examples, the most effective of which were drawn from their own culture, or cultures perceived (by them) to be similar to their own. A low student literacy level required instructors to explain and reinforce the concepts taught throughout the learning moment generated by the simulation. Generally, student's lack of experience with formal education hindered the process of training and assessment.

Table 3: "Lessons Learned" considerations for use of specific technologies in selected forms of simulation

Key Points – Specific Simulation	**Reasoning**
Consider the Human Activity – when doing the actual task in the work environment, what is s/he really doing?	Simulation should allow a replication of the activity in question with sufficient fidelity and appropriate granularity to support transfer of learning. Selected forms of simulation must allow sufficient repetition per student to support the learning process. Selected forms of simulation should support the use of the same human senses involved in the actual process as closely as practically possible. Is this form of simulation practical and safe to use? Consider safety of students and instructors. Does it impose other requirements, such as equipment or infrastructure?
Consider the issue of resourcing for the technology planned for use	How many of this form of technology do you need for each class? Does this technology create a limitation on what scope and level of detail you can teach, or how it can be used?

	Development time for production, pilot and revision may be a factor. See Bates (1995) ACTIONS Model for guidance [14].
Consider the practical effects of environment on the Technology planned for use	Will the technology survive the physical working environment? Think dust, vibration, impact, and humidity.
What is the potential impact of this user community on the technology?	Will the specific device or approach used survive in the filed or be likely damaged quickly? Is the user community liable to unknowingly abuse it?
Is the interface suitable to this audience?	Will the design audience actually be able to interpret the technology (can they see how it relates to reality)?

2.3. Infrastructure Issues Influencing Content Delivery

The supportability of a specific technology for teaching and learning was a major factor. One aspect is access to and affordability for the user community of required consumable components. Still another is the issue of physical geography and related support for the use of the form of simulation. A last and major consideration is availability of infrastructure to support the use of technology-based simulation. Communications and power distribution infrastructure are not well established in Afghanistan. As a result, although cell phones are in wide use, the cost of data on a cellular network restricts utility.

Infrastructure-related restrictions on simulation technologies such as Virtual Reality (either visual, auditory or tactile in orientation) in ANP training included a lack of power distribution infrastructure and the required resources to generate power when and where needed. Many remote training establishments used diesel generators for electric power generation, and the availability of fuel was a constant concern. Further, while the use of off-the-shelf consumer computer game-based technology may have been useful, there were limitations imposed on its use by the nature of the available electrical power supply and existing infrastructure. For those few establishments that could make use of a personal computer to deliver stand alone or networked training content (using Virtual Reality or not), budget, bandwidth and network capacity imposed restrictions for connectivity, as a common lack of landline telephone and wireless infrastructure or satellite uplink facilities was a major obstacle.

Similarly, the relatively few roads, long distances between communities, relatively high risk of injury or death to travelers restricts the movement of simulation devices to air travel, which reduces the number of sites that equipment might be moved to and imposes a high cost of use as a result of relocation. As a result, content delivery for formal training was limited to variations on Face-to-Face models, taking place at fixed installations with simulation in ANP training involving Role play with small props or the use of real equipment in controlled circumstances (either Immersive Functional Representation or Team-Based Activities).

Related to this concern was one of the movements of either students or instructional staff from their residential areas to the separate training areas. The impact of having the EUPOL, GPPT, NATO and NGO staff living in areas that were separated from the places in which the client community lived and trained presented risks to the trainers due to the need to travel on a daily basis to and from the work site, often through areas of potential high risk. ANP students faced similar risks.

A follow-on result was that during periods where it was determined that travel from accommodations to the work site presented too high a risk to personnel, training for the ANP using members of the international community as instructors was either delayed on very little notice, or cancelled outright. Immersive Functional Representations (IFR) and Team-Based Activity Representations (TBAR) approaches also suffered as a result of infrastructure issues, although this was not as restrictive as was the case for internet-dependent, computer-based applications. The most successful approaches to simulation had the smallest requirements on the existing infrastructure. Examples questions to ask regarding Infrastructure are at Table 4 below.

Table 4: Infrastructure considerations for the selection of content appropriate forms of simulation

Key Points - Infrastructure	**Reasoning**
Consider the requirement of your planned form of simulation for consumable resources. Can these needs be met?	Any simulation form selected must not impose an undue resource burden on the user community. This can include not only availability of materials, but the cost of the materials, or the requirement for having a qualified specialist available to maintain the technology.
Does the available infrastructure support the technology you plan to use?	Is your chosen form of simulation technology dependent on a specific power supply, or does it require communications infrastructure? If these needs cannot be met, the technology in question will at best be restricted, or can't be used at all.

Is the Geography of place a factor in planning the use of the form of simulation?	This may involve movement of the simulation devices or it may involve availability of required resources (such as vehicles, or the consumables directly related to your training). Is climate a factor? This may include the temperature, humidity, and shelter requirements for training or assessment using the simulation selected. Urban and cultural geography and activity centers may be major factors and restrict access to planned employment sites or for the placement / positioning of required infrastructure. What is your plan if the telephone lines are repeatedly cut and you depend on DSL?

2.4. Cultural influences Impacting Training Delivery

Consideration of the audience is a key factor in designing course content and selecting appropriate training and learning aids. Determining the actual as opposed to perceived needs of the proposed user community through the employment of a repeatable, verifiable methodology is critical to success. Similarly, determining an effective approach that is also acceptable and perceived as relevant to the defined objective is a critical consideration. This is tied to a set of issues and assumptions common to the Military establishments within NATO in Afghanistan, and to the various NGOs involved in the mission. This involved planning, funding and delivering appropriate simulation in training. In part this involved the common view that expertise increases with seniority. While senior managers generally have developed expertise in management, the further they are from the working level, the more likely it is that a manager's personally developed expertise in the detailed execution of specified tasks has been the victim of skill and knowledge fade. Linked to this first point was an implicit assumption by some members of the international community that as they had been trained, or had conducted training, they were experts on all aspects of getting the ANP trained. This was and continues to be a case of proving Kreuger & Dunning's [15] point that individuals are not necessarily aware of their actual level of competence in specific areas, and that inaccuracies in self-assumed expertise and self-perception of level of personal competence can be the downfall of good intentions. As a result of the input of a few individuals in key positions, progress in delivering needed training to the ANP was unnecessarily delayed. In one instance, progress in developing training was not only stopped, but confidence in the process was undermined. In another, the views and actions of one individual undermined the effectiveness of an international working group. In both cases, the result created confusion. In a third, related example, the circumstances involved delivery of a staff course for senior ANP by an ex-military civilian that was poorly documented and which did not actually increase overall proficiency in its initial version owing to inappropriate content for the intended audience. At worst, the impact of these examples of misplaced assumption of competence took time and resources to correct, and undermined progress in making the ANP self-sufficient for creating their own training programs. While in each instance the cause of the problem was corrected, these situations could have been prevented by improved understanding of limitations and better communications.

As observed earlier, three of the eight categories within the Eightfold Path model were not used in training the ANP. These were the Functional Part Whole Representation, Representative Role Playing Games and Compound Representation.

These could have been used by the ANP, but the culture of the entrenched NATO training establishment did not support adoption of these approaches.

Clear communication in support of the process of teaching, learning, and assessment of developed capabilities was also a major obstacle in the effective employment of simulation for both training and assessment. As mentioned previously, the working language of NATO in Afghanistan was English. While English is used by the Afghan business community in areas frequented by NATO personnel and civilian members of the international community, English remains a language understood by a relatively small percentage of Afghans. Practically speaking this resulted in the need for translation services for most functions that took place outside of NATO, EUPOL, GPPT or UN establishments, and much of the teaching practice involving Mentors directly training Afghans. The lack of a common language occasionally created bottlenecks to progress [10, 11, 12, 13] This bottleneck extended to the use of computers for training, and added an additional complication to the potential use of Virtual Environments for training ANP – the computer keyboards needed Dari symbol labels to be attached to permit use.

Further, any software required menus to be available in Dari, and the creation of a Dari script font for interaction. While this was of some use for literate students, it did not help students with low or no literacy or numeracy skills.

Table 5: Cultural considerations in planning and delivering training and educational content

Key Points - Culture	**Reasoning**
Ensure clear planning and communication for all efforts in creating and delivering effective and appropriate training to achieve the common objective.	Plans should involve clear understanding of and agreement on the objective and the method of attaining it. At no time should either of these points be in conflict with the culture of the place in which the training is to be developed, delivered and conducted. Additionally, confirm the expertise of all involved in critical tasks and use the experts available effectively within the scope of their qualifications.
Ensure that the goal and technology used for the designed simulation is not in conflict with the culture of the place in which it is proposed for use.	If the format or goal of the simulation (or really any training or learning aid) is perceived to be conflict with the values, goals or customs of that culture, it is likely that the product will not be used as intended, if at all.
Ensure effective employment of subject matter experts for technical planning and task execution.	Specialists in all areas should be employed to advise managers on and conduct or supervise execution of tasks within their area of expertise. Further, these experts should be both formally accredited outside of their organizations, and have different experience to enable the provision of effective advice. Responsibility should remain with managers, but any dismissal of technical advice given by a Subject Matter Expert must be justified and documented. Advice and approaches to developed solutions must meet the needs of the client community, not be best for and based on what is most familiar to the provider of the service.
Ensure that the design user audience understands what to do, how to do it as well as why it must be done in that manner.	Misunderstandings between cultures based on language cues can lead to adverse outcomes. Ensure clear understanding and get confirmation before use of tools or products.

Ensure a "right fit" of technology-based approach to the audience's needs and values that support the stated goals and minimize misuse.	Ensure that the approach to simulation and the related technology selected to provide training is appropriate to the desired goals of the design user community. Consider potential misuse of the simulation, and design safeguards to minimize misuse. Show the design user audience how to select the appropriate approach and avoid dependence on others for training.

An additional language-related complication was that of comparative vocabulary and understanding of new concepts in developing training. It was not uncommon for there to be misunderstandings between groups of Dari and English speakers, as often Dari would not contain an equivalent word, and a concept expressed in one or two word in English would have to be explained in detail to a Dari speaker. Once explained, the concepts were understood, but it was agreed that the English terms for the concepts would have to be adopted by Afghan training staff to prevent confusion. Aside from language, the traditional culture of Afghanistan created complications in training. Specifically, men and women do not mix for training, nor do Officers and Non-Commissioned members attend the same classes at the same time. This cultural factor resulted in the requirement to create versions of scenario-based training for each group. Specific to this point, creation of different versions of scenario-based simulation for either training or assessment-supported acceptance of the product, as it fit with the way the culture in that place functioned.

CONCLUSIONS

The use of simulation has and will continue to be an effective approach for training and assessing a student's readiness to perform specified tasks. This paper has identified and explained a sample of the key lessons learned in delivering training that made heavy use of simulation for training a population which had limited levels of literacy and who functioned in a setting with a limited infrastructure to perform tasks that presented significant risk to the individuals performing them. This is not a comprehensive list, but does represent a set of key lessons learned. It is suggested that the foregoing points be at least considered when planning future training efforts in recovering states.

Separate from the specific considerations of technology selection are the common factors identified below at Table 6, which apply to any of the simulation classes identified in the Eightfold Path model. These are general guidance and provided working solutions to meet the needs of the ANP for building simulation in support of individual training, as their use as a "check and balance" on consideration of options forced an ongoing re-evaluation of approaches for training and assessing individual and group competency.

Table 6: Content specific considerations in selecting classes of Simulation

Key Points – Content Specific to Model	**Reasoning**
Human Activity	Each classification of simulation is based on a representation of human activity. Which type and specific application of simulation allows the closest representation of what the students / test subject(s) will actually do in the work environment?
Concrete vs. Abstract	What is the nature of the activity and does it require concrete representation or can the representation be abstract in nature? (Hint: Does it introduce concepts or relationships and/or apply concepts to perform tasks?)
Isolation vs. contextualized	Is the new content to be presented in isolation to eliminate distractions and allow the subject to focus on the application, or is the surrounding environment important for providing relevant cues?
The ability or skill level of the trainee	This deals with the ability of the trainee to use a specific form of interface, as well as the content or level of detail involved in the simulation.
Formative vs. Summative	This is dependent on the policies of the place of application; If the assessment is only to determine learning progress and correct errors; it is used for Formative assessment. If being used as a final check of competence it is Summative. Whether or not to use simulation as a test of competency is a policy decision for the credentialing authority.
The level of granularity require to support learning or assessment	How high is the level of detail required to support learning or be a valid benchmark for assessing ability?
Time Required to develop and deliver	Development time for production, pilot and revision may be a factor. See Bates (1995) [14] ACTIONS Model;
Cost of the selected approach	Some approaches cost more than do others, but have similar support potential for assessment [again, see Bates (1995)].

References

[1] A Historical Timeline of Afghanistan (May, 2011). PBS News Hour. [On line] Available: www.pbs.org/newshour/updates/asia-jan-june11-timeline-afghanistan/

[2] Report on Progress Toward Security and Stability in Afghanistan (2013, November). Department of Defense, United States of America. Ref ID 5-E54A663.

[3] Huffam, C.J. (2004). A Brief History of Educational Technology in Centralized and Distributed Learning. Unpublished Paper. University of Calgary.

[4] Huffam, C.J. (2010). The Eightfold Path: A Taxonomy of Simulation Based Assessment. In Proceedings of the 31st Interservice / Industry Training and Simulation in Education Conference (I/ITSEC), Nov 29 – December 2 2010. Orange County Convention Centre, Orlando Fl. USA: National Training and Simulation Association.

[5] International Technology Education Association (ITEA). Technology. [On Line] Available: http://www.iteawww.org/TAA/Glossary.htm Acessed April 17th 2004

[6] Leinen, A. (2000). Edu-Speak, the dictionary. [On Line] Available: http://user.mc.net/~kwentz/eduspeak.html

[7] World Bank Global Distance Education Net. Technology. [On Line] Available: http://www1.worldbank.org/disted/glossary.html Accessed April 17th 2004

[8] Albright, D.; Buehler, K. & Hinderstein, C. (2003). Roadmap to Responsible Export Controls: Learning From the Past. Institute for Science and Security (ISIS).□236 Massachusetts Ave NE, Suite 500 Washington, D.C. 20002. [On Line] Available: http://exportcontrols.org/glossary.html

[9] Developing Afghan Security Forces. North Atlantic Treaty Organization.[On Line]Available: http://www.nato.int/cps/en/natolive/topics_92726.htm Accessed 20 March 2014

[10] Kopp, Olaf Captain, German Police Project Team. Green Village Compound, Kabul Afghanistan. Interview and personal email communications, January – March 2014

[11] Read, Derek WCdr Personal interview February 18th 2014. New Kabul Compound, Kabul Afghanistan

[12] Winkler, Volker Captain, German Police Project Team. Green Village Compound, Kabul Afghanistan. Interview and personal email communication, January – March 2014.

[13] Tyler, Tracy Dyncorps International. Interview and photographs of search procedure as taught to Female ANP Personnel. Camp Eggers and New Kabul Compound, Kabul Afghanistan November 2013

[14] Bates, A.W. (1995). Technology, Open Learning and Distance Education. Routledge Studies in Distance Education. London: Routledge

[15] Kruger, J. & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence leads to inflated self-assessments. *Journal of Personality and Social Psychology,* 82, 189-192.

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JOINING THE ADL PARTNERSHIP LABS: A History of the NATO Partnership Lab, Projects, Responsibilities and Relationships

Paul THURKETTLE*

WHO ARE WE?

In November 2010, NATO's Allied Command Transformation (ACT) was formally accepted as an Advanced Distributed Learning Partnership Lab. This acceptance marked 7 years of strong cooperation between the United States ADL Initiative, The United States Joint Forces Command and NATO HQ ACT.

When ACT was created in 2003, following the direction of the Heads of State of NATO nations at the Prague Summit, its mission was to lead NATO in transforming its military structure, forces, capabilities and doctrine. One of the key elements in this task was to improve and enhance education and training throughout NATO, ensuring NATO and its partners were fully prepared for future challenges. With great foresight, the designers of this new command included a small section to introduce NATO to a new concept of online learning called Advanced Distributed Learning (ADL), and to ensure technology enhancements relating to education and training would be identified and, where feasible, used.

This small section, Education and Training Technologies (ETT) under the individual Education & Training Branch, started with only one member, whose enormous task was to identify where the capability had reached, liaise with our nations, and come up with a plan for NATO introduction.

One nation leading ADL was the United States; Joint Forces Command based in Suffolk, Virginia, which in addition to developing online learning was also working with the international community through the Partnership for Peace Consortium's (PfPC) ADL working group. Under this group, the Co-operative Development Team (CDT) concept was formed, to establish in Nations and in NATO, teams that would be capable of developing courseware and, most importantly, doing so using interoperable standards and tools.

Over the next few years the ETT section, with the support of the Joint Forces Command, stood up its first Learning Management Service (LMS) using the

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popular open source package Ilias. The section grew to 6 members, and we started developing our first courses directly supporting NATO operations, exercises, and academic programmes. Ilias was accredited to operate on the NATO networks, both unclassified and classified, which was a first for an open source application within NATO. In 2007 we reached full operating capability.

ADL was a new idea on the block for NATO, and at first was received very nervously by the schools and training centres. Viewed as a potential threat to the instructors and facilities, it was a challenge to win acceptance, and only in offering blended learning could we gain momentum. Our ability to prepare the student for arrival at the schoolhouse already in command of the subject basics actually expanded the quality of available face-to-face time for trainers and trainees. Of course, this only worked if the student had completed the ADL course online; this became a challenge and required the schools' close support and a willingness to enforce the online element.

ADL was slowly gaining acceptance, but still faced many obstacles to its successful use. Its ability to reach students "Anytime, Anywhere" outside and inside of NATO networks was recognised as a solution to preparing augmentees to deploy to the International Security Assistance Force (ISAF). This multinational audience in the thousands with a constant changeover could not realistically attend classroom training, and thus ACT was tasked to prepare a 10-hour package for all deploying augmentees. This course served as both a pre-training package for ISAF classroom training and as support for the 80% of staff who were unable to attend any formal training.

The rest, as they say, is history. To date we have had over 40,000 students take the ISAF package, with another 25,000 taking other courses on our servers. ADL and e-Learning are now firmly established in the educator's toolbox, and in many ways we are now suffering from the success of the programme. E-Learning is often seen as a cheap solution to any training problem, and now we must educate our prospective customers on the value and limitations of online solutions.

From a one-man band, the section has grown to a team of 10 that develops and delivers courseware in support of NATO and delves into the new technology world to experiment and evaluate new ideas and concepts including immersive and mobile capabilities. We also have the mandate to bolster ADL/e-Learning growth within NATO and support nations who seek to develop their own capabilities.

This is an exciting time and innovation is not standing still. Our continuing challenge is to keep abreast of what's new, while also methodically evaluating new gadgets and changes in academic thinking to ensure they truly have a value and are not just the latest "shiny objects."

The ACT (NATO) Partnership lab is very proud to be part of this community and will seek to continue its support and influence to promote our message and community.

WHAT DOES MEMBERSHIP IN THE PARTNERSHIP LABS DO FOR US?

As we developed NATO's ADL/e-Learning capability, we relied heavily on standards and doctrine already in use across the world. Our adoption of SCORM(R) was a logical choice to meet published technical standards and ensure the interoperability of courses between NATO and national bodies. The capabilities and resources of the ADL Partnership Labs is an excellent skilled resource to tap, and its leadership is already heavily involved in NATO such as the NATO Training Group.

The NATO partnership lab has very limited resources but, by combining our wisdom and skills, we can achieve so much more. NATO has very little to offer the group, other than its enthusiasm, reach throughout the NATO and partner community, and limited funding to support projects and working groups. What we gain from the group is so much more, a seat at the table of the new technical standards and innovations, an excellent skilled support group both in the technical and management levels and, of course, a sense of belonging to a worldwide community of like-minded enthusiasts. It is a great relief to know, when challenged, that a support group is out there facing the same challenges, having some of the solutions, working with us to solve our common problems.

As more nations join the partnership, our community will continue to grow, resulting in increased awareness and development of common goals and development of standards and doctrine we can all work to because we all helped develop them!

"There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things."

Machiavelli

WHAT ARE WE WORKING ON?

Because the NATO Partnership Lab has limited resources, we must focus on certain emerging technology along with our normal course development and quality improvement efforts. The two areas we feel are the most exciting for NATO are mobile delivery options, to support our audience's desire to "bring your own device," and immersive training.

Using the excellent products created by the multinational MoLE (Mobile Learning Environment) programme, we can now offer secure mobile delivery of courses on the most popular mobile devices. Adopting this "out of the box" technical solution has raised the challenge of converting our courses to fit into a new template as well as management decisions on what courses to offer in this medium – or even if courses can be converted "on the fly" to suit the students' devices. We welcome the support and experience of our community and nations as we establish our policies and practises in this area.

Immersive training using virtual worlds and serious game technology, along with technological advances in the human machine interface, is an area with rapid growth and excitement. The possibilities are endless and again we are challenged to focus on certain areas and not be distracted by the plethora of tools and hardware available. We have therefore focused on two key areas. One area is development of individual and small team trainers using immersive engines like Unity. These "games" take the student through the doctrine and tactics, giving them the information, education and skills to complete a mission or set of objectives. At the moment these projects are focussed on Civil Military Interaction, NATO Maritime Boarding, and NATO security practices.

Our second area of focus is to develop a distributed training "live" environment, where NATO and nations can meet to practice their skills and learn and test their interoperability. If prior to an exercise or operation, the augmentees can meet "virtually" using the software product Virtual Battlespace Three (VBS 3), which is used by many of our nations to discuss, practice their mission and even be certified, then on arrival at the exercise or operation, they can be productive immediately. NATO has procured 50 licences to "loan" for short periods to enable multinational experimentation and rehearsal. This project is also a NATO Tier 1 Smart Defence programme with the United Kingdom as the lead nation.

WHAT COMMUNITIES ARE WE INVOLVED IN?

Very much like the Google Circles social programme, our community has many overlapping communities of interest. These all have designated goals and mandates, and it is very important to ensure similar topics are socialised between the different audiences to avoid duplication or wasted effort.

The ACT ADL Partnership Lab is currently involved in:

- Operating the NATO Learning Management Servers on major NATO networks
- Operating on behalf of the PfPC the Learning Management Servers for the PfPC Community

- NATO Education and Training Facilities supporting members in the area of ADL/e-Learning
- The NATO Training Group – Individual Training and Education Developments Task Group
- Smart Defence 1.4 Immersive Training Environments Programme
- Leading member of the PfPC ADL working group
- Hosting the annual e-Learning Forum
- Exhibitor at the ITEC and I/ITSEC conferences
- Education and Training Technology contributor to the NATO Connected Forces Initiative
- Close liaison and cooperation with the United States Joint Staff

FUTURE

In the eleven years since ACT was created, with the mandate to encourage the transformation of NATO and its nations, few areas have changed as much as technology and the acceptance of technology for education and training. The incredible growth of online learning in the academic world, with all levels up to PhD now being offered, has paved the way for (albeit more slowly than in the outside world) acceptance of this medium and encouragement for its use. Along with the new "shiny objects" being thrust upon us, this has created an avalanche of demand that we must "keep up with our children." Our only way to do this is to make maximum use of the communities we have and ensure our cooperation towards common goals.

We know our membership in this community goes a long way to that goal.

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Paul THURKETTLE is a British NATO civilian working at one of the two NATO strategic commands, the Allied Command Transformation, which is based in Norfolk, Virginia. His twenty-four year NATO career and 12-year Royal Air Force service has covered telecommunications, command and control systems, technology and training. Now in his role as the lead for NATO in adopting technology for education and training, he is introducing e-Learning into NATO covering all aspects of this field from serious games to mobile learning. Paul lives in Hampton, Virginia with his two children and as many boats as he can afford.

Volume 2, Number 6, 2014
JADLET Journal of Advanced Distributed Learning Technology

MOTIVATION AND ONLINE LEARNING

Geir ISAKSEN*

Abstract: *This article is based on a post-graduate thesis which received an A at the Institute for Adult Education (VOX) spring 2004 and looks at which measures can be facilitated such that the teaching principle of motivation is optimized during development of online learning for the Norwegian Defence (NoD). These measures are collected in a checklist to ensure pedagogical quality and focus on student motivation. This list has become a standard piece of the information available to NoD courseware developers and is included in NoD`s methodology for developing e-learning. By looking at the Didactical Relational Theory (DRT), well-known principles of learning and variables affecting success with online learning, the checklist helps to ensure that student motivation is optimized in all NoD online courses. The checklist contains the following important aspects tied to achieving student motivation: Objectives and goals, involvement, feedback, emotions, socialization and self-efficacy. During the last couple of years the checklist has been successfully used during the development of a number of online courses. These courses include both hardskills courses such as application- and computer systems training and soft-skills courses such as education in laws of armed conflict.*

Keywords: *Motivation; Online; Learning: Didactics; Methodology; Teaching principles.*

I. INTRODUCTION

The Norwegian Defence (NoD) is undergoing their most extensive transformation process ever. In order for this transformation to be successful, there is a great need for continuous skills development. The objective of the research was to make a contribution to how the NoD can increase the likelihood of succeeding with the delivery of material for necessary skills development.

1.1. Didactic Relational Theory (DRT) Model

Bjorndal & Lieberg (in Nordskog & Popperud, [1]) present a model for relevant factors that one has to consider in order to succeed with knowledge dissemination. The model is known as the Didactic Relational Theory (DRT)

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model. It emphasizes six relevant factors: goals, framework, work methods, participant, content and assessment. All these factors are mutually related and must be considered in all stages of knowledge dissemination. Focus in this paper is limited to working methods.

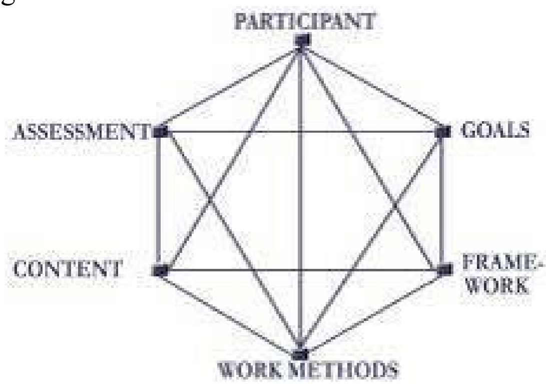

Figure 1: DRT model

1.2. Working methods

Loeng et al. [2] present 5 main categories of working methods in connection with knowledge dissemination:

1. Small group learning: a method that from a qualitative perspective builds on learning through cooperation [3]. One learns in an environment in which the participants mutually support each other.
2. Discussion: learning based on the free exchange of academically relevant opinions between all participants in a group.
3. Case method: learning activities that take as their starting point a description of a situation. Work with cases usually takes place in a group, but can also be done individually.
4. DSI (Demonstration Simulation Instruction): one combines the demonstration of skills that are difficult to describe, the simulation of a true to life situation as well as instruction that will result in the acquisition of the skills by the students. Digital learning is usually defined as being within this category of work methods.
5. Lectures: one-way communication from an active lecturer to receiving participants.

1.3. Digital learning as a working method

This paper focuses on digital learning, as a work method most strongly associated with DSI according to Loeng et al.'s categorization [2]. In their "pedagogic house'" Torgersen & Vavik [4] divide teaching methods into digital and analogue learning. Regardless of whether one is talking about digital or analogue learning, these arenas contain three main elements.

Main elements in learning	
Factor	**Type**
Learning medium (What is used?)	Classroom, PC, overheads, projector
Availability of subject material	Paper, books, CD-ROM, Internet
Form of communication	Between student, teacher and co-students

The authors have developed a model based on Torgersen & Vavik [4], which is shown in Figure 2. The model structures the abovementioned three elements with respect to analogue and digital learning.

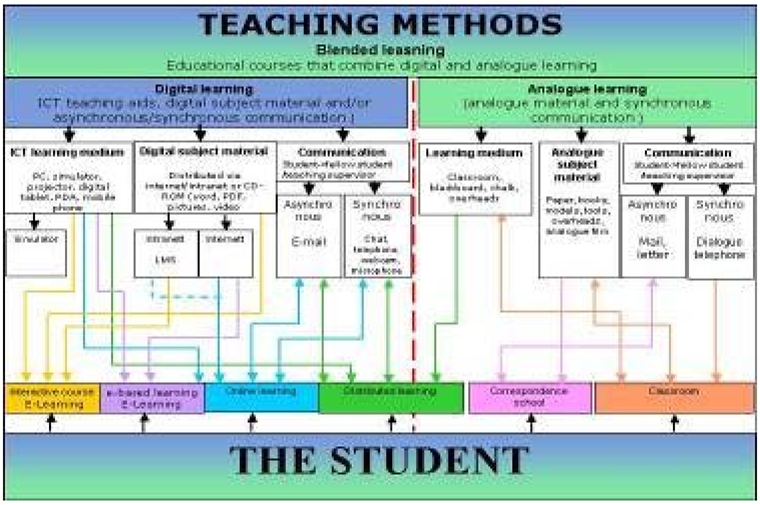

Figure 2: Teaching methods based on main elements.

Seen in relation to digital learning, these main elements can be explained in the following manner:

Main elements in digital learning	
Factor	**Type**
ICT learning aids	PC, tablets, mobile phones, simulators,
Availability of subject material	CD-ROM, Internet, Intranet
Communication	Asynchronous/synchronous

Based on how the different main elements are utilized, digital learning can be grouped into the following four categories: interactive course, e-based learning, online learning, and distributed learning. The paper focuses on online learning because this, unlike the other three categories, covers all three of the main elements that come under digital learning.

1.4. Online learning: An approach to digital learning

This type of digital learning is utilized by most academic institutions that provide education. Online learning usually takes place over long periods and often consists of several modules with continuous assessment.

Main elements used in online learning	
Factor	**Type**
ICT learning aids	Classroom, PC, projector
Availability of subject material	Subject material is made available via the Internet or intranet. Assignments and compendiums are downloaded to the student's own PC.
Communication	In online learning it is normal to use both asynchronous and synchronous communication between the students, or between the students and teaching supervisor. Assignment papers are submitted by email to the teacher, while cooperation between the students takes place in chat groups.

II. ONLINE LEARNING AND OPERATIONALISATION OF SUCCESS

The paper discusses how the NoD can successfully utilize the online learning work method. In connection with this, the paper discusses how online learning can reinforce existing knowledge vis-à-vis the principles for successful knowledge dissemination. In order to do this, the following questions need to be answered:

1. How can one operationalize measuring success?
2. Which variables affect success?

2.1. How to measure success

Some research has been done on success with IT, which, among other things, has resulted in various general models. Seddon et al. [5] created one of the most recognized general models. This shows which factors affect success with IT.

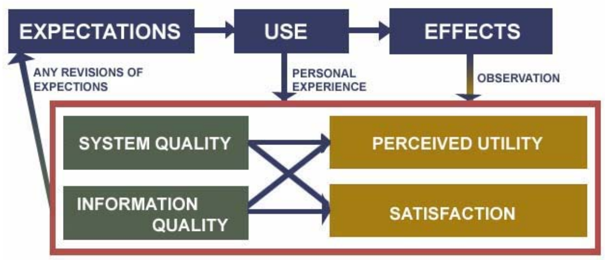

Figure 3: Seddon et al. Factors that affect success with IT.

The model created by Seddon et al. [5] operationalizes the measurement of success through "perceived utility" and "satisfaction" among those who use the system. Furthermore they say that "system quality" and "information quality" are the primary manipulable factors that influence "perceived utility" and "satisfaction." They expand on this in the model by also emphasizing the minor manipulable influencing factors, including users' expectations regarding the net benefit of using the system and how the system is actually used. When developing IT systems (such as digital learning resources, for example) we must first and foremost focus on system quality and information quality since we have less influence over factors such as expectations and use. The paper focuses on system quality with respect to digital learning resources. This does not mean that we regard information quality as less important, but since we wish to contribute with general results that are independent of the information/knowledge that is going to be disseminated, it is natural not to focus on the "information quality" variable.

2.2. Focus on system quality in the development of online learning

Laudon & Laudon [6] describes "system quality" using the following three key terms: technology quality, process support and organization adaptation. This implies that one can only achieve good system quality if the following criteria are met:

- Technology quality: the technological platform must be of good quality.
- Process support: the system must support the desired processes.
- Organization adaptation: the system must be adapted to and embedded in the organization in which it is going to function.

From the perspective of online learning, we can interpret these three key terms in the following manner:

- *Technology quality:* the learning management system (LMS) and distribution of the digital academic material must work problem free.

• *Process support:* synonymous with pedagogic quality; the online learning must be constructed in accordance with pedagogic teaching principles that result in good learning for the individual student.

• *Organization adaptation:* the organization and its management must arrange things such that individual employees have an opportunity to carry out the online learning.

This paper concentrates on pedagogic quality (process support). Furthermore we have chosen to operationalize pedagogic quality through "compliance with established teaching principles for the development of online learning."

III. PRINCIPLES OF TEACHING

The CAMPVISE principles described in FUD [7], the MACVICIT principles [4] and the TOMAS principles [4] are all examples of established principles of teaching in Norwegian education communities.

3.1. CAMPVISE Principles of teaching

The current Norwegian curriculum for primary and lower and upper secondary school education (L97) involves 8 teaching principles that are known as the CAMPVISE principles [7]. These include all the principles that are also described in the so-called MACVICIT principles [4] and in addition progression (P). The CAMPVISE principles involve focusing on the following in the facilitation and implementation of training:

Table 1: CAMPVISE outlined

***C**oncretisation*	***A**ctivation*	***M**otivation*	***P**rogression*
***V**ariation*	***I**ndividualisation*	***S**ocialisation and cooperation*	***E**valuation*

3.2. MACVICIT Principles of teaching

Torgersen & Vavik [4] present yet another set of variables that affect good teaching. The MACVICIT variables involve focusing on the following in the facilitation and implementation of training:

Table 2: MACVICIT outlined

***M**otivation*	***A**ctualisation & activation*	***C**oncretisation*	***V**isualisation, guidance & variation*
***I**ndividualisation*	***C**ooperation*	***I**ntegration*	***T**rust, security, enjoyment & belonging*

3.3. Summary of different principles of teaching

The common denominators in the CAMPVISE and MACVICIT are:

Table 3: Common teaching principles

***M**otivation*	***A**ctivation*	***C**oncretisation*
***C**ooperation*	***I**ndividualisation*	

This paper focuses on the teaching principle of motivation since it is regarded as the most basic factor – the very "driving force: behind all teaching. If no motivation is generated among the students, the chances of the students immersing themselves in the training at all are very small.

Based on our problem analysis we have defined the following problem:

How can online learning be facilitated such that the teaching principle of motivation is optimised?

IV. MOTIVATION AND MOTIVATING

The term motivation derives from the Latin word "movere," which means to move. This has to do with the basic issue of what driving forces make us act.

Kaufmann & Kaufmann [8] define motivation as follows:

"Motivation is the biological, psychological and social factors that activate, provide direction and maintain behavior in varying degrees of intensity in relation to goal achievement."

Nordskog & Popperud [1] expand upon this definition somewhat by defining motivation as the inner state of excitement of the individual student. This state of excitement must be satisfied to aid increased learning. Arnold Hofset [9] defines motivation in the following manner:

"What we do (pedagogically) to create motivation. These are the external means – the carrot and the stick. Incentives, rewards, penalties and motivational means provide us with some opportunities for variation."

Motivation can further be categorized into an inner and external dimension. Whereas the inner dimension is created by one's own interest in the teaching going on, the external dimension is created by a desire for, for example, a permanent job, higher salary, or other goals that can be characterized as some form of reward.

There are a number of theories associated with motivation. It is normal to group these into four main categories [8]. However, the transitions between these categories are fluid. For example, a needs theory can also be a cognitive motivation theory. An overview of the various categories is provided below:

Table 4: Different categories of motivational theories

Category	Details
Needs theories	Attempts to arrive at a set of basic needs that can explain most of what we humans undertake. The best-known theory was developed by Abraham Maslow, but there are other needs theories such as, for example, Alderfer's ERG theory, McClelland's needs theory and Deci & Ryan's self-determination theory.
Cognitive motivation theory	This theory stresses that actions are a result of a conscious choice. Key terms within this category of theories include "objective," "goal management," "expectations," "benefit," and "reward."
Social motivation theories	This type of motivation theory focuses on how the individual's perception of his or her relationship to his or her fellow human beings can have a motivational or de-motivational effect. Key theories include "the theory," "the theory regarding fairness in procedures," "social information processing theory," etc.
Job characteristics theories	This type of theory focuses on the fact that it is the characteristics of the training or job itself that affect the student's motivation and performance. The best-known theory is Herzberg's two-factor model.

In order to discuss how online learning can be designed to optimize the teaching principle of motivation, we have chosen to make our discussion based on theories from three of these four categories: needs theories, cognitive motivation theory, and job characteristics theories. "Social motivation theories" have been left out, because these theories focus on external factors which are difficult to manipulate with respect to training in general. In the following discussion, each of the factors involved in the chosen theories will be discussed in relation to online learning.

4.1. Needs theory

This paper considers two different approaches to needs theories: Abraham Maslow's and Clayton Alderfer's needs theories and Deci & Ryan`s Self Determination Theory (SDT) [10].

Based on an analysis of these theories, the paper discusses how online learning can be facilitated in such a manner that it reinforces social needs, esteem needs, self-actualization, the need to experience skills, the need for self-determination, and the need to belong [11].

The CANE model is a two-step cognitive based model for work motivation developed by Richard Clark [12]. The model's first step attempts to explain what influences the mental effort to acquire knowledge through learning. It suggests that mental effort is a product of the following three variables: Control value (Will the effort the learning requires make me more effective?), Emotions (Do I feel anything about this?) and Personal "agency" (Can I do this [self-efficacy] and will I be allowed/have an opportunity to do this?).

More specifically this means that one has to focus on why the learning will make the student more effective (control value), one must implement measures that promote positive emotions, and one must focus on reinforcing the self-efficacy of the students through convincing them that they will manage it, and that they have the support of the management in carrying out the training.

4.2. Objective theories

Common for the most important principles here are that specific goals promote effort better than general goals, that difficult goals have a greater motivational effect than easier goals if they are accepted, and that feedback about results leads to greater effort than no feedback does. Concrete feedback provides informative guidance to the student. *Goals/objective* and *feedback* are thus the two most important factors in objective theory.

4.3. Job characteristics theories

The best-known job characteristics theory dealt with in this paper is the two-factor model involving driving and restraining factors developed by Herzberg [13]. The theory takes as its starting point the assumption that a person who is enjoying something will also be motivated and productive. Herzberg [13] also found that there was a basis for differentiating between two factors:

1. Motivational factors: have a positive effect on enjoyment
2. Hygiene factors: lead to the absence of negative working conditions

As far as motivation is concerned, Herzberg [13] operates with six different factors:

a) ***Achievement****:* people are motivated by the satisfaction of completing a task, solving problems and seeing the results of the tasks they have carried out.

b) ***Recognition****:* people are motivated by unambiguous praise for well-performed tasks.

c) ***Work itself****:* people are motivated when the tasks in themselves are interesting, varied, challenging, creative, etc.

d) ***Responsibility***: people are motivated when they get an opportunity to have control over their own work situation and have a certain degree of freedom to determine themselves how tasks should be resolved.

e) ***Advancement***: people are motivated if they see that well-performed tasks can lead to career advancement. Seen in relation to training this could involve, for example, training providing certification or something similar that can act as a means of career advancement.

f) ***Growth***: people are motivated when they have the time and an opportunity to learn new things and develop new skills. In the further discussion of motivational factors from the perspective of online learning we will not be dealing with this factor, since it is precisely growth that is the goal of all training.

4.4. Summary of motivational factors

Based on the analysis of the factors discussed earlier, the following six different motivational factors are regarded as the most important in relation to online learning. This because we consider that these factors cover the whole picture of how to motivate learners.

Table 5: The chosen motivational factors

Objective/goals	**Involvement**	**Feedback**
Emotions	**Socialisation and belonging**	**Self-efficacy**

The six chosen motivational factors are supported by previously carried out studies. An analysis of eight eLearning courses with responses from 497 respondents carried out by Thurston [14] indicates that clear course goals, interruptions during the course, available feedback during the course, self-regulation, and faith in one's own mastering are important factors that separated those who completed the course from those who did not.

V. OPERATIONALIZATION OF THE MOTIVATIONAL FACTORS

Based on experiences from online learning developed and used by Norwegian Defence (NoD), and research within the subject, the six factors are operationalized to be considered by NoD in the further development and use of online learning.

5.1. Objective (purpose) and goals

In order to motivate the individual student vis-à-vis online learning it is important to communicate clear goals vis-à-vis the training and the overall objective (purpose) of the training.

As far as objectives are concerned, communicating a clear expression of the purpose of the course will clearly have a motivational effect. It is important that students see the immediate benefit in relation to their own personal development as well as the relevance and utilitarian value in relation to their own work situation. For example, one could have a separate "What's in it for me?" sequence at the start of the course. Here one can illustrate the benefits the training will provide the individual. These could be personal benefits such as certification, study points, an advancement, or work related benefits such as more efficient work processes.

Using online learning, one can also take as one's starting point the individual student's individual objective by giving students an opportunity to express their standpoint and their expectations. From this, one can generate an objective for the training that is based on both the organization's expectations and objectives, and those of the individual employee.

Referring to clearly expressed and specific training goals at any given time has proven to have a motivational effect. According to Hofset [9], a list of the course's learning goals can be one of the best short-term goals for mature students who want to learn, since they can cross them off as they master them. Furthermore, the goals' degree of difficulty must be adapted to the target group. This means that each student must have something for which to strive. This can best be done if one can differentiate the degree of difficulty according to the individual student's aptitudes and starting point.

This can be operationalized by having different ways of performing a task. One approach can be that the users themselves choose how difficult the training will be. For example in the case of application training, one can design simulations that allow the users themselves to choose a "show me," "guide me," or "let me" approach. By differentiating between the goals based on the students' expectations one is also facilitating the communication of clear, personal expectations that the individual students can adopt. Another issue associated with goals is the communication of each individual's progress in relation to achieving the expected goals and progression. For example this could involve illustration using a progression bar/progress indicator or by an advanced menu structure in which course goals that have been achieved are crossed off.

5.2. Involvement

Activation

Activation of the students during an online course is a necessary part of motivational work. Activating can be done in many ways. It can be done using various types of cases, games, simulations, discussion groups, and chat, in addition to traditional responses to tasks.

Case based training can be done by giving a student an on-going task during the course based on the same setting and/or metaphor. This ensures a common theme throughout the entire course. The various tasks linked to the case must be relevant and realistic to the individual student.

Games stimulate the students' competitive instincts and help to make the learning more engaging. Most people will experience games as somewhat pleasurable and fun, which helps to create inner motivation. Dr. Robert Ahlers and Rosemary Garris of the US Navy Submarine Laboratory concluded after a three-year research project that games work well in a training context because they provide an opportunity for success, create a form of meaning, encourage curiosity, and, to a certain degree, fascinate the student [15].

Simulations can be facilitated in various ways according to the individual's aptitudes as mentioned under objectives/goals.

Discussion groups and chat activate students because they can shed light on a problem in a communal setting and provide them with an opportunity to reflect. Discussion groups are based on asynchronous communication, unlike chat, which takes place synchronously. By establishing discussion groups, the teaching supervisor has an opportunity to activate the students and at the same time check that the individual students are playing an active part in the discussion. Given that chat takes place in real time, there is less of an opportunity and time for reflection. On the other hand, chat involves an expectation of quick feed-back in which students are asked questions in real time.

This increases the likelihood of activation. Increasingly now, the Norwegian Defense Forces is seeing a generation of students who expect learning based on activities supported by the same technology they are familiar with from their leisure activities, such as games, etc.

Influence and participation

Allowing students to influence and contribute to the teaching system and the scope of the teaching generates involvement. This can be operationalized through modularisation and flexibility. By modularizing the training, one can differentiate and thus put together training paths based on pre-testing and/or advance dialogue with the teaching supervisor (e.g., via email or chat). Flexibility can be created by, for example, non-fixed start times and free progression. The belief that this is perceived as positive is supported by a survey published by Torstein Rekkedal [16].

5.3. Feedback

Course progress

Receiving continuous feedback has a motivational effect on students. This can be operationalized in the form of a progression bar or a progression report during the online course.

Learning progression

Frequent and immediate feedback is an essential feature of motivating learners. In the case of training involving many small tasks, feedback about whether or not the answer was correct should be displayed immediately. The pleasure of answering an individual task correctly may not be that great, but it will be reinforced by the triumphs following each other so closely [9]. This works best with interactive courses. In the case of online teaching, students should receive feedback about their learning progression from the teaching supervisor. This can be done using synchronous and/or asynchronous communication (chat or email). The teaching supervisor's ability to monitor the progression and efforts of individual students gives him or her the opportunity to provide students with continuous feedback. This can supplement and/or replace final feedback.

Emotions

Emotions, and in particular, frame of mind are challenging factors to influence in connection with online learning. However, by generating emotions one can bring out desired reactions from the students such as, contemplation and reflection. At an eLearning conference in the autumn of 2003, representatives from the entertainment industry focused on playing on emotions in a training context. Their message was that the teaching industry must get better at generating emotions in students like the entertainment industry does in both films and amusement parks. As part of this message, they said that the teaching industry must work more on the "art of storytelling." Storytelling is one of the most effective aids to generating emotions such as laughter, grief, fear, reflection, etc. Good visualization is very important when it comes to reinforcing storytelling. Using things such as 3D figures with changing emotional expressions, virtual reality (VR) and artificial intelligence (AI) can influence a student's frame of mind.

Sound is also an important means of generating emotions. For instance Norwegian Defense Forces successfully use sound in introductions to online courses with the aim of putting students in the right frame of mind. The NoD has also utilized sound in connection with relaxation during the training. The purpose of this was to give students a break in the training and motivate him or her to start the remainder of the training. Surveys show that adults cannot manage to concentrate continuously for more than one hour at a time, which is why breaks are important. Based on feedback from students, NoD has made it a requirement to supplement all text with speech during online learning.

5.4. Socialization and belonging

A good means to increase students' sense of socialization (in online learning) is to allow every student and teaching supervisor to create their own profile that contains both a photo and information about themselves. By making these available to fellow students and teaching supervisors, one can get them to bond and create a virtual social community. This is used at the NoD Staff School in Oslo. One can also encourage socialization between students and teaching supervisors by facilitating forms of communication such as chat and email. This, together with student and teaching supervisor profiles, helps students to make better use of each other's resources. Technology enables participants' pictures and profiles to be automatically displayed when they participate in discussion groups and when using email and chat. Furthermore one can organize discussion groups linked to topics and subjects through "Communities of Practice."

A sense of belonging is closely linked to socialization. It is important to create a sense of belonging with respect to the company or organization to which the students belong. Internal company online learning can, for example, be done by the head of an organization, which emphasizes the importance of the student developing the relevant skills. This will help to increase a sense of belonging and recognition. It is possible to facilitate this through one-way communication in the form of film clips, sound files, or similar means. One example of this in NoD, is the use of Chief of Defense General Sigurd Frisvold (ret) in the introduction to an online course about human recourse management.

5.5. Self-efficacy

There are various means of facilitating training that take into account that students' confidence in their own ability to learn will vary. Using a pre-test and/or introductory communication between the teaching supervisor and the individual student gives one an opportunity to ascertain a student's confidence in his or her ability to learn, which can then be taken into account in the training.

As step 2 in the CANE model, Clark [12] proposes a linear curve correlation between mental effort and confidence in one's ability to master the relevant knowledge acquisition/learning (self-efficacy). The figure below illustrates this correlation.

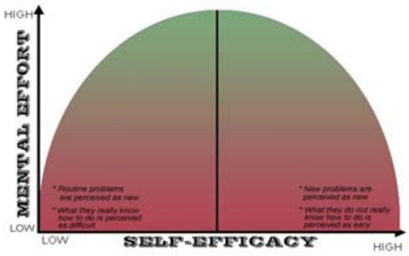

Figure 4: The correlation between mental effort and confidence in one's own ability

On the basis of this figure, one can conclude that you must be aware of those who have too much and those who have too little confidence in their abilities to take in the relevant subject material. After detecting different individual starting points, one can, for example, create different introductions for different students. Some students will have to be helped to get going by, for example, asking them simple questions to begin with and then gradually increasing the level of difficulty. Others will need to be challenged from the start and others again will perhaps need some "deprogramming" before the learning can begin. The latter can be operationalized by, for example, expanding on a subject and getting the student to reflect on previously ingrained attitudes and old learning. Some students need a clearly defined path to follow while others want to be free to choose their own paths. A survey by Thurston [14] concludes that a clear structure, good user friendliness, and easy access to the course content are important in building up self-efficacy.

CONCLUSIONS

To make it easier for developers of online learning within NoD (and others) to optimize learner's motivation, a checklist has been developed. This checklist has been validated through development of several online courses in NoD such as Human resource and Laws of war. Students' feedback suggests that the developer has succeeded to motivate them. The checklist has proven helpful to developers, remembering to focus on the learners' motivational needs during the development of such courses. This list has become a standard piece of the information available to NoD courseware developers and is still enclosed NoD`s methodology for developing e-learning. (See the Learner's Motivation Checklist in Appendix A1.)

Acknowledgements
Thanks to my fellow students Pål Andre Ramberg and Åsmund Berg-Nilsen who co-authored the thesis that this article is based upon.

References

[1] Nordskog, H. & Popperud, O., 2000. *Voksenpedagogikk, Modul 1 Sentrale emner i voksenpedagogikk*. NKI forlaget and Norsk fjernundervisning

[2] Loeng, S., Torgersen, G.E., Melbye, P.E., Lodgaard, E., 2001. *Voksenpedagogikk i kompetansesamfunnet*. Compendius

[3] Stensaasen, S. & Sletta, O.S., 1993. *Gruppeprosesser – læring og samarbeid i grupper*, 2nd edition, Universitetsforlaget
[4] Torgersen, G. & Vavik, L., 2004. *Forskningsmetode i IKT-pedagogikk*. Stjørdal: Læringsforlaget DA
[5] Seddon, P. B. et al., 1997. *The IS Effectiveness matrix: The Importance of Stakeholder and Systems in Measuring IS Success*.
[6] Laudon, K.C. & Laudon, J.P., 2001. *Essential Management Information Systems – Organization & Technology in the Networked Enterprise*. 4th edition, Prentice Hall, New York
[7] FUD, Ministry of Education, Research and Church Affairs., 1997. *Læreplanverket for den 10-årige grunnskolen.*
[8] Kaufmann, G. & Kaufmann, A., 1998. 2nd edition: *Psykologi i organisasjon og ledelse.* Fagbokforlaget
[9] Hofset, A.M., 1995. *Pedagogikk for videregående skole og voksenopplæring.* Universitetsforlaget
[10] Deci, E.L, & Ryan, R.M, 2000. *The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behavior*, *Psychological Inquiry, 11 (227-268)*
[11] Eriksen, T.H; Gad, T; Martinsen, Ø; Thomson, G., 2003. "*Selvledelse – menneskelig kapital i det nye arbeidslivet*". Gyldendal Akademisk
[12] Lowyck, J., 1999. *"Trends in Corporate Training"*. University of Lauven Press, Leuven Belgium.
[13] Armstrong, M., 2001. *"A Handbook of Human Resource Management Practice"*. 8th edition, Kogan Page Limited.
[14] Thurston, P. W., 2003. *Going further with e-learning: Factors influencing persistence, transfer and intentions to continue*. IITSEC Orlando, FL: National Training System Association
[15] Prensky, M., 2001. *Digital Game-Based Learning*, McGraw-Hill, New York.
[16] Aleksandersen, J, Ask, B, Jamissen, G, Myklebost,. 2001. *"Nettbasert læring i høgre utdanning – noen norske erfaringer"*. Published by SOFF, Tromsø.

Appendix

A1: Learner's motivation a checklist

1. Objective (purpose) and goals:	
1.1	Is the objective/purpose of the course clearly expressed?
1.2	Is the objective relevant with respect to the student's work situation?
1.3	Has a 'What's in it for me?' sequence been included as part of the introduction to the course?
1.4	Have the benefits the training will provide each individual been expressed?
1.5	Has account been taken of the individual students' expectations in the formulation of the objective?
1.6	Have specific training goals associated with the course been clearly expressed?
1.7	Do individual students have an opportunity to cross off as they master the various training goals?
1.8	Have the goals been prepared in such a way that all students have something to strive for?
1.9	Has a progression bar/progress indicator been included that provides a visual indication of the course goals that have been achieved?
2. Involvement: activation, influence and participation	
2.1	Have different means of activation been developed (cases, games, simulations, discussion groups and/or chat)?
2.2	Is the course module based?
2.3	Have pre-tests and/or dialogues been incorporated for differentiated training paths?
2.4	Is the course flexible vis-à-vis starting and ending times (progression)?
3. Feedback: course progress and academic progression (measure discussed under 1.9)	
3.1	Is continuous feedback provided regarding course progress from the perspective of total course volume?
3.2	Is feedback provided immediately (in the case of interactive courses)?
3.3	Does the student receive feedback vis-à-vis academic progression from the teaching supervisor?
4. Emotions	
4.1	Have you tried to influence the student's frame of mind using sound?
4.2	Have you tried to influence the student's frame of mind using photos, animations and/or video?
4.3	Have you tried to influence the student's frame of mind using humour?
4.4	Has storytelling been designed into the course as a means?
4.5	Have you used 3D figures that express emotions, virtual reality (VR) and/or artificial intelligence (AI)?
5. Socialisation and a sense of belonging	
5.1	Can students and the teaching supervisor quickly and easily enter their own user profile with a photo and personal information in order to aid socialisation?
5.2	Has chat been included as a form of communication?
5.3	Has email been included as a form of communication?
5.4	Does the design incorporate discussion groups linked to specific topics and/or subjects?

5.5	Does the design include elements that create a sense of belonging to the enterprise in which an important senior manager emphasises the importance of the training?
6. Self-efficacy	
6.1	Has a pre-test been implemented to ascertain the students' self-perceived mastering ability?
6.2	Has introductory communication between the teaching supervisor and students been incorporated to ascertain the students' self-perceived mastering ability?
6.3	Have different introductions been developed in order to influence the degree of the individual student's self-perceived mastering ability?
6.4	Has the course been designed with a clear structure?
6.5	Has the course been designed with good user friendliness in mind?
6.6	Is the course content easily accessible?

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DISTANCE EDUCATION FOR THE POLISH ARMED FORCES NEEDS

Assoc. Prof. Piotr GAWLICZEK*, LTC Dariusz POCZEKALEWICZ**

Abstract: *The paper deals with the issues related to the education and training within the National Defence University, Poland. The essence of the institutional specificity is described. The importance of the advanced distributed learning (ADL) tools is underlined. In this context the observations, reflections on the training for the Polish Armed Forces needs are offered. Also the ADL role within the DEEP programs is mentioned. Finally, the conclusions are presented on the international importance of the endeavors by the NDU Warsaw ADL team.*

Keywords: *distance education; ADL; e-learning, NDU Warsaw, Polish Armed Forces.*

I. INTRODUCTION

The National Defence University (NDU) in Warsaw is a unique institution of higher education in Poland. Despite the fact that it is the highest educational institution of the Polish Armed Forces focused on the military officers' command and staff education, the number of civilian students has been growing.

NDU enjoys the reputation of having a unique history: it inherits traditions of the oldest Polish military schools, mainly the School of Knights, War College — literally, the "Higher War College" – and the General Staff Academy. On the 1st of October, 1990, the General Staff Academy of the Polish Military Forces was changed to NDU [1]. Today NDU consists of two faculties: the Management and Command Faculty, and the National Security Faculty. There are also three Training Centres: the Foreign Languages Teaching Centre; the Military Personnel Training Branch, which includes the War Games and Simulation Center, Chemical, Biological, Radiological, and Nuclear (CBRN) Defence Training Centre of the

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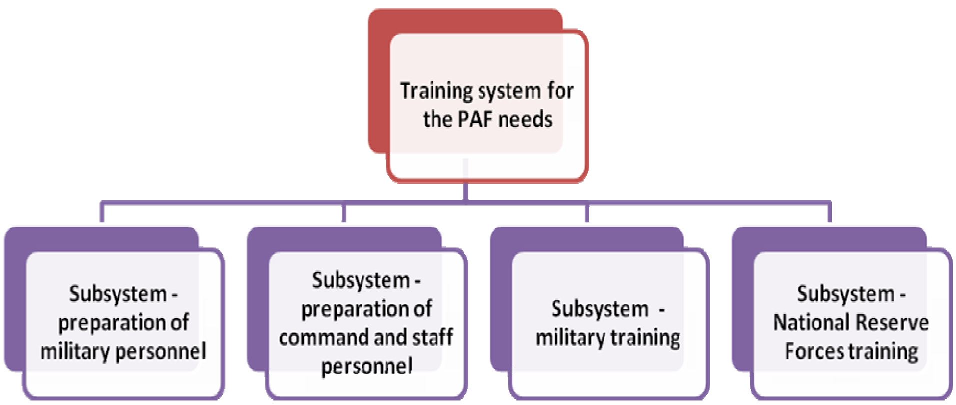
Polish Armed Forces (PAF); and the Officers Training Centre, Distance Learning Division.

Considering the many changes within the security realm, NDU has been working to adjust/change the educational and training paradigm. In this respect, NDU Warsaw education and training processes are supported by new technology and innovative systems [2]. Poland's advanced distributed learning (ADL) programme is dedicated both to civilian and military students. Five years ago NDU began developing and using advanced technologies throughout the education and training process and quickly became a leader in the Polish Armed Forces. During these developmental activities, NDU has been leveraging the good examples from other ADL partnership laboratories and joined the ADL Partnership Network in 2012. The Poland ADL Partnership Laboratory (Poland ADL Partnership Lab) is part of NDU and is located in Warsaw, Poland. The Partnership Lab is a collaborative project between ADL Initiative and the Polish Ministry of National Defence. NDU directs the work of the Poland ADL Partnership Lab. The Poland ADL Partnership Lab focuses on cooperation with the armed forces and especially with the newly formed General Command of the PAF.

II. DISTANCE EDUCATION AS THE PART OF TRAINING OF THE POLISH ARMED FORCES SYSTEM

In order to show the involvement of the Poland ADL Partnership Lab in the development of distance education and training for the PAF needs, a model system of training of the PAF is presented on the following figure. It is possible to identify four subsystems:



2.1. Subsystem preparation of military personnel [3]

Within this subsystem, there are courses for Bachelor's, Master's, PhD levels and postgraduate students. The main idea is to support the educational process through the Learning Management System (LMS) and Virtual Classrooms. NDU has adopted a blended learning model, which means that Information and Communication Technologies complement the traditional curriculum. In the process of education, the means of communication between teacher and students are critical. The didactical materials include ADL courses which are conformant with the SCORM 2004 specification.

The Poland ADL Partnership Lab is implementing new ways to use technology for teaching foreign languages. In this case, the Poland ADL Partnership Lab undertook the steps towards the participation in the project for '**C**re**A**ting **M**achinima **E**mpowers **L**ive **O**nline language **T**eaching and learning (CAMELOT) [4] which is funded by the European Union. Nine project partners over a period of two years will develop machinima for language learners and develop a teacher training course on how to create machinima and how to use it in education (how to blend with traditional learning). Frank Dellario of www.machinima.org defines machinima as: "*filmmaking within a real-time, 3D virtual environment. In an expanded definition, it is the convergence of filmmaking, animation and game development. By combining the techniques of filmmaking, the flexibility of animation production and the technology of real-time 3D game engines, Machinima makes for a very cost- and time-efficient way to produce films*." It should also be noted that this project also includes the use of mobile learning (mLearning) technology.

2.2. Subsystem – preparation of commands and staffs

Meeting the needs for command and staff personnel training for the PAF is a key area of training activities. It is aimed to prepare key personnel to perform their tasks and missions. This subsystem includes both national and international dimensions. Each academic year NDU carries out command-staff exercises, and the distance learning solutions are available for the military students and course members.

There is also the possibility for personnel to have access to ADL systems, which allows better theoretical preparation for these exercises. Personnel have access, via mLearning tools, to such resources as tactical signs and technical and tactical parameters of weapons. Regarding the international aspects, the main goal is to prepare military staff for service in the international community. This preparation is achieved by web-based training combined with traditional training (blended learning). During the ADL courses, it is possible to transfer intercultural knowledge and understanding, develop intercultural communication skills, and improve language competence and oral communication skills.

2.3. Subsystem – military training

This subsystem is implemented by commanders at all levels of command and specialized training centers, focused on the development of high combat qualities. Beginning in 2014 the Poland ADL Partnership Lab began conducting a stationary course about ADL methodology for personnel of training centers. At the end of the course, the graduates know about all the stages and phases of the preparation and development of teaching material that meets the needs of the LMS. NDU also allows all soldiers and military employees to have access to the e-learning platform, the repository of ADL courses, and virtual lectures recorded during the Security and Defense Forums.

2.4. Subsystem – National Reserve Forces training

While the PAF continues to work on the concept of training within the National Reserve Forces, NDU has been implementing training for the National Reserve Forces. It is possible to gain theoretical knowledge and practical training which will be useful for service in the armed forces and paramilitary services. The best solution for students wishing to join the National Reserve Forces is to obtain the theoretical knowledge through distance education. In this case NDU launched a separate platform for e-learning courses on: organization of armed forces, tactics, regulations, communications systems, and introductory knowledge of CBRN. Along with their studies, students can enjoy the additional training that will help them to obtain higher military rank in the future.

III. DISTANCE LEARNING IN DEEP

The Defence Education Enhancement Programme (DEEP) was initiated in 2006 to realise alliance initiatives that enhance defence institutions in selected partner countries with regard to ensuring civil and democratic control over the armed forces. The main aim of the programme is to develop and reform education in the defence sphere. This includes such activities as preparing programmes and methodology of teaching or conducting researches. These efforts are coordinated by International Staff (IS) representatives and a nation that has undertaken the role of leadership in a particular project. The IS and the lead nation also work in cooperation with International Military Staff (IMS), North Atlantic Treaty

Organization (NATO) School Oberammergau, NATO Defense College in Rome, NATO Allied Command Transformation (ACT), and the European Command (EUCOM). There is a common fund of NATO and U.S. Department of Defense (Warsaw Initiative Fund) to finance the activities.

The DEEP programme is one of several tools of educational cooperation and is an important element in practical support in selected partner countries. A major advantage is that initiating DEEP does not require substantial costs, from either the partner or the supported ally. This results in considering a possibility of expanding the group of countries. NDU's role in this field is visible and appreciated by the experts who notice the importance of reforms in military education. Poland's commitment is an essential element of support for partner countries. In this context, in the assessment of an institution, any further activities could be oriented at expanding DEEP to other nations. The Partnership for Peace (PfP) nations expect the Alliance to be able to provide the assistance and expertise; therefore, there is a requirement to continue to invest in the time and resources and partner nations in their efforts to streamline their educational capabilities.

In September 2012, NATO Headquarters hosted the 1st functional Clearing-House conference to summarize the current activities of donor countries involved in DEEP. The 2nd functional Clearing House conference took place in Norfolk in June 2013, and the 3rd functional Clearing House took place in Bucharest in June 2014. Such events are to be continued; giving this initiative a more organised and institutionalised form within NATO activities. The conferences showed that Poland was one of the most active allies in this field. It was officially reassured that NDU is and will stay an important element of the network which enhances defence education and also a significant academic contributor in the field of security. And ADL is a formidable tool to be used in this regard.

IV. CONCLUSION

In order to meet all the expectations, NDU is looking for and sharing innovative solutions. There are military and civilian students to be taken into account as far as the various forms of learning and training are concerned. On one hand, there is the dedicated organizational structure (two faculties and three training centers) and on the other hand, the education and training process is supported by new technology and innovative solutions [5].

To address the learning needs of the broad range of students, NDU Warsaw has developed many in-house courses for the PAF and for civilian students. The development of ADL activities within NDU Warsaw is widely recognized and very well received by foreign nations. The members of the ADL team participated in various international and domestic events (conferences, seminars, workshops and meetings) that focused mainly on the exchange of experiences and best practices. It also concerns technical and methodological issues and data exchange on the latest developments. The symbolic example is PfP Consortium ADL Working Group: NDU Warsaw was the host of the ADL WG meeting in Warsaw in November 2013 [6].

References

[1] National Defence University, 2014. NDU Publishing Department, Page 9.

[2] Gawliczek, P., 2013. The innovative military technologies in a circle: military, industry, armed forces, education and training institutions, *Journal of Polish-American Science and Technology No. 7*

[3] Doctrine of Training Polish Armed Forces, DD / 7 (A)

[4] http://camelotproject.eu/ (08/22/2014)

[5] Gawliczek P., 2013. Showing the way. Contributions from the newest NATO countries, *Connections 2013 special edition, PfP Consortium Quarterly*.

[6] Keremidcheva G., 2014, Advanced Distributed Learning Working Group, *In Annual Report 2013 PfP Consortium of Defense Academies and Security Studies Institutions*. Republic of Austria / Federal Ministry of Defence and Sports, 5/2014, March 2014, Pages 47-52.

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Volume 2, Number 6, 2014
JADLET Journal of Advanced Distributed Learning Technology

TRAINING NEEDS ANALYSIS APPLIED TO THE ROMANIAN MILITARY DOMAIN OF FOREIGN LANGUAGE LEARNING FROM THE VIEWPOINT OF THE SPECIFIC CHARACTERISTICS OF ADL SYSTEM

Daniel BELIGAN*, Ion ROCEANU*, Dragos BĂRBIERU*, Cătălin RADU*

***Abstract**: Technological changes have developed in such a manner that they have changed significantly the theatre of military actions and, as a result, the requirements of military training and education. The technological transformations are continuing to generate new possibilities for the differnces, complexity and the dynamics of the instruction while expanding the base of associate knowledge. A current characteristic for military personnel is the need of continuous training. The system of continuous training in foreign languages is part of the system of continuous training of the Ministry of National Defence personnel. This article tries to review the needs of training, specific for the Romanian military system of learning foreign languages, having as a premise the idea that, at least part of the requirements may be satisfied by the advanced distributed learning system.*

***Keywords:** training needs; learning foreign language; online components*

I. INTRODUCTION

Training may be described as "the acquirement of competences, concepts and attitudes that result in an improved performance at the workplace" [1]. Broadly speaking, we are dealing with a need for training when there is a difference between what a person should know in order to perform well and what a person already knows. An analysis of the needs of training is an instrument used to identify what courses and training and educational activities have to be offered to the employees in order to develop their skills and knowledge to perform their job or their future job at the highest level. Another approach (Lundberg, Elderman, Ferrell and Harper, 2010) [2], (Chiu, Thompson, Mak and Lo, 1999) [3] defines the

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analysis of training needs as a review of the learning and developing necessities within an organization. The analysis refers to the skills, knowledge or behavior needed by the persons belonging to an organization, as well as to their effective development. The analysis of the training needs is considered to be the foundation of all training activities (Reed and Vakola, 2006) [4]. In other words, the analysis of the training needs defines the learning objectives, which offer systematic opportunities of training that allow the elimination of performance gaps, the clarification of the education and training level, and the identification of the means to successfully achieve the desired results.

A well-structured analysis should be based on a more accurate and comprehensive understanding of organizational needs, as well as of the nature of the problems that are to be analyzed. In order to analyze the training needs, the following objectives have to be taken into account:

- Determine to what extent the training is necessary and, at the same time, relevant for a specific activity;
- Determine to what extent the training will improve the performances of the organization/team;
- Determine if the training will produce a quality growth compared to the previous activity.

When a training analysis is performed, we have to take into consideration the following important questions:

- What tasks are to be performed?
- How often are these tasks performed?
- How important is each task?
- How difficult is each task?
- What types of training are available?

II. STEPS IN TRAINING NEEDS ANALYSIS

The system of continuous training in foreign languages is part of the system of continuous training of the Romanian Ministry of National Defence personnel; and it represents all administrative structures and educational entities that are organized and function in a correlated way. These administrative structures and educational entities are based on certain principles, in order to accomplish the educational goals and objectives in the field of foreign languages. They are adapted to the operational requests imposed by the present and the future missions of the armed forces, as well as to the development tendencies of the international cooperation relations of Romania in the field of defence.

In 2010, the Human Resources Management Directorate, the coordinating structure of the programs for learning foreign languages within the Ministry of National Defence, began an analysis that had as its main objective the efficient execution of these programs.

The starting point, **the idea**, of this step was the need to use the full potential of technology to design, organize, and develop modules/courses for linguistic training that may allow distance learning, including the use of online communication environments [5].

The outcome of the analysis was a proposal to use specific components of the advanced distributed learning system, namely using educational platforms, which, through specific instruments, allow the development of online course modules and initial online testing.

Expected results:

- Correlation of training needs in the field of language learning with job requirements;
- Reduced costs;
- Achievement of continuity of learning and training;
- More efficient use of educational resources;
- Maintenance of the level of achieved proficiency.

The pedagogical analysis has aimed to establish general and specific competencies and the way in which the contents are presented for each level/type of course in order to identify the proper didactical support.

Roles involved:

- Coordinator – Human Resources Management Directorate
- Didactical expertise – the 130 foreign language teachers in 17 centres for foreign languages.
- Technical expertise – the specialized structure from "Carol I" National Defence University.

The types of learning taken into consideration:

- intensive, 4-6 hours daily, to reach 28 hours a week;
- a non-intensive system, with required daily classes and weekly meetings to accomplish the established didactical objectives;
- blended system, with both face-to-face and distance learning, with required daily classes and weekly meetings to accomplish the established didactical objectives;
- tutoring system, in a quantum of classes set by each institution, for each type of course.

Technical analysis has taken into account all the possible types of content, the standards to design the content, which types should be accessed online, and which types should follow the educational standards.

Costs/benefits:
- the reduced costs for transport, accommodation, daily fee for the persons that are tested in the garrisons of residence. They are no longer tested in specialized centers belonging to the Ministry of National Defence;
- the elimination of the time away from the workplace of the persons being tested and of those that are using online tutoring;
- the infrastructure used already exists.

III. TRAINING NEEDS ANALYSIS SPECIFIC TO THE ROMANIAN MILITARY FOREIGN LANGUAGE LEARNING SYSTEM

The first step in training needs analysis is represented by identifying positions requiring specific language skills and the level of these skills. The language skills represent the body of communication knowledge, abilities, and attitudes in a foreign language needed for a certain position.

Establishing a list of posts with language requirements shall be made in each military unit, under the coordination of the chiefs of personnel structures, taking into consideration the specific needs of each position and the job description. The lists will be centralized by the Human Resources Management Directorate.

The second step is the identification of the persons that belong to the personnel category that must be part of a program of continuous training in foreign languages. Being part of this program, namely the need of training is determined by the deficit of competences reported to the language requirements of the position occupied or about to be occupied by a person.

The analysis of the needs of continuous training in learning foreign languages takes place every year and, obviously, it takes into consideration the personnel that are included or will be included on the list of positions with language requirements from the Ministry of National Defence.

The third step is an initial evaluation to determine the level of competences with a comparison to the language requirements of the position. The personnel tested who are to be part of a program of continuous training are sorted into groups according to level of knowledge. This evaluation is made only for the persons that do not have a STANAG 6001 certificate (standard that shows the level of knowledge of a foreign language).

Starting with the academic year 2012-2013, this initial testing was done through a multi-level online test, which is the first stage of the program of continuous training in the field of foreign languages that uses an online component.

The next step is represented by the proper continuous training, through various courses, organized by the specialized centers of the Ministry of National Defence. According to the form of organization, these centers are:
- traditional, intensive, face-to-face courses;
- online courses;
- blended courses.

According to the level of knowledge of a foreign language these courses are:

- beginner;
- familiarization;
- pre-intermediate;
- intermediate;
- post-intermediate;
- advanced.

A second stage of using the online foreign languages continuous training programs is represented by online tutoring modules, which are used to maintain and further develop the skills acquired during the intensive full-time courses.

The following scheme represents, in a nutshell, the whole cycle, starting with the analysis of training needs, up to the "elimination of performance gaps," namely acquiring the necessary skills, with all the steps needed by the online component, specific for the advanced distributed learning:

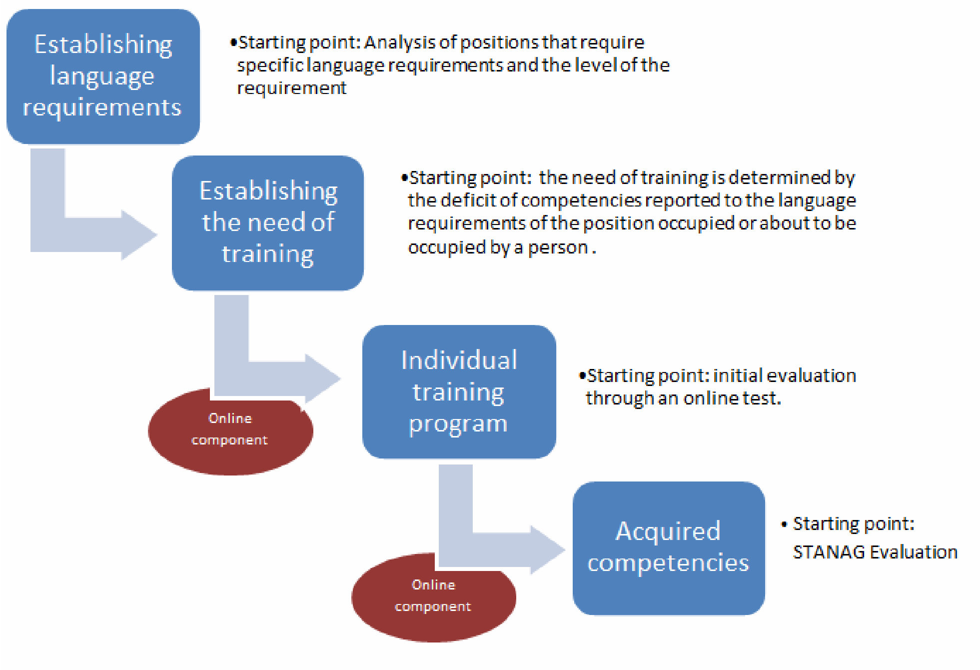

Figure 1: Implementation cycle of training needs

IV. DESCRIPTION OF THE ONLINE COMPONENTS

The first online component is a multilevel online test, organized into 4 sections, one for each language skill, namely listening, speaking, reading and writing. It was developed by Human Resources Management Directorate using the facilities provided by "CAROL I" National Defense University ILIAS Learning Management System [6]. The test aims to assess the preliminary level of English skills and it assigns the military staff to proper courses on the basis of their level of knowledge (familiarizing, pre-intermediate, intermediate, advanced, etc.)

What is specific is the fact that the assessment is performed online, within the military unit of the candidate or at the closest one meeting the minimum technical criteria, namely internet connection, headset and microphone, and a default voice recorder.

For each candidate, the assessment comprises two stages. The first one tests the listening and reading skills in one day. The second one is planned for a different day, testing the writing and speaking skills. For the first two skills that we have mentioned before, the learning management system sets the skill level automatically, based on the number of correct answers (Figure no 2).

Short Form	Official Form	Minimum Level (in %)	Passed
INC	BEGINNER	0.00	passed
FAM	FAMILIARIZATION	12.00	passed
PRE	PREINTERMEDIARY	32.00	passed
INT	INTERMEDIARY	52.00	passed
POST	POSTINTERMEDIARY	72.00	passed
AV	ADVANCED	92.00	passed

Figure 2: Scheme of distribution on the level of competency based on the score obtained

For the writing and speaking skills, the evaluation is done by teachers. The evaluation of the speaking skill requires that after the candidates listen to the task, they launch the voice recorder, record their answers, save the audio file under their name and task number, upload the file on the platform and close the recorder. The teachers open each candidate's test, click on the audio file of each task, listen to it and grade it manually. Based on the grades given for the four tasks performed, the learning management system sets the skill level automatically. The same procedure is required for writing, only that the uploaded files are written texts.

The final level of knowledge for each candidate is set by considering all skill levels using criteria among which the productive skills (speaking and writing) are decisive.

A very important aspect that needs to be mentioned [7] is the fact that the questions of the tests are chosen randomly from pools of questions organized on skill levels. Therefore, the computer will generate a different test for each skill and candidate

The second online component consists of five distinct English tutoring modules (Figure no 3). The online tutoring modules are organized in series and groups and are taught by teachers of English from MOD language centers. The modules are particularly aimed at those who have graduated from foreign languages courses and want to maintain their abilities or even to perfect them through individual study under the guidance of a teacher. The course comprises several units within which students may find materials grouped by skills or themes. Each lesson has self-evaluation exercises. The units are set to unfold at a certain time to create a constant learning pace. Besides the learning activities of the course, the tutors may create tasks and give homework that may also be solved on the online platform. Each tutor supervises and guides between 18 and 24 students. Currently, the first 4 modules have been produced and the 5th module should be finalized in this year.

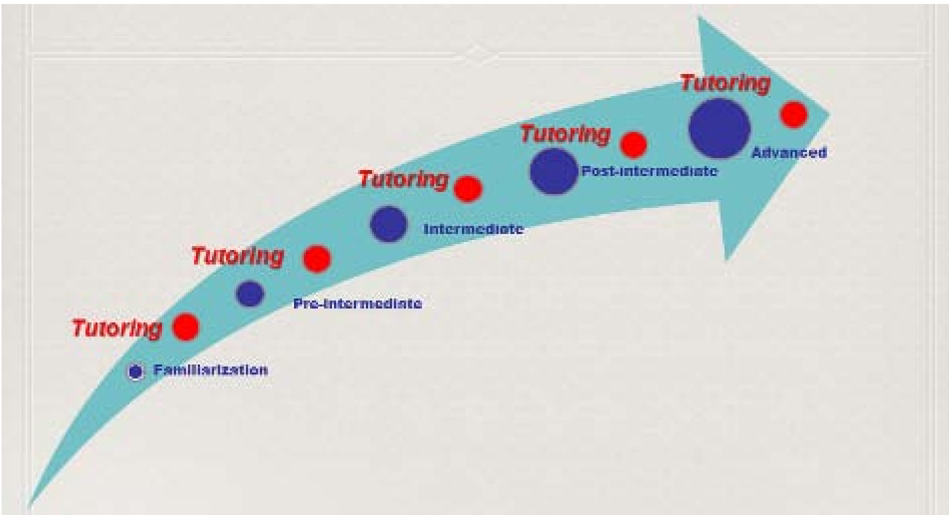

Figure 3: Online tutoring modules

CONCLUSIONS

In itself, technology is neither good nor bad, because it is only a tool [8]. It depends on the goal of its use and how it is used. Of course, no one claims that using online components is a perfect solution. But it offers advantages regarding reduced costs; the opportunity of delivering the content in real time, where and when is needed; and gives possibility for a larger number of students to study without affecting their current tasks. Even the most advanced and fastest technological systems cannot help the mission of education and training if they are poorly designed, or if they do not involve the understanding and learning of the provided educational content in an appropriate manner. However, it would be a mistake to ignore the possibilities that are offered by today's sophisticated technologies.

References

[1]. http://en.wikipedia.org

[2]. Lundberg, C., Elderman, J. L., Ferrell, P. and Harper, L., Data gathering and analysis for needs assessment: A case study, pp. 27–34, 2010

[3]. Chiu, W., Thompson, D., Mak, W., and K.L., Lo, Re-thinking training needs analysis: A proposed framework for literature review, pp. 77 – 90, 1999

[4]. Reed, J. and Vakola, M., What role can a training needs analysis play in organizational change? Journal of Organizational Change Management, 2006, Vol. 19, pp. 393 – 407

[5]. Roceanu, I., Beligan, D., Developing the ADL capabilities in "Carol I" National Defense University, Bulletin of "Carol I" National Defense University, 2014

[6]. Beligan, D. et al. - Technology for preliminary language assessment and improvement of language training programs, Journal of Advanced Distributed Learning Technology, no 3-4/2013, pp. 14-22

[7]. Beligan, D., Roceanu, I., Radu, C., Barbieru, D., Case study regarding the usability of online platforms system both as a learning environment and a collaborative working environment, e-Learning and Software for Education Conference, 2014, volume III, pp. 455-460

[8]. Gardner, H., Disciplined mind, Sigma Publishing House, Bucharest, 2011, p. 145

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PROBLEM BASED LEARNING THROUGH THE MOBILE APPLICATION

Goran P. ŠIMIĆ*, Andrija KARADŽIĆ*, Aleksandar JEVREMOVIĆ**

***Abstract**: The research described in the paper shows several aspects of implementing the procedural knowledge in e-learning: dynamic creation of the procedural tasks, automatic processing of student solutions, delivering the content, and providing the interaction through the mobile learning channel. Problem based learning (PBL) of Java programming language is used as research case study. An example Web service, developed for data exchange between mobile client and PBL service application, is presented.*

***Keywords:** Mobile Learning; Problem Based Learning; Advanced Distributed Learning; Web Service; Android Application.*

I. INTRODUCTION

Due to their modular architecture, contemporary learning management systems (LMSs) offer various possibilities for modifying and improving their interface and functionalities. It is easier now than ever before to create a new software module which fulfills our e-learning demands and can act as a specific entity plugged in the system by registering its functional (class) libraries and necessary tables that hold the extra data used. This way, different e-learning tools can be developed in an efficient and productive manner. There are no limitations for implementing numerous pedagogical tactics and strategies. Moreover, different technologies can be used together providing the conditions for implementing a variety of e-learning approaches. This paper is focused on one of these – problem based learning (PBL).

Almost all current LMSs are designed for delivering declarative knowledge. Learning the content and answering the questions related to this content represent the main e-learning pattern. For implementing procedural knowledge in e-learning, many more resources need to be engaged – either the teachers, supported by

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technical staff, have to spend more time in content preparation (i.e., in-house approach) or the institution has to seek solutions outside the organization (i.e., engaging contractors or joining the efforts with the similar institutions as a less expensive approach).

The research described in this paper shows several aspects for implementing the procedural knowledge in e-learning: dynamic creation of the procedural tasks, automatic processing of student solutions, delivering the content, and providing the interaction appropriate to the learning channel. PBL of Java programming language is used as a sample procedural knowledge domain. It provided easy access to subject matter experts, well defined domain structure and many task types that differ not only in content but in complexity. Delivering the content and providing the interaction through the mobile platforms represented another challenge in the research. After an overview of related research, section III provides information about the server-side system architecture and general solution. Section IV shows interesting details about automatic processing of learners' solutions and the last section addresses the mobile client architecture and data exchanging principles. Some examples are presented before the conclusion, which discusses how these results can be used in the other procedural knowledge domains as well as considerations about future development.

II. RELATED WORKS

PBL has been used as a pedagogy method implemented in curriculums since 1969 [1]. In the past 40+ years, numerous definitions and descriptions of the PBL have been published in books and journals. As a method, PBL was founded by subject matter experts (SMEs) without educational psychology or cognitive science background in contrast to the traditional transfer of knowledge from the teacher to the learner, in which the facts and concepts represent the main part of transferred content. PBL represents an instructional approach in which the learning happens through the process of making hypothesis and deductive thinking in order to find the solution for the assigned task (problem) [2]. PBL is concerned with solving different kinds of problems under the considered domain [3].

Firstly it was used in medicine long before the appearance of its software implementations. Nevertheless, PBL is accurate today as it was more than 40 years ago due to its sophisticated methods and achieved results. It is not possible for the learner to become the SME without experience in solving realistic problems. Unfortunately, it can be expensive, sometimes impossible to use. Therefore the implementation of PBL can be found in many intelligent tutoring systems (ITSs): SlideTutor [4] designed for PBL in dermatopathology helps the students to prove their diagnoses (hypothesis) by choosing and combining the appropriate concepts from the domain ontology; CIRCSIM-Tutor [5] represents another medical ITS designed for PBL by performing Socratic dialogs with the students for solving the problems in the domain of cardiovascular physiology. Creation of meaningful problems represents one of the most important parts of PBL pedagogy [6]. The problems appropriate to the learner's knowledge level challenge him/her to research the accessible resources to find the puzzles needed to complete the task. Mostly used in medicine, PBL is proposed to be performed as a team - combined with the collaborative learning [7].

Apart from its implementations in medicine, PBL has been adopted as one of the most appropriate methods to teach different types of knowledge and skills required in computer science (CS). In the classrooms it is used as a pure pedagogical method in which the teacher plays the roles of facilitator and SME while the learners split into groups and try to solve the problem by using methodologically correct approaches [8]. In such scenarios, the focus is on collaborative work of the learners. Unfortunately, PBL happens to only support group sessions providing no individual learning support. Therefore, there are various CS ITSs designed for this purpose. They can be considered as PBL tools, because they are mostly designed for learning specific matter [9], some of which help with learning how to design software. Representatives of such systems are KERMIT, for individually learning database conceptual design, [10] and COLLECT-UML [11], for learning UML class diagrams which support both individual and collaborative learning. Others are mainly focused on implementation issues - these are ITSs designed for learning programming in some targeted language. ELM ART, a Web-based ITS [12] for learning the LISP programming language, represents one of the most referenced due to its ability to adapt problems based on an episodic learner model. SQL Tutor represents an example of ITSs designed for learning the SQL queries [13] which is interesting for using domain models based on constraints instead of concepts and their relations. Regardless of differences in design and scope of application, there are some common characteristics among the mentioned ITSs, such as dependency on well defined domain ontology and problem types.

As far as mobile technologies are concerned, the first opportunity to create a practical application related to distance learning in a more interactive way came with the onset of so called “smart” devices. There were, of course, possibilities related to older mobile technologies, but the ones that could support a mobile distance learning system were scarce, and those that were more widespread were not able to support complex applications. Modern society became very dependent on “smart” devices, primarily phones and tablets, because they now allow media access, social networking, and even some work/office related activities such as document reading and editing, at a modest price and with high mobility. The main feature of the "smart" device is the operating system, which allows for all the work to be done. Android OS platforms are used in research due to the ease for application development (various development tools, open source platform with possibility of modification), its quality (stable work on smart phones of different producers), and wide popularity (almost 70% presence in the market).

III. OVERALL SYSTEM ARCHITECTURE

The mobile learning application presented in this paper was developed as an extension of the desktop e-course version. The application itself relies on a Java web service to provide problem generation and solution analysis. The idea behind it is to deliver almost the same "desk-top" functionality to the mobile clients. There are two challenges: the first is keeping away unnecessary processing from the mobile client as much as possible in order to save the devices limited resources; and the second is to duplicate the dedicated PBL application platform from the user data. To achieve both the benefits from mobility of a mobile device, and still maintain the components needed for a distance learning application of this type, the hybrid layered architecture has been implemented (Figure 1). So called "Thin client, fat server," architecture is implemented on the one side (mobile application - LMS) and "Peer entities" is on the other one (LMS – PBL Web application). A user with a device communicates with the web service on multiple occasions during a study session (Section 5). The interaction between mobile clients and PBL application happens through the LMS. This way, a mobile user has to log into the LMS first and after that can use the PBL resources in the same manner as if it were a local LMS resource.

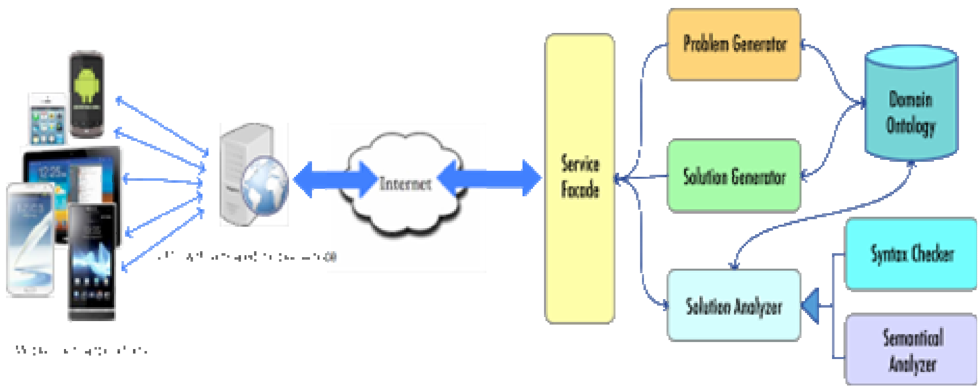


Figure 1: Overall system architecture

The back end of the PBL Web application represents the core of the system. Its structure is modular and consists of problem and solution generators and a solution analyzer. These three components represent compositions of logical parts specialized for each particular type of problem. For instance, there are parts responsible for variable declarations, array manipulation, conditional statements, cyclic structures, function definitions, etc. Such an approach enables the easy and safe addition of new modules for new problem types. All of the components depending on the domain ontology are being implemented as a base of constraints and rules that are defined for the targeted programming language. The most complex part of the PBL implementation is the solution analyzer. Due to the Java programming language domain that is used as a case study, one more external component is used – Java compiler as a syntax checker in the first phase of analysis. If the learner's solution passes the syntax checking, it is semantically analyzed. The solution is fragmented and sequentially delivered for checking to the particular expert modules. This way the declaration SME checks the declarations of variables and functions in the solution, while loop and conditional statement SMEs check function bodies. As a result, the complex problems and solutions are decomposed into simpler parts that are much easier to handle and manipulate.

IV. DATA EXCHANGE SOLUTION

The indirect PBL accessibility provides the data distribution on particular parts of the system: the mobile client application is capable of exchanging and representing the delivered data. The LMS provides the course framework in which the resources other than PBL are accessible as well as recording the activities that happened during the learner's session. The local LMS database is used for these purposes. This way, PBL resources are fully dedicated to problem and solution generating as well as analyzing the learner's solutions. These activities need much more processing power due to their dynamic nature and complexity. On the other hand, the data exchange is designed to be as simple as possible. The next step is the service response on the mobile client initial request (Figure 2).


```
▼<root>
   <label>Select the problem type</label>
   <sessionid>25F58CAA5E4C05539E118A5376BF34E7</sessionid>
   <lang>english</lang>
   <action>problem_page_xml.jsp</action>
  ▼<selection name="problem_types">
     <option value="primitive_types">Primitive types</option>
     <option value="arrays">Array declaration or creation</option>
   </selection>
 </root>
```


Figure 2: The initial PBL service response

The hybrid mode is used – the service delivers pure XML data as an http response to an http request. This way, the memory and process-consuming Web service stub – the skeleton framework – is avoided on both sides of communication. *DefaultHttpClient*, *HttpPost* and *HttpResponse* classes (included in regular Android SDK distribution) are used in mobile application instead. The sessisonless nature of the service is overcome by introducing *sessionid*, the additional element which is unique for each client and its current session. Localization is declared by the *lang* element. The service dynamically instructs the client how to address its next request. The *action* element is introduced for this purpose. Finally, the problem types are delivered as the *options* contained in the *selection* element. Their *value* attributes represent the parameters expected by the service in the next request.

```
/problem_page_xml.jsp?sid=25F58CAA5E4C05539E118A53768F34E7&lang=english&problem_types=primitive_types
```

Figure 3: The 2^{nd} step request

The PBL service delivers the dynamically generated problem in the next step (Figure 4). The structure of the delivered content follows the same manner as in the previous case. The problem is the only new element. Its attribute *id* is used for analyzing the learner's behavior during the session. The sub-element *ptext* contains the concrete task the learner has to solve. If the declared localization is not English, the text is encapsulated in the *CDATA* section for protecting specific alphabet characters from wrong interpretation during the XML parsing process.

```
▼<root>
   <label>Solve the next problem</label>
   <sessionid>25F58CAA5E4C05539E118A5376BF34E7</sessionid>
   <lang>english</lang>
   <action>report_xml.jsp</action>
  ▼<problem id="2685" type="primitive_types">
     <ptext>Define boolean variable o and set o to true</ptext>
   </problem>
 </root>
```

Figure 4: The task message

The learner's solution is delivered to the service for analyzing through the http post request. The service response is different depending on the solution's correctness, or on mistakes made by the learner. In the next example (Figure 5), the solution has passed syntax checking but had semantic errors. In the example, the feedback message is enveloped with *semantic_analysis_review*. The return message is fragmented by '\n' formatted character and it helps the mobile application to render it in a desired way.

Figure 5: The service final response

In a case of syntax errors, the response content consists of a *compiler_msg* instead of a *semantic_analysis_review* element with the text fragmented in the same way. As shown, relatively flat structured messages sent to mobile client are machine readable almost without parsing, supported with a minimum number of XML elements.

V. MOBILE CLIENT ARCHITECTURE

As an Android application, the mobile client strongly depends on activity classes. The next illustration presents the mobile conceptual model (Figure 6). There are five activities that implement all of the functionalities. *Splash* is used as startup activity, with the main purpose to bypass the time for loading application resources and instantiates the main activity. *MainActivity* first checks for an Internet connection and if one exists, the application starts *TaskActivity*.

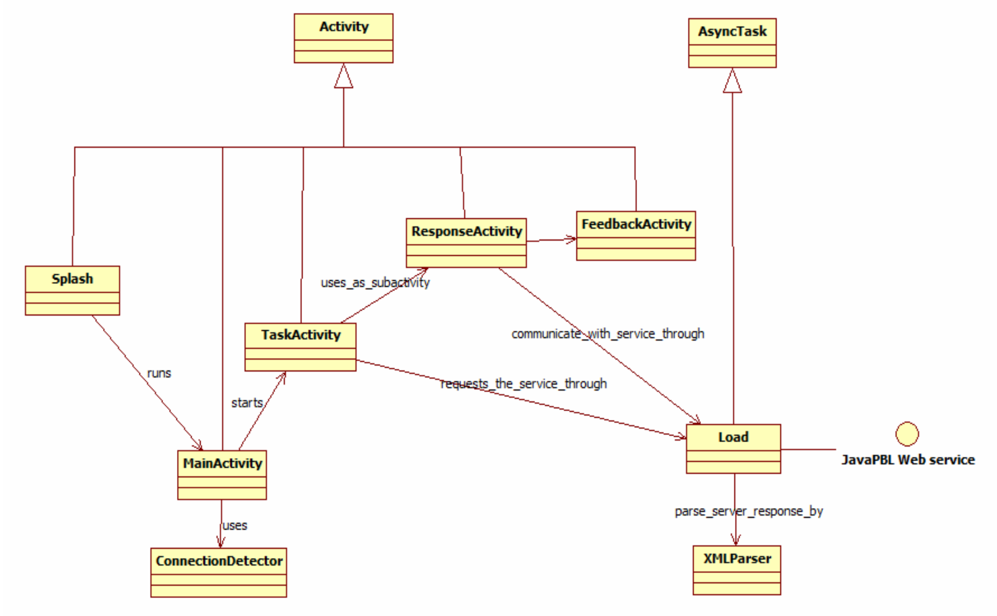


Figure 6: Mobile client class model

The instance of *TaskActivity* is responsible for requesting tasks from the PBL Web service. Also, it instantiates the *ResponseActivity* as its sub-activity and delivers to it the responsibility for processing the service's response as well as all following actions that could be performed by users. Both *ResponseActivity* and *TaskActivity* perform the communication with the remote service as asynchronous task implemented by class named *Load*. This way, the separate process thread is created that runs independently of the other tasks. Parsing of XML data is required due to XML messaging between two parts of the system. The *XMLParser* class is used for this purpose. There is also minimal memory consumption due to temporary nature of the data used. During a session, all of the data are stored in the application's working memory and removed from there after the application is shut down.

VI. EXAMPLE OF USE

At the start of the session an introductory splash screen, provided by the *Splash* activity, is shown to the user (Section 5). Following is the main menu, from which the user can select the type of problem that is to be solved (Figure 7). This menu is created dynamically by using the first XML message delivered by service (Figure 2).

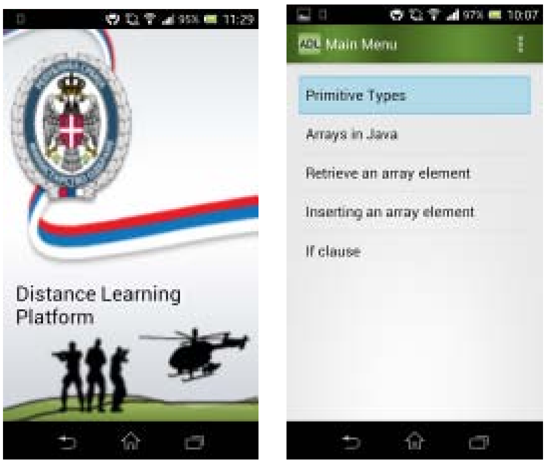


Figure 7: An example of problem type selection from the main menu

After the problem type selection, the client application sends a request to the PBL service for task delivery. The service dynamically generates a problem as an XML file and sends it in response. The client application parses the file and renders the content to a human-readable format. Meanwhile, the user is taken to another screen (another Activity, in the Android language), where he or she is presented with the generated problem (Figure 8). Below the problem is a multi-line text input field for holding the source code entered by the learner as the solution. To make easier code entering, an auto complete module is implemented, allowing the user to select text from a list of Java keywords instead of typing it manually. After the solution has been entered, the learner can check it by submitting and receiving the service feedback. This response consists of remarks on mistakes found in the solution and the correct (system) solution. At this point, the learner can try a new task of the same type, or go back to the main menu to select another problem type.

An additional option is added there – *feedback*. It is not directly related to the PBL process but provides the regular users to be involved in the testing phase. It is found that additional feedback activity (Section 5) is a simple way for collecting the learner's comments on the delivered content (tasks, service feedbacks), user interface, and navigation. At this time, as depicted in Figure 8, learners can improve their responses or correct wrong responses.

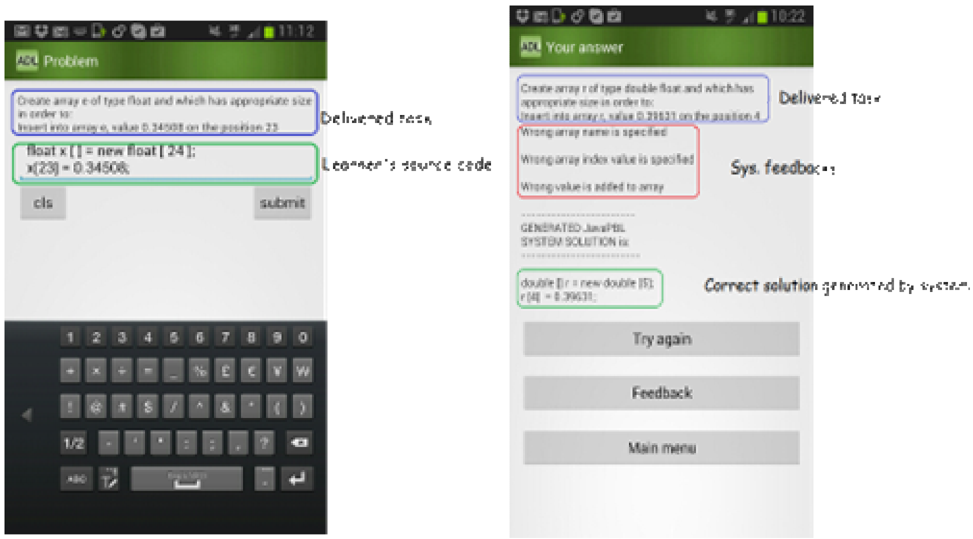


Figure 8: Solution entering and service feedback forms

VII. CONCLUSIONS

Presented results verify the fact that the flexibility of contemporary LMSs and their modular architecture provide a wide area for improving e-learning. Predominant declarative knowledge transfer has gradually been replaced with more advanced learning tactics and strategies, one of these is PBL. On the other side, it is proved that the content exclusively taught by using desktop development tools can be learned in a much easier way. In the presented case study, PBL of Java programming language is used due to its well structured ontology and experiences collected from the previous research [14].

There are no evaluation results because the application is still in the testing phase, and the focus is on debugging the functionalities already implemented. However, there are some conclusions based on test users' feedback. For example, it is appropriate for simple problem types – from variable declarations to definitions of the functions that can include loops, conditional statements, and array manipulation. For more complex programming tasks (e.g., coding complete applications), the mobile client is not appropriate due to small display size, typing limitations as well as -code navigation abilities. Improvement of the user interface is necessary, e.g., font size should be adjustable and auto complete options should be better organized. The users also found as a problem that if they access any other resource, the actual content (e.g., specific task and solution that is not yet completed and submitted) is lost and they are redirected to the main menu.

Though mainly used through the 3G mobile network, and response time being very dependent on the quality of service, no one complained about the service response time. That was most likely due to the content being provided by the simple interaction service that depended on small size content. Related to this, the solution size should be limited depending on the type of problem. Without constraints, malicious users could submit huge amounts of content to be processed that could cause a denial of service. Generally, the users are satisfied with the mobile application. They recognized that it is appropriate for the novice programmers, because they can use it in any time and any place, without requiring access to a computer. Moreover they suggest invoking more variations of the problem. They should be of the same or similar complexity, but offer better task scenarios. Test users have found that after several tries of the same problem type, it gets boring regardless of the delivered tasks being completely different. To maintain interest, the users should be provided with the tasks that include more realistic scenarios. One of test users gave a good example for it: instead of defining function *y* that sorts string array *z* in ascending order, the task may be presented as "Define a function that sorts student names in ascending order."

This feedback gives us the directions for future improvements. The users' satisfaction represents one of the basic principles necessary for durability of the application. One of the first steps in the future will be combining the PBL with the other learning resources by using the same mobile application. Http request / response mechanism in PBL services gives us the opportunity to deliver other types of content. In accordance with the presented overall system architecture, the biggest challenge in such an approach would be delivering these additional resources in a contextual way. For instance, if the user makes the same mistakes in his or her solutions that are related to misunderstanding of domain concept *X*, additional content related to *X* should be delivered or presented. Use of references is being considered as a solution. It means that the LMS resources can be referenced from the PBL as needed "on the fly" due to the large storage capacity of an LMS. However, apart from good results on the prototype application, the next phase of research will focus on incorporating the collected experience in the domains different from IT.

References

[1] Neville, A., 2009. Problem-Based Learning and Medical Education Forty Years on, Medical Principles and Practice, 18, Pages 1-9

[2] Barrows, H. S., 1996. Problem-based learning in medicine and beyond: A brief overview. New Direct. Teach. Learn. 68, Pages 3-12

[3] Boud, D. & Feletti, G., 1997. The Challenge of Problem-Based Learning. Kogan Press, London

[4] Crowley, R., and Medvedeva, O. 2006. An Intelligent Tutoring System for Visual Classification Problem Solving. Artificial Intelligence in Medicine, 36, Pages 85-117

[5] Mills, B., Even, M. & Freedman, R. 2004. Implementing directed lines of reasoning in an intelligent tutoring system using the atlas planning environment. International Conference on Information Technology: ITCC 2004, Pages 729-733

[6] Torp, L. & Sage, S., 2002. Problems as possibilities: Problem-based learning for K-16 education (2nd Ed.). Alexandria, VA: Association for Supervision and Curriculum Development

[7] Barrett, T., 2005. Understanding problem-based learning. In Barrett et al. (Eds.) Handbook of Enquiry & Problem Based Learning, Dublin, AISHE, Pages 14–25

[8] Nuutila, E., Torma, S., Malmi, L., 2005. PBL and Computer Programming — The Seven Steps Method with Adaptations, Computer Science Education, 15, Routlege T&F Group, Pages 123-142

[9] O'Grady, M., 2012. Practical Problem-Based Learning in Computing Education, ACM Transactions on Computing Education, 12, Article 10

[10] Suraweera, P. & Mitrovic, A. 2004. An Intelligent Tutoring System for Entity Relationship Modelling. International Journal of Artificial Intelligence in Education, 14, Pages 375-417

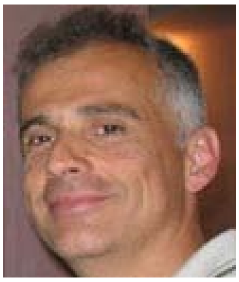
[11] Baghaei, N., Mitrovic, A., 2005. COLLECT-UML: Supporting Individual and Collaborative Learning of UML Class Diagrams in a Constraint-Based Intelligent Tutoring System, Lecture Notes in Computer Science, 3684, Springer, Pages 458-464

[12] Weber, G, Brusilovsky, P., 2001. ELM-ART: An Adaptive Versatile System for Web-Based Instruction, International Journal of Artificial Intelligence and Education, 12, Pages 351-384

[13] Mitrovic, A., Ohlsson, S. 1999. Evaluation of a Constraint-Based Tutor for a Database Language, Artificial Intelligence in Education, 10, Pages 238-256

[14] Simic, G., Jevremovic, A., 2012. Problem-based learning in formal and informal learning environments, Interactive Learning Environments, 08/2012, Volume 20, Number 4, Pages 351-367)

AUTHORS



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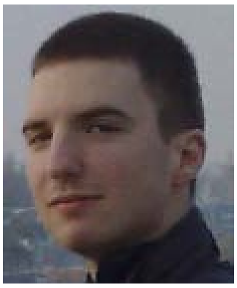

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FOR AUTHORS

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