Editorial

Charalampos Karagiannidis and Sabine Graf, Co-Editors
George Magoulas, Guest Editor

Welcome to the Bulletin of the IEEE Technical Committee on Learning Technology, Volume 15, Number 1, January 2013 issue.

This issue is edited by Guest Editor Prof. ***George Magoulas***, and includes articles on the topic: ***Eliminating boundaries: innovative learning environments to integrate formal, informal, and on-the-move learning experiences***.

The issue also includes a section with regular articles (i.e. articles that are not related to the special theme), where Canessa et al. address the verification of attendance in massive open online courses through the Pinvox system.

We sincerely hope that the issue will help in keeping you abreast of the current research and developments in Learning Technology. We also would like to take the opportunity to invite you to contribute your own work (e.g. work in progress, project reports, dissertation abstracts, case studies, event announcements) in this Bulletin, if you are involved in research and/or implementation of any aspect of advanced learning technology. For more details, please refer to the author guidelines at http://www.ieeetclt.org/content/authors-guidelines.

Special theme of the next issue: Learning Analytics
Deadline for submission of articles: March 15, 2013

Articles that are not in the area of the special theme are most welcome as well and will be published in the regular article section.

Special Issue on Eliminating boundaries: innovative learning environments to integrate formal, informal, and on-the-move learning experiences

This special issue is an attempt to explore how best educational technologies can be used to eliminate learning boundaries by integrating formal, informal, and mobile learning experiences, and create innovative learning environments.

The means by which learners interact with the world and learn from it are currently more closely related to technology than to traditional sources of information. Interactive learning environments give learners and educators access to courses, content, and institutional portals through a variety of platforms and devices, and with the emergence of semantic technologies, educational applications are expected to become even more intelligent, providing higher level of learner support.

Although a large part of the learning experience nowadays takes place in informal settings, formal education does not benefit much of it as it is not usually aware of the informal learning encounters that learners have engaged with outside formal settings. Moreover, the challenges of integrating formal and informal learning experiences and scaffolding learners in this process have not been fully explored. That would be useful, for example, when learners are on-the-move, when they drop out of formal education or they return to the educational system, or when they need to combine formal education with general day-to-day activities, such as a museum visit or work experiences.

The included papers describe attempts to change educational practices and pedagogies, enhance institutional systems with modalities, delivery mechanisms, and tools that facilitate learners' participation, collaboration and communication, and extent the context learning is happening.

In "The Pedagogy of Things: Emerging Models of Experiential Learning", Watson and Ogle explore the evolution of pedagogies as technologies that support learning become more ubiquitous. They investigate how experiential learning can benefit most from the advanced forms of learner-environment and learner-to-learner interaction that these technologies enable. The authors describe previous attempts in the literature to leverage these technologies in order to develop innovative learning models, and identify some of the challenges involved. They also provide insights about the design of learning activities that exploit the features of the technologies for experiential and contextualized learning.

The issue of designing and orchestrating learning activities is examined by Cohen in "Using the F2F Classroom as a Forum to Share Discoveries from Informal Technology Channels". The author describes a case study that uses learning activities that combine educational opportunities from informal and formal contexts. This approach allows students to pursue authentic learning tasks, employing social media for discovery learning outside the classroom and interaction with tutors and peers during class room discussions. Classroom sessions facilitate engagement with learning activities and scaffold learning that occurred out-of-school. This is a hybrid learning approach that combines elements of social constructivism, exploratory learning, and collaborative learning to bridge the gap between formal and informal learning experiences.

In "Connect, Participate and Learn: Transforming Pedagogies in Higher Education", Baran explores how social media tools can shape learning and teaching of a graduate course, and help students engage in formal and informal learning experiences. The paper presents a case study that

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demonstrates the transformative nature of these tools. They promote a new paradigm of teaching and learning that places teachers and learners in the driver's seat to co-construct learning and extend learning and interaction beyond formal learning contexts. The author describes how a blended course, which included face-to-face sessions, out-of-school learning, online learning, and collaborative activities, was designed. Using a variety of social media tools (e.g. wikis, blogs, social bookmarking, and networking) helped extending classroom interaction and facilitated integrating different pedagogies in the course, which were enabled through specific learning and teaching activities afforded by these tools.

The importance of collaboration and social interaction is emphasised in "Teach Ourselves: A Peer-to-Peer Learning Community Linking In- and Out-of-class Activity" by Beal, Strohm, Schwindy and Cohen. The authors present a case study of Teach Ourselves - a web-based system collaborative learning environment for middle school students. Teach Ourselves includes peer-to-peer activities, and social and game-like components that aim to engage students with math and science. The authors present a pilot study that explores the feasibility of Teach Ourselves as a classroom activity, and assesses students and teachers initial reactions and thoughts about using the application. Their findings show that the application successfully engaged students during both school and out-of-school hours, and that incorporating social and game-like elements into a learning application has the potential to bridge formal and informal learning.

"Developing Media Competence in Vocational Education – Architecture Design for Context-sensitive and Individual Learning" by Di Valentin, Emrich, Werth and Loos presents a conceptual architecture for a new tool named Social Navigator. The Social Navigator aims to provide individualized support and recommendations to users working on specific tasks and learning content in the domain of vocational education and training. The authors adopted a design-oriented approach, which included systematic literature review and expert interviews with representatives of the vocational education sector, to derive requirements for the design of this tool. The tool offers context-sensitive recommendations, such as support for searching media types, or best practice for using multimedia content or social media, depending on the type of the assignment or task. The paper describes an application scenario to illustrate how the tool is used to consider each individual's preferences and the status of each participant within the educational qualification process.

The role of the technical infrastructure in supporting user choices and their preferred tools is investigated in "Enhancing Learning Environments by Integrating External Applications". Alario-Hoyos, Bote-Lorenzo, Gómez-Sánchez, Asensio-Pérez, Vega-Gorgojo and Ruiz-Calleja describe the GLUE! (Group Learning Uniform Environment) architecture. The GLUE! core and adapters enable lightweight integration of external applications in different learning environments, helping opening up and extending, in a sense, institutional VLEs and LMSs. Thus, depending on the learning context, the instructors or the learners can use GLUE! to automatically create and configure different instances of each external application or tool, and integrate them in Institutional Learning Environments, Personal Learning Environments, or Open Source Environments supporting Massive Open Online Courses. The proposed approach is eminently suitable for collaborative and group work learning scenarios and has been experimentally evaluated.

"A Case Study on Multi-Modal Course Delivery and Social Learning Opportunities" by Oyarzun and Martin shows how innovative course delivery methods can be created by combining face-to-face teaching and online virtual classrooms with social media. Students who prefer formal learning can attend face-to-face sessions and synchronously communicate and collaborate with peers, who attend the same course in virtual classrooms, or alumni on social networks. The authors describe the various technologies required to support this form of multi-modal delivery and explain how these can be combined with social networks to incorporate an informal/social learning dimension and transform the learning process.

Tinapple, Olson and Sadauskas in "CritViz: Web-Based Software Supporting Peer Critique in Large Creative Classrooms" propose to move away from the traditional classroom model of giving feedback and evaluating student work by facilitating large classroom critique sessions. They identify the basic requirements for an online tool to manage the process of generating high quality real-time feedback on students work and enable peer critique in large classrooms. Moreover, they introduce CritViz, their tool for real time grading, feedback and critique of creative work in large classes, and present a scenario of its use. The findings of their pilot studies provide evidence for CritViz's effectiveness in orchestrating large-class critiques, and of its potential to alter the "motivational structure" of large classes.

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The Pedagogy of Things: Emerging Models of Experiential Learning

C. E. Watson and J. T. Ogle

Abstract— **The emergence of ubiquitous computing technologies have made the once theorized "Internet of things" a reality, and this quickly evolving technological infrastructure, in conjunction with a variety of mobile devices, including smartphones and tablets, is providing incredibly rich opportunities for learning. This article provides a description of these technological innovations and posits experiential learning as a key pedagogical strategy that is likely to benefit most from these technologies. It also provides examples of this new pedagogy of things, a pedagogy that embraces the emerging technological attributes of the real world around us.**

***Index Terms*—mobile technologies, pedagogy of things, experiential learning, social media**

I. Introduction

In 1991, working as the chief technology officer at Xerox PARC (Palo Alto Research Center), Marc Weiser shaped and observed emerging trends in computing (Weiser, 2002). He predicted a time would come when computing would become ubiquitous and technologies would become a part of and disappear into the environment around us (Weiser, 1991). They would "weave themselves into the fabric of everyday life until they [were] indistinguishable from it" (p. 94). This vision of the future is currently emerging as a reality. Many devices in homes, automobiles, public environments, retail stores, and even clothing are being equipped with computing capable of collecting and sharing information via the Internet and/or with mobile devices. It is believed that we are fast approaching a point where there will be more "things" on the internet than there are people (IBM Social Media, 2010), and this Internet of things is not only changing how we interact in the world, it will also change how we teach and learn within it. Faculty, teachers, and instructional designers, especially those that embrace experiential learning, are beginning to take advantage of these new capabilities by developing pedagogical approaches that leverage the technologies emerging in the environment around us. This is the pedagogy of things.

Experiential learning has long been embraced by those engaged in study abroad, service learning, environmental education, the arts, experimental school-based programming, and outward bound. This emerging Internet of things holds great promise for these areas as well as any course or discipline that engages in research, data collection, or activities outside of traditional classroom walls. The Association of Experiential Education defines experiential learning as "a process through which a learner constructs knowledge, skill, and value from direct experience" (1994, p. 1). Grounded in Dewey's conceptions of authenticity in instructional activities (Dewey, 1916; Dewey, 1938) and Vygotsky's notions of social learning (Vygotsky, 1978), experiential learning overtly connects knowledge development to interaction and environmental experiences (Kolb, 1984). It is within this context that pervasive and permanent technological augmentations in the real world are changing the very nature of the word "authentic" (Watson, 2011).

Characteristics of this new authenticity include capabilities that are not only highly supportive of student-to-student interaction, but they are also supportive of student-to-environment interaction and vice versa. Our physical landscape now contains data collecting and sharing nodes that can provide a persistent and evolving connection between students, teachers, digital artifacts and the physical world via cellular, Bluetooth, WiFi, and other connectivity means. Ultimately, the new pedagogy of things is enabled, to a large extent, by the rapid and broad adoption of smartphones, tablets, and other similar devices that enable mobility while possessing connectivity functionality (Watson & Plymale, 2011). The potential for instructional impact is underscored by a Pew Research Center survey conducted in 2011 that found that 49% of 18-29 year olds now have a smartphone (Smith, 2011). These personal mobile devices have core features, such as touch screens, global positioning access, compasses, accelerometers, cameras, persistent Internet connectivity, and an incredible range of applications, which enable data collection, social networking, collaboration, and the analysis and synthesis of data. Large group multi-user web conferencing and collaboration platforms, similar to those currently in vogue for traditional distance learning, are emerging for the mobile device as well (Luo & Benlamri, 2009). In educational contexts, these capabilities and emerging systems can be used to leverage social learning theory, situated cognition, authentic learning, and discovery learning.

Merrill (2002) reviewed respected instructional design theories and discerned five common learning principles across these theories, among them are utilizing real-world problems,

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encouraging the application of new knowledge, and integrating new knowledge into the learner's world. These common learning principles overlap with what have been termed essential criteria of experiential learning (Moon, 2004). These essential criteria also emphasize learning activities that encourage active and personal engagement, are relevant to the learner, and provide opportunities for self-directed learning. These complimentary theoretical perspectives, coupled with the affordances of pervasive computing, comprise the structure and context for the pedagogy of things.

II. The Pedagogy of Things in Practice

A number of examples of the pedagogy of things in practice have recently emerged in the literature. Wisman and Forinash (2010) suggest a model of science education that takes experiments common to the traditional laboratory and moves them into the real world. Rather than studying acceleration by rolling a ball down a slope in class, students can use the accelerometer in their phones to "be the ball" in the real world. Amusement park rides and bicycles become educational tools when coupled with sound pedagogical practice and a well-designed curriculum. Wisman and Forinash suggest that such an approach has the dramatic potential to change students' relationship with their own learning and ultimately change how they view science.

As a means to increase student engagement in a study abroad context, iPads were used to enable students to access relevant content when visiting historically significant locations. As an example, when students visited Wenceslas Square in Prague, they were able to access photographs of famous events that took place in that physical location. As a result, the relevance for the visit to this location was made palatable and more personally meaningful (Shewmaker & Shewmaker, 2011).

Beddal-Hill, Jabbar, and Al Shehri (2011) adopted smartphones and tablets for teaching and performing ethnographic and other qualitative methods of research. In one project, students recorded observations during ethnographic field trips using Apple iPhones. The smartphones were used to capture photos, video, and audio, geo-tag locations, write notes and communicate via e-mail. While the convenience and portability of the iPhones were found to be very helpful in collecting and sharing data in an unobtrusive manner, the ability of the device to enable learning and research in new ways outside of the traditional classroom context is the shift that is important to note.

Augmented Reality (AR) is a growing area of interest in experiential learning and situated cognition research because of its potential to provide social connectivity, context/location awareness, and access to additional information and artifacts in a physical location. AR is the addition of digital information, in the form of graphics, photos, and/or three-dimensional models over a view of the physical environment. AR can be marker-based or markerless. Marker-based AR relies on Near Field Communications (NFC), Radio Frequency Identification (RFID), Quick Reference (QR) Codes (Ruzkio, Wetzstein, & Schmidt 2005; Paolucci et al., 2008), and/or image recognition and processing (such as Google Goggles). When the camera of the mobile device is pointed at the marker, an event is triggered, which typically loads audio, video, text, 3D graphics or holographs via Web service. Markerless AR relies on proximity, using GPS, cellular triangulation, and the device's compass to trigger an event or display an augmentation. Users can add their own markers or geotags to AR environments in-situ, thereby adding the mesh of linked and information-rich objects in the environment that those who visit that location in the future can access, edit, and contribute.

In describing a project using handheld computers in an augmented reality simulation game (*Environmental Detectives*), Klopfer and Squire (2007) note that handheld computers (in this context, Pocket PC's running a mobile version of Microsoft Windows) provide five key attributes that make them of interest in education: portability, social interactivity, context sensitivity, connectivity, and individuality (Klopfer, Squire & Jenkins, 2002). They leveraged these affordances to design and author the game for use by college and high-school age students, in which students are asked to help with information gathering following a toxic spill on campus. Among the pedagogical implications of their work, Klopfer and Squire found that social information exchange held a high degree of importance, as teams of students had to decide what to share with other teams due to an inability to explore the entire field of play during the simulation. Additionally, they found that physical location plays a critical role in augmented reality games; as the scenario unfolded in their own community, students felt a higher level of emotional engagement than they did on field trips.

Similarly, Dunleavey, Dede, and Mitchell (2009) developed an AR simulation that was place-independent, allowing teachers to make use of it at school rather than requiring a field trip for implementation. In *Alien Contact!,* middle and high school students work through a scenario designed to impart math, language arts, and scientific literacy skills in an inquiry-based game. Using markerless AR (interactions triggered by proximity) in combination with physical props, students moved about their school grounds, interacting with virtual characters and collecting data that would they would use to determine the intentions of alien visitors. Students were divided into teams with different roles for each team member and tasked with collecting data and solving math, language and scientific literacy puzzles. Dunleavey et al.'s findings included a high level of engagement amongst the students, with students and teachers both recognizing the novelty of performing math in a physical, evidence-based manner rather than through typical means (2009). The researchers also note the positive social interdependence among students as a result of the "jigsaw pedagogy" whereby the AR provided each team member with different and incomplete information chunks which relied on the team as a whole to synthesize. The research team also noted the power of AR to contextualize and ground learning in a physical setting, in contrast with conventional classroom instruction, which is typically decontextualized and abstract.

In a project using GIS to engage students in inquiry-based learning, Coulter and Polman (2004) concluded that focused curricular planning led to a more successful implementation than an "activity exposure" approach. This is a significant point to note, as there must be curricular relevance for the learner to see meaning in the activity and to be purposefully motivated to engage in the learning task at hand (Kember, Ho & Hong, 2008). Further, cognitive overload and unproductive mental effort are risks to learning in real world, discovery-based learning contexts, especially those that have a high dependency on multimedia use (Clark, Yates, Early & Moulton, 2010). Both of these concerns underscore the need for instructional design practices as pedagogy of things instructional strategies are designed, developed and implemented.

III. Challenges

A primary benefit of emerging technology as applied to teaching and learning is access to information. The pedagogy of things presents an opportunity for learners to access information in real-world contexts. The challenge for teachers will continue to be identifying and making the best of use of applications and services that align with the learning objectives defined for the course or program. These technologies are typically used outside the classroom, and are, thus, affected by logistical limitations. The mobile technology itself is expensive and fragile. Smartphones and tablets must be managed and maintained. Many of the research examples cited above are cost and time prohibitive. However, there are free and relatively easy to use applications and services for augmented reality for example, whether using QR codes or GPS. Given the effort that is required to prepare activities using these technologies, care must be taken to maximize their impact and make the most use of learners' time.

IV. Recommendations

Preceding in-field activities with classroom, or library-based research, and preparation, and following up with summarizing evaluative activities that help learners integrate their new knowledge will prove more successful than treating the field activities as isolated exercises. Leverage the pedagogy of things by asking learners to activate prior knowledge and apply that knowledge in the field activity; for example, have learners add their own annotations to the mesh of information, asserting their own conclusions in the field prior to a summary exercise. Doing so makes learners active participants in the creation and validation of new knowledge.

The pedagogy of things can provide access to information hidden to the naked eye. This information can be embedded in environments outside the typical classroom, environments that may be helpful in integrating knowledge into the learners' everyday world. Instructional design theory and practice are still keys to maximizing the effectiveness of this mesh of information embedded in our everyday world.

V. Conclusion

Regardless of the affordances mobile computing provides, as with other instructional settings, sound pedagogy and instructional design will remain primary determinants of success. The pedagogy of things allows for experiential and contextualized learning where traditional learning activities may not. These technologies provide access to information in novel ways and contexts, but the challenges to their implementation require careful thought regarding their use.

References

Association for Experiential Education (AEE). (1994). *AEE definition of experiential education*. Boulder, CO: Association for Experiential Education.

Beddal-Hill, N.L., Jabbar, A., & Al Shehri, S. (2011). Social mobile devices as tools for qualitative research in education: Iphones and ipads in ethnography, interviewing, and design-based research. *Journal of the Research Center for Educational Technology, 7*(1), 67-89.

Clark, R. E., Yates, K., Early, S., & Moulton, K. (2010). An analysis of the failure of electronic media and discovery-based learning. In K. H. Silber & W. R. Foshay (Eds.), *Handbook of improving performance in the workplace, volume one: Instructional design and training delivery.* Hoboken, NJ: John Wiley & Sons.

Dewey, J. (1916). *Democracy and education.* New York: Macmillan.

Dewey, J. (1938). *Experience and education.* New York: Macmillan.

Dunleavy, M., Cede, C., & Mitchell, R. (2009). Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning. *Journal of Science Education and Technology*, *18*, 7-22.

Kolb, D. A. (1984). *Experiential learning*. Englewood Cliffs, NJ: Prentice Hall.

IBM Social Media. (2010). The Internet of things. Retrieved from http://www.youtube.com/watch?v=sfEbMV295Kk

Itin, C. M. (1999). Reasserting the philosophy of experiential education as a vehicle for change in the 21st century. *Journal of Experiential Education, 22*(2), 91- 98.

Kember, D., Ho, A., & Hong, C. (2008). The importance of establishing relevance in motivating student learning. *Active Learning in Higher Education, 9*(3), 249-263. doi: 10.1177/1469787408095849

Klopfer, E., & Squire, K. (2007). Environmental detectives – The development of an augmented reality platform for environmental simulations. *Education Technology Research and Development*, *56*, 203-228.

Klopfer, E., Squire, K., & Jenkins, H. (2002). Environmental detectives: PDAs as a window into a virtual simulated world. Paper presented at the *International Workshop on Wireless and Mobile Technologies in Education*, Vaxjo, Sweden.

Luo, J.Y., & Benlamri, R. (2009). An innovative approach to bringing comprehensive ubiquitous learning tools onto the mobile phone. *Ubiquitous Learning: An International Journal, 2*(3), 129-150.

Merrill, M.D. (2002). First principles of instruction, *Educational Technology Research and Development*, *50*(3), 42-59.

Moon, J.A. (2004). A handbook of reflective and experiential learning: Theory and practice. London: RoutledgeFalmer.

Paoluccia, M., Broll, G., Hamarda, J., Rukzioc, E., Wagnera, M., & Schmidt, A. (2008). Bringing semantic services to real world objects. *International Journal on Semantic Web & Information Systems*, *4*(1), 35-49.

Rukzio, E., Wetzstein, S., & Schmidt, A. (2005). A framework for mobile interactions with the physical world. Paper presented at the *Wireless Personal Multimedia Communication Conference*, Aalborg, Denmark.

Shewmaker, J., & Shewmaker, S. (2011). Ipad and study abroad: Interactive learning in the international environment. Retrieved from http://www.acu.edu/technology/mobilelearning/Research/

Smith, A. (2011). 35% of American adults own a smartphone. Washington, D.C.: Pew Internet and American Life Project,. Retrieved from http://pewinternet.org/Reports/2011/Smartphones.aspx

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Watson, C.E. (2011, November). Our new "real" world: Participatory culture and the pedagogy of things. Paper presented at the 2011 TEDxYouthGreaterNashville conference, Nashville, TN.

Watson, C.E., & Plymale, W.O. (2011). The pedagogy of things: Ubiquitous learning, student culture, and constructivist pedagogical practice. In T. Kidd & I. Chen (Eds.), *Ubiquitous learning: A survey of applications, research, and trends*. Charlotte, NC: Information Age Publishing.

Weiser, M. (1991). The computer for the 21st century. *Scientific American, 265*(3), 94-104.

Weiser, M. (2002). Mark Weiser (1952-1999), The founder of ubiquitous computing. *IEEE Pervasive Computing*, *1*(1), 18.

Wisman, R., & Forinash, K. (2010). Mobile science. *Ubiquitous Learning: An International Journal, 3*(1), 21-34.

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Using the F2F Classroom as a Forum to Share Discoveries from Informal Technology Channels

Deborah Elizabeth Cohen

Abstract—**Today there are many learning modalities from which to choose, formal and informal, in and out of the classroom. When learning activities are structured to employ useful affordances of the two types, a complementary mix resulting in innovative, engaged learning can be achieved.**

Index Terms—**Social media, hybrid learning, discovery learning, authentic learning, community of learners**

In a recent class I taught in South Korea, we took advantage of the wired infrastructure and the social media channels for discovery learning outside of the classroom. Once in the classroom, we contextualized, scaffolded and elaborated upon what students had discovered on their own employing social constructivist, collaborative learning.

By structuring leaning activities to make the most of the educational opportunities offered by the informal and formal classroom contexts, authentic learning tasks were pursued outside the classroom while engagement resulted from interactions with the professor and other students during classroom discussion.

The class was a new course offered through the Mass Communications Department at Sogang University on social media and social change focusing on women's issues. Students received assignments requiring them to monitor social media channels, thereby involving them in primary research. A presidential election was underway that ultimately resulted in the election of South Korea's first female president, Park Geun Hye. There was a standing assignment to monitor election-related social media networks and report on changes in the candidates' status in each class.

There were also two major assignments in class: the first to analyze the use of social media tools related to the betterment of women' status in South Korea or internationally. Students found and analyzed a campaign available on the web and through informal social network channels. The criteria for analysis were based on lectures and readings related to attributes and uses of social media including cross cultural aspects as well as women's issues in developing and developed nations. Students wrote papers and presented their findings to the class through PowerPoint presentations allowing them to demonstrate artifacts and material features of the chosen campaigns including website presence and information architecture, Youtube videos, Facebook communications, etc. Students freely questioned one another and commented upon topics suggested by the presentation related either to women's issues or social media use. They placed their PowerPoint presentations on our classroom website for future access and further reference by other students.

For the second major assignment, students selected a campaign of their choice – created or preexisting – and developed social media strategies with which to implement it. Again, they wrote a paper and a PowerPoint presentation to share with the class. Through their proposed campaigns they presented an impressive array of solutions to remedy many of South Korea - and the world's – current social ills including discrimination in the workplace, unequal division of household labor, inadequate support for the children of working parents, inhumane standards of beauty, and the need to better access to resources for sexual health. As in the last assignment, students freely questioned one another and commented upon topics suggested by the presentation. Through these presentations, students demonstrated that they had absorbed the basic tenets of women's social change campaigns and that they knew how to effectively and creatively use social media to disseminate information and cultivate community.

Education in South Korea typically involves memorization of professor lectures and texts. In our classroom discussions, students spoke openly about their political opinions and analysis of the political events of the day. The open discussion, critical thinking, and creativity displayed by students in this class are not typical of South Korean students' usual classroom behavior.

Why did this class have these effects on student learning and experience? As previously mentioned, it was essentially a hybrid class that made the most of student access to South Korea's wired environment outside of class and used strategies to make the most of our face-to-face time. Activities were assigned requiring students to use social media channels for discovery and authentic learning in what was essentially an exploratory learning environment (Dabbagh and Bannan-Ritland, 2005). The authentic learning activities used in this

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class involved following the evidence provided by social media networks to document a presidential election unfolding in time, analyzing a real campaign, and creating a simulated campaign. Students had the opportunity to do primary research on the internet and have the excitement of sharing it in the classroom, with engagement resulting from knowledge sharing, social constructivism, and learning through examples provided by interactions with others through classroom discussion. A community of learners developed (Ormrod, 1999).

As our world becomes increasingly wired, evidence of many current and unfolding events is freely available through informal channels. Through hybrid learning combining exploratory learning in informal, technological arenas with learning through working with others in the formal classroom, exhilarating - and non-routine - learning experiences can be possible.

REFERENCES

[1] N. Dabbagh and B. Bannan-Ritland, *Online Learning Concepts, Strategies and Application*. Upper Saddle River, NJ: Pearson Education, 2005.

[2] J. Ormrod, *Human Learning*. Upper Saddle River, NJ: Prentice Hall, 1999.

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Dr. Cohen is currently a member of the International Communications Association. She has won awards for curriculum development from Intel Corporation and filmmaking awards including Best Classic Roots Culture Film from the 2010 Cinema on the Bayou Film Festival, a Bronze Apple from the 1991 National Educational Film and Video Festival and Honorable Mention from the 1991 Northwest Film and Video Festival.

Connect, Participate and Learn: Transforming Pedagogies in Higher Education

Evrim Baran

***Abstract*— There is an emerging need for a transformation of traditional pedagogies in higher education environments. Social media tools present opportunities for designing learning experiences that afford extended social interaction and collaboration. This paper presents a case where several social media tools were used as course platforms in the context of a blended "Social Media in Education" graduate course. In addition to presenting instructional design decisions behind the course organization and delivery, this paper aims to introduce an example of how an open course content was created with the learners on different social media channels and helped them eliminate learning boundaries by engaging in formal and informal learning experiences. Various affordances of each social media tool for different pedagogical purposes are presented.**

***Index Terms*—Higher education, learning, pedagogy, social media**

I. Introduction

For more than a decade, educational institutions have been challenged to reconsider their current teaching approaches in the light of an increasing popularity of social and networked Internet technologies among highly active and participative Internet users. New media technologies have provided opportunities for users to create, share and express themselves in different media channels [1]. We are now witnessing a large technological shift in the history that is being driven by users who want to be engaged, active, social and networked than ever before. However, how much of this shift is reflected in our current educational practices is still questionable.

Although educators are witnessing a shift in the notions of learning and teaching as shaped by social and cultural practices of social media and new digital technologies, traditional teacher-directed pedagogies still dominate higher education learning and teaching environments. Technology is generally used in the form of integrating conventional learning management systems (LMS) to the teaching settings with the implementation of standardized, unintuitive, highly structured and static tools that comes default with these systems. These LMS platforms often lack the necessary tools and social structure to support student engagement and just-in-time social connection. Within those systems, teacher is seen as the source of the information in a closed learning environment and the student as the passive consumer of the static content that is presented online. The educational philosophy that undergirds these systems limit teachers to think and act within the defined traditional teaching paradigms lacking the flexibility to be creative and adoptive to different learning contexts [2]. Moreover, the conversation that happens within these systems dies after the semester ends and generally doesn't extend to the informal learning environments.

The ubiquity of open social media tools offers a new paradigm of teaching and learning that places teachers and learners as co-constructors of learning. These tools not only support participation at different levels, but also extend learning and interaction beyond formal learning environments. Considering these affordances as critical elements of emerging higher education pedagogies, a case study was conducted to investigate the integration of social media tools in a blended course on "social media in education". This paper presents the instructional design decisions behind the organization and the delivery of the course as well as the affordances of various social media tools for different pedagogical purposes.

II. Context

A. Course Goals

Social Media in Education course was designed to help educators immerse themselves in the theoretical and practical aspects of social media in various educational contexts. The purpose of the course was to allow educators not only to learn and practice several social media tools but also critically analyze their use in their educational settings. Following questions guided the design of the course:

- What do we mean by "social media"?
- How do we encourage, discuss, understand and design educational environments with the emerging social media tools in the age of participatory culture?
- How can we encourage the critical usage of social media and build sustainable learning environments and networks?

Rather than examining social media tools in isolation, this course intended to explore the interrelationships among different tools in specific cultural communities that grow upon around them, and the educational activities they supported. Weekly course activities included the discussions on social media concepts, the examination of the affordances and limitations of social media tools, and hands-on activities for

This work was carried out while Dr. Baran was a Ph.D. student and instructor within the Curriculum and Instructional Technology Program at Iowa State University. The "Social Media in Education" course presented in this case was offered as an elective graduate course in a blended format to the graduate students from different disciplines.

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exploring the integration of the tools within students' unique learning and teaching contexts.

B. Course Participants

This course was targeted to the graduate students from diverse disciplines who were interested in the implications of social media within their educational contexts. The purpose was to bring different perspectives, school of thoughts, implications, and experiences to the learning context. The students who were enrolled in the course came from the disciplines of human computer interaction, business, family and consumer studies, fashion and retail, and educational technology. The diversity in the backgrounds and educational levels provided a rich discussion and collaboration setting where learners were constantly challenged with different perspectives on the issues related to social media use in educational contexts. For instance students who were working as teachers and technology coordinators in the K12 school contexts brought fresh and first hand experiences and observations about children's use of social media in their everyday life.

C. Course Topics

The course was organized around the topics of theories and concepts on social media in education including connectivism [3], [4] social networking [5], new media literacies and participatory culture [1], [6], copywriting and creative commons, Web 2.0 and social collaboration environments, learning Space Mashups [7], [8], Dj culture, edupunks, open educational resources and open access [9]. Students learned basic processes, concepts, and terminology associated with the social media such as tagging, rss, folksonomies, tag clouds, rss readers, microblogging, social networking, social bookmarking, blogging and wikis.

While working on the concepts presented in the literature, students engaged in hands-on learning activities to become knowledgeable of social media tools for teaching, facilitating learning and designing learning communities. The purpose was to introduce students social, educational, political and cultural issues associated with social media in education, help them build sustainable online learning communities using social media tools, and become critical consumers and producers of social media content in their own learning contexts.

III. Course Design

A. Structuring a blended course on social media platforms

The Social Media in Education course was designed in a blended format with synchronous face-to-face meetings and asynchronous online meetings in a period of four weeks during the Summer 2010. First half of the course included both face to face and offline sessions where students worked on various activities each day related to the social media tools and their use in educational settings. In the second half of the course, students worked on their projects where they designed and developed a social media project that they planned to implement in their own educational context.

A significant portion of the course learning happened outside of the scheduled face-to-face sessions at the online asynchronous sessions. Students gained experiences about social learning processes such as writing reflective blog posts, commenting on participant blogs, building class resource repository, exploring social learning tools and creating educational social media.

B. Creating an open course content collaboratively on wiki

A wiki platform was designed as the central point where all interactions happening in other course platforms (e.g. course blog, twitter, and course social bookmark) were called via RSS feeds. The massive online activity in the social media platforms can create "avalanche of information that feels absolutely overwhelming" (p. 71) [6]. This is particularly an important issue when social media is integrated into the courses. To overcome the excessive communication and participation in several social media platforms used in this course, students were introduced with the RSS (Real Simple Syndication) feeds of the course platforms, the aggregators (feed collectors) such as Google Reader, and personalized dashboards such as iGoogle, pageflakes, and netvibes. Using these, students were able to keep track of the class interaction in various platforms in an efficient and organized way. Moreover, the course wiki was designed in a way that the widgets of different platforms such as Twitter and Diigo were embedded on the side bar, collecting the current interaction and latest content from each tool and displaying them as part of the wiki site.

PbWorks was used as the wiki platform in this course. The course content including syllabus, schedule, activities, readings, assessment materials, and presentations were presented at the wiki. Students were assigned as authors of the wiki so that they could build on the initial content created by the course instructor. Details regarding the guidelines for authoring the wiki were also provided. The wiki platform helped course participants easily edit the collaborative course space. For example, students generated content for the social media toolbox page where the educational uses, benefits, limitations and resources on various social media tools were listed (See the course wiki platform at PbWorks http://socialmedialearning.pbworks.com/).

In the wiki platform, students were encouraged to generate an open content on social media in education that was presented openly to public for reusing and remixing purposes.

C. Generating a collective resource repository with social bookmarking

Social bookmarking can enhance collaborative information discovery and provide a location for storing the resources and a collaborative space for bringing people with similar interests together. It can serve as an extensive resource for students to access after the classes end. There are various social bookmarking services that are used extensively by the Internet users such as Digg, StumbleUpon, Delicious, and Diigo. These platforms allow users save, store, group, and share their bookmarks online and also join groups with like-minded people. Users can follow or be followed by other individuals who post similar types of bookmarks and engage in a conversation.

In order to allow students to store, describe and share numerous web resources on social media and education, a group was created in Diigo social bookmarking platform. The resources were tagged using the course tag “ci593b” and other descriptors and shared within the Diigo group where all students were assigned as members. Diigo class group was used extensively during the course as an online space for encouraging group collaboration. Students shared online resources, commented on each others’ bookmarks, annotated their own bookmarks, and attended to online discussions about the bookmarks (See the course bookmarks at http://groups.diigo.com/group/ci593_b).

During the course, students contributed to the resource collection on social media in education by sharing and commenting on various resources. Social bookmarking helped students keep up with the recent news and resources on social media and education topics that were updated frequently in online platforms.

D. Course blog as a reflection and discussion space

A blogging space was incorporated into the course to help the instructor and the students blog about their reflections on the course topics. During the online sessions, students and the instructor used the Edublogs platform. The course instructor posted her reflections on the course activities after each offline session and shared her comments on the agenda for the following online activities. The blog was designed as a platform to create an interactive discussion environment where students expressed their opinions and commented on each other’s posts (See the course blog at http://socialmedialearning.edublogs.org).

Course blog helped students keep track of their own learning progress and read instructor’s reflections on the course activities and topics.

E. Social networking for extending the classroom interaction

A significant portion of students’ time were devoted to reading formal and informal online texts on various social media channels, watching the videos and following the tweets and updates related to the course content. Twitter helped class members receive updates about recent news and resources related to social media. Students were encouraged to use class tag in their tweets in order to create an easy access to the class related topics. Twitter was also used as a tool to connect the classroom to the experts and educators around the world who were interested in the use of social media in educational environments. For instance Twitter was incorporated as a backchannel in one of the guest speaker sessions. The guest speaker, while presenting on Skype, interacted with the students with tweets and answered the questions that the students asked using the course hash tag. Additionally, a Facebook group was created for the class to help students interact socially and informally in a social network with personal stories and pictures at the beginning of the class. Facebook and Twitter posts were linked through Twitterfeed that allowed posting class related tweets on the Facebook Wall. Connecting various platforms via RSS feeds helped to collect various online interaction at certain hubs.

IV. Conclusion

This paper intended to present a case where several social media tools were integrated in a blended course on social media in education. Because university students have embraced the capabilities of social media channels, using these tools in blended courses might enhance the social interaction in the classroom and carry the conversation outside of the formal teaching environments. The purpose for using several tools in the course was not only helping students experience the integration of social media tools in learning environments but also presenting an example where the unique affordances of each social media platform could be used for different pedagogical purposes. Fig. 1 illustrates how each social media platform was integrated into the course with the specific learning and teaching activities they afforded.

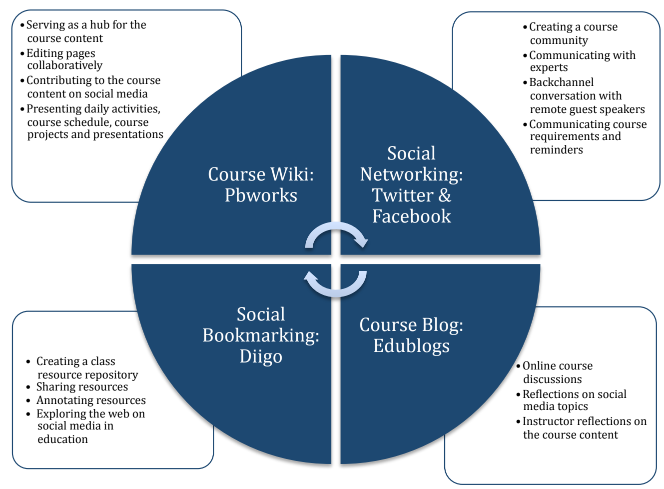

Fig. 1. Course Design on Social Media Platforms

This course was designed with an initial mission to provide educators an extensive resource on social media in education that was shared with the Creative Commons “Attribution-NonCommercial-ShareAlike” license. The instructor designed the initial course content, yet an extensive resource collection on different social media platforms was created with the students throughout the course and made available to public for reusing, repurposing and disseminating purposes. Instead of keeping the course content in a closed course management system, the purpose was to reduce the barriers to sharing, remixing and reusing educational resources on social media.

As societal structures get more dynamic and complex with the new technological innovations, the divergence between higher education and the society grows. Four categories exist where this discrepancy becomes apparent between educational settings and everyday life: Analog to digital, tethered to mobile, isolated to connected, generic to personal, consumers to creators, and closed to open [10]. Higher education institutions now face with a pressure to adapt to the changing structures within the system they exist. Therefore changes in higher education systems need to address “increases in connectedness, personalization, participation, and openness” [10]. This course was an attempt to bridge the gap between the educational settings and everyday life of the students, and increase their awareness about the way higher education systems could be designed with the characteristics of openness, participation, connection, and sharing.

The ubiquity of open source and social media tools offer a new paradigm of teaching and learning that places teachers and learners as co-constructors of learning. Recognizing this potential, instructors may incorporate social media tools into their educational environments with innovative uses and develop pedagogically sound and sustainable learning environments. Several pedagogical decisions should be considered to create pedagogically sound practices. Instructors who intend to integrate social media tools into their educational settings may follow the recommendations that grew out of this study:

- Analyze the affordances and limitations of each social media tool with pedagogical methods, content, and the context of the instruction.
- Spend considerable time on planning and design of learning experiences before the course starts.
- Allow flexibility for change and revisions as the course progresses.
- Consider students' levels, interests, backgrounds, and knowledge on the use of social media tools in their everyday life and educational settings.
- Rather than using each social media tool in isolation, follow an integrated approach.
- Communicate clearly the purpose and the usage of each social media tool with the students.
- Review the institution's policies on social media use, and create social media guidelines (eg. privacy, security) for the specific course. Allow student input in preparing these guidelines.
- Integrate authentic assessment activities with social media tools into the courses.
- Take advantage of social media as a way of connecting the class to the experts around the world.
- Conduct formative evaluation of the course and frequently receive feedback from the students.
- Explore the opportunities for creating an open content with and for the students. Be familiar with the Creative Commons licenses.
- Encourage students' participation in creating and contributing to course content.

REFERENCES

[1] H. Jenkins, K. Clinton, R. Purushotma, A. J. Robinson, and M. Weigel, "Confronting the challenges of participatory culture: Media education for the 21st century" (White Paper). MacArthur Foundation, 2006 [online]. Available: http://www.newmedialiteracies.org/files/working/NMLWhitePaper.pdf

[2] L. Lane (2009). Insidious pedagogy: How course management systems affect teaching. *First Monday* [online]. *14(10).* Available: http://www.uic.edu/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/2530

[3] G. Siemens (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology & Distance Learning* [online], *2(1).* Available: *http://www.itdl.org/journal/jan_05/article01.htm*

[4] *S. Downes (2008).* Seven habits of highly connected people. *eLearn Magazine* [online]. Available *http://www.elearnmag.org/subpage.cfm?section=opinion&article=97-1*

[5] D. M. Boyd, and N. B. Ellison (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication [online]. 13(1)*. Available: http://jcmc.indiana.edu/vol13/issue1/boyd.ellison.html

[6] W. Richardson (2009). *Blogs, Wikis, Podcasts, and Other Powerful Web Tools for Classrooms.* Thousand Oaks, CA: Corwin Press.

[7] B. Lamb (2007). Dr. mashup or, why educators should learn to stop worrying and love the remix. *EDUCAUSE Review. 42(4).* pp. 12-24.

[8] S. Wheeler (2009). Learning space mashups: Combining web 2.0 tools to create collaborative and reflective learning space. *Future Internet [online]. 1(1).* pp. 3-13. 2009. Available: http://www.mdpi.com/1999-5903/1/1/3

[9] L. Yuan, S. MacNeill, and W. Kraan (2008). Open educational resources—Opportunities and challenges for higher education [online]. Available: http://learn.creativecommons.org/wp-content/uploads/2008/09/oer_briefing_paper.pdf.

[10] D. Wiley and J. Hilton (2009). Openness, dynamic specialization, and the disaggregated future of higher education. *The International Review of Research in Open and Distance Learning [online]. 10(5).* Available: http://www.irrodl.org/index.php/irrodl/article/view/768/1414

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Teach Ourselves: A Peer-to-Peer Learning Community Linking In- and Out-of-class Activity

Carole R. Beal, Jane Strohm, Lauren Schwindy, and Paul R. Cohen

Abstract—Teach Ourselves is an online collaborative learning environment designed to engage middle school students with math and science through the inclusion of peer-to-peer activities and game-like components. Students learn from and teach each other as they solve and create math and science word problems, and earn points and badges. An exploratory study with 132 students in six classrooms indicated that much of the activity occurred during out-of-school hours, suggesting that the social elements helped to attract students to continue the activity outside of the formal classroom setting. Qualitative feedback from students and teachers was strongly positive.

***Index Terms*—Collaborative Learning, Informal Education, Computer-Assisted Instruction, Serious Games**

I. Introduction

THIS paper presents a case study of Teach Ourselves (TO), a web application designed to encourage and engage middle school students with math and science. The middle school years have been identified as a critical point at which many students, particularly girls, lose interest in science, technology, engineering and mathematics (STEM) subjects [1], [2]. Innovative approaches are needed to ensure that students remain engaged with these subjects through high school and beyond.

Teach Ourselves is an online community in which students solve math and science word problems created by other students, and create and share their own problems with peers. Teach Ourselves includes features that were inspired by recent research on the engaging properties of computer games, including the chance to earn points and badges, to compare progress with other users, and to engage in social activities such as communicating with peers and providing feedback in the form of compliments ("+1") or criticisms (flagging) [3]. The number of points that can be earned by solving and creating is determined by a dynamic economy that varies with the number of problems available to solve in various domains. Students can track their points on their profile page, and can compare their performance to others by checking the leaderboards.

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In addition to its game-like components, Teach Ourselves is also designed to support creative activity by students. This aspect of the system was inspired by research on the cognitive and motivational benefits of "problem posing." In problem posing, students generate new problems and questions from available information, or seek out information about a topic of interest and use the information to discover new relations [4], [5], [6]. Problem posing is thus distinct from the much more common practice of requiring students to solve problems that have been prepared by teachers or that are presented in textbooks. Problem posing is argued to provide students with the opportunity to reflect on what is known and not known, to restate a problem in a new equivalent form or to vary problems in new ways, and to engage in explanation: all processes that should lead to better problem solving and transfer to new problems [7].

In addition to the hypothesized cognitive benefits, problem posing has also been claimed to increase student motivation, whereas solving problems defined by others day after day often leads to student boredom [8], [9]. Teachers have reported anecdotally that the activity of problem posing leads to class engagement and higher interest, especially among students who are not generally enthusiastic about math and science subjects [10]. Problem posing has also been suggested to help students become more confident and feel a greater sense of "ownership" about the topic [9].

II. Features of Teach Ourselves

A. Problem solving

When the student logs in to TO, he or she can view a list of the problems that are already available to be solved (i.e., word problems created by prior student users), along with the current points value for each problem. If the student solves a problem within three attempts, he or she earns the points. Each incorrect attempt elicits a brief feedback hint, and the problem solver can also view a multimedia help file created by the problem author. If the student does not enter the correct answer, he or she can try the problem again (although the points value may have fluctuated).

B. Problem posing

Students can also earn points by creating their own problems. In fact, the values for creating new problems are significantly higher than for solving existing problems, because problem authoring is generally more challenging and time-consuming. To create a new problem, the student works with a template that includes areas for typing in problem text, adding a graphic, entering two pieces of feedback that would be shown if the future problem solver enters incorrect answers, and a help item [11]. An example is shown in Figure 1, below.

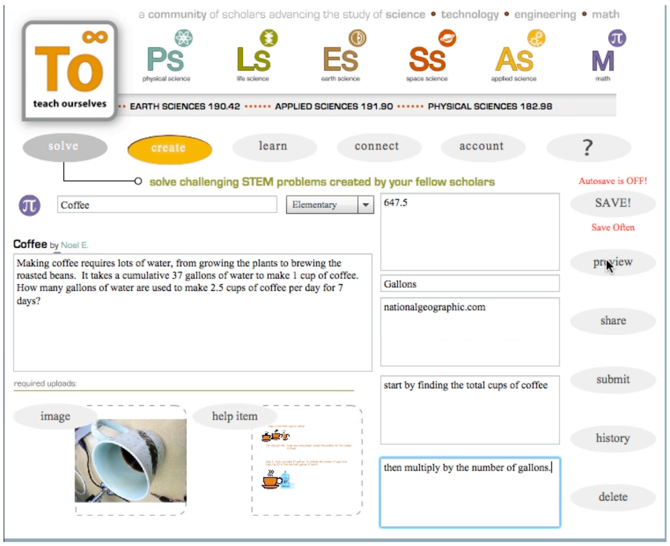

Fig. 1. Problem authoring template in Teach Ourselves

Help items can be pictures, slide shows (created with PointPoint), screencast or cell phone videos or other media. Help items are intended to provide an explanation or worked example that can guide the user to the solution but without providing the answer.

When students are ready, they submit their work to their teacher for review. Teachers use an integrated rubric to check that the problem includes accurate and appropriate content, that the answer is correct along with any associated units that need to be specified, and that the attributions for any source materials are listed. If the teacher approves the problem, the student can publish it so that it is available for other students to solve within the TO application, and earns the contracted number of points. Teachers can also return the problem to the author with comments and suggestions for revision. Sample student-authored problems available in the "try this!" area of www.teachourselves.org.

C. Social and game-like components

TO includes social networking features such as the ability to +1 ("like"), flag and comment on a problem, along with discussion boards. Also included are game-like features such as leaderboards that show users in terms of overall points, points by domain, class, school and other groupings. Individual progress summaries can be viewed by the student on his or her profile page, including points earned by solving and creating, +1s (compliments) provided by other students, badges earned and stars provided by teachers for high-quality work and helpful feedback given to peers. Students can check their progress and status (badges, compliments, flags) on their account page, as shown in Figure 1.

Figure 2. Student account page in Teach Ourselves

III. Exploratory Study

We conducted a pilot study to explore the feasibility of Teach Ourselves as a classroom activity, and to obtain initial feedback from students' and teachers to the application. The study was conducted in six middle school classrooms in Arizona, USA, and ran for about 90 days on average. As the study progressed, we realized that there was a fair amount of unexpected activity occurring at times that would not typically be considered part of the school day (i.e., before 7:30 a.m., and after 3 p.m.). Thus, the study research questions were extended to include an analysis of in-school versus out-of-school use by students.

A. Participants

The study included 132 students who were 12.3 years old on average; 73 (55%) were girls, and 59 (45%) were boys. Class sizes ranged from 15 to 28 students per teacher.

B. Procedure

Teachers participated in one two-hour training session conducted using web-conferencing software. Teachers received a modest stipend in compensation for the out-of-school time involved in learning to use TO and providing feedback to the research team.

The TO application was seeded with approximately 100 word problems that had been created by previous users.

After completing the training, teachers created accounts for their students, and then integrated the activity into the classroom. Participating teachers were free to integrate TO into their instruction in various ways. Some had students work on solving and creating problems as part of a required in-class activity that sometimes carried over into homework. One teacher used it exclusively as extra credit, while another teacher used it intensively as part of her technology elective. In some cases teachers used additional incentives, such as extra credit points towards a grade, a class party upon meeting the goals, or converting TO points to class currency to purchase real rewards.

At the end of the activity, teachers and students were asked to complete an anonymous online survey about their reactions to TO.

C. Data Collection

Students' navigation actions within the TO application were automatically time-stamped and recorded, including logging in, choosing an activity (e.g., solving problems, creating problems, looking at leaderboards, making comments on the discussion boards, etc.) and logging out.

In addition, students' work within the application was available, including records of the points earned, and the number of problems solved and published.

Students' and teachers' responses to the online survey completed at the conclusion of the study were not linked to user identification numbers to preserve confidentiality.

D. Data processing and scoring

Data were assembled for each student, including the number of points earned from solving and publishing word problems, and the number of problems solved and published.

Quality of the problems created by the students was analyzed after the study was completed. A measure of problem quality was established based on a rubric for problem text (i.e., complexity, 0 to 4 possible points), help item quality (i.e., level of helpful information provided, 0 to 4 points), and solvability (i.e., was the problem readily solvable as a contained unit or did it require additional research or learning; 0 to 4 points). The maximum value 12 indicated the highest quality problem. Problems were rated by one of two trained researchers; disagreements based on a subset of 20 problems were rare and were resolved by discussion.

Navigation events logged for each student were extracted and the event timestamps were used to categorize the events by day (weekday or weekend; holiday weekdays were counted as weekend days) and time (by hour, from midnight to midnight). School activity was defined as events occurring between 7:30 a.m. and 3:00 p.m. Evening activity was defined as actions occurring between 8:00 p.m. and midnight. The total number of navigation events in these categories was calculated for each student.

IV. Results

A. Student problem solving and creating

On average, students solved 146 problems and created 5.2 new word problems. Consistent with previous work with older students, students earned more of their points from solving other students' problems (80% of total points earned) than creating their own (20% of total points earned) [12].

B. Problem quality

The new word problems that were created and published by students in the study were rated for quality by the research team following a rubric ranging from 0 (unintelligible text, poor or non-existent help item, no clear right answer) to 12 (ideal, clear problem with a single right answer, no errors and effective help item). On average, students' work was rated 7.5 out of 12 possible points, with a low 4 points to a high of 10 points.

Average problem quality varied somewhat across the six classrooms, from a low of 6.6 to a high of 8.5. Not surprisingly, students who earned more points overall also had problems that were independently rated as being of higher quality, suggesting that more extended involvement with TO was associated with better work.

C. Out-of-school access

We used navigation events such as logging in, clicking on menu items and entering responses to ascertain when students were accessing TO. Students had an average of 1,210 total navigation events recorded during the study, with a range from 50 to 7,318. Of these, 49% occurred during out-of-school hours, meaning at times other than Mondays-Fridays from 7:30 a.m. to 3:00 p.m. In fact, only 27 students (20% of the sample) *never* accessed TO during out-of-school hours.

Looking more closely at the out-of-school access information, most appeared to be in the evening hours (8:00 p.m. through 12 midnight); evening use accounted for about 15% of the total navigation events. Weekend activity accounted for about 9% of the navigation events, with 35% of the students logging in at least once on a weekend day. Interestingly, there was a significant correlation between the number of events during evening hours and events on weekend days, suggesting that those students who were more engaged with TO after school were also likely to check in over the weekends.

The average percentage of navigations that occurred out of school was compared across the six classrooms. The results of a one-way ANOVA indicated that there was significant variation across the classrooms, $F(5,126) = 34{,}195$, $p < .01$. One teacher reported that she used TO primarily as a homework activity, so the high percentage (90%) of events occurring out of school for her students was not unexpected. A second classroom included students who rarely (11.6%) accessed the system outside of school. This left four classrooms (85 students) where TO was implemented by teachers during the school day. In these classrooms, 45% of the navigation events still occurred outside of school hours.

D. Qualitative responses from participants

Because students' feedback was provided anonymously, it was not possible to link specific comments with individual student data recorded within the TO application. However, the feedback provided by students was generally very positive. Students reported that they liked the social connection to peers, and the ability to learn through creating and solving problems while earning points. Sample comments (errors in originals) include: "One thing I really like about Teach Ourselves is the idea of competition. The leader boards really keep kids on their toes to try and get to the top. I think it makes people more focused on the problkems and more determined to solve them." "I like how it tells you which questions are worth more and how you can ern ponts on it." "I enjoyed extremely the leader board I think it is kinda fun." "I trying to git in first ranking." "I love Teach Ourselves. I like the thrill of getting points and getting on the leader board." "I like how it focuses on points and badges." "I like how it makes learning fun and I am doing it on my own time!"

Teachers identified many benefits to using TO with their students including self-evaluation, critical thinking, digital literacy, and reinforcing STEM knowledge. All (100%) said that they thought their students had enjoyed TO and that it had helped them learn domain-specific material; 89% said it helped students improve higher-order thinking. "TO provided them with opportunities to practice and master math and science skills being taught in their core subject classes." "Creating help items and writing their own problems allowed them to organize new ideas and evaluate their own learning process."

Teachers were asked to describe one thing they liked about the activity and one thing that they felt needed to be improved. Positive comments included the following: "It helped the students be more analytical about their work." "They had to decide the best way to express their question and the appropriate format for the answer." "It got the students really thinking about the information and how to ask a robust question about it instead of just telling someone the information." "I enjoyed seeing the creative problems that were created." "I'm amazed at how creative and well-written some of my students' questions are." "I really think this is helping my students with their higher-order thinking." "Their excitement about the program was evident - they LOVED having Teach Ourselves days." "I witnessed my students take pride on their work and become more confident and sure of themselves."

V. Conclusion

Both the qualitative feedback and the behavioral data collected as students worked with Teach Ourselves suggested that the application was successful at engaging students both in and out of school. Of course, one limitation is that the behavioral analyses were based on raw navigation event logs, meaning we do not know what students were actually doing within the application. We also do not know why they were accessing TO after school; it is possible that some were completing assignments that had been started during the school day. Even so, the finding that 80% of the students used TO out of school was striking given the focus on math and science topics, which are not always highly appealing to many middle school students. Adolescents spend a great deal of their out-of-school time engaged with entertainment media and social networking. The experience with Teach Ourselves suggests that incorporating some of the social and game-like elements into an academic application may have the potential to bridge formal and informal learning.

Acknowledgment

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References

[1] Beal, C. R. (1994). *Boys and girls: The development of gender roles*. New York: McGraw Hill.

[2] Leder, G. C., Pehkonen, E., & Torner, G. (2002). *Beliefs: A hidden variable in mathematics education*. Dordrecht: Kluwer.

[3] McNamara, D., Jackson, G. T., & Graesser, A. (2010). Intelligent tutoring and games. In Y. K. Baek (Ed), *Gaming for classroom-based learning* (pp. 44-65). Hershey PA: IGI Global.

[4] Brown, S. I., & Walter, M. I. (1990). *The art of problem posing*. Hillsdale NJ: Erlbaum.

[5] Cai, J., & Huang, S. (2002). Generalized and generative thinking in U.S. and Chinese students' mathematical problem solving and problem posing. *Journal of Mathematical Behavior, 21*, 401-421.

[6] Polya, G. (1962). *Mathematical discovery: On understanding, learning, and teaching problem solving*, Vol. 1. New York: John Wiley.

[7] Chi, M. T. H. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science,1,* 73-105.

[8] Contreras, J. N. (2003). A problem-posing approach to specializing, generalizing and extending problems with interactive geometry software. *The Mathematics Teacher, 96*, 270-275.

[9] English, L. (1997, Nov.). Promoting a problem-posing classroom. *Teaching Children Mathematics,* 172-179.

[10] Simic-Mullter, K., Turner, E., & Varley, M. C. (2009). Math Club problem posing. *Teaching Children Mathematics, 16*, 206-212.

[11] Birch, M. & Beal, C. R. (2008). Problem posing in AnimalWatch: An interactive system for student-authored content. *Proceedings of the 21st International FLAIRS conference,* Coconut Grove FL, May 15-17, 2008.

[12] Beal, C. R., & Cohen, P. R. (2012). Teach Ourselves: Technology for problem posing in the STEM classroom. *Creative Education*, 3, 513-519.

[13] Iannotti, R. J., Kogan, M. D., Janssen, I., & Boyce, W. F. (2009). Patterns of adolescent activity, screen-based media use and health indicators in the United States and Canada. *Journal of Adolescent Health, 44*, 493-499.

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Developing Media Competence in Vocational Education – Architecture Design for Context-sensitive and Individual Learning

Christina Di Valentin, Andreas Emrich, Dirk Werth and Peter Loos

Abstract—**This paper presents an approach for integrating media education into the vocational education and qualification chain. Therefore, an architecture proposal for a technological learning concept called "Social Navigator for Media Competence" is made, which provides users recommendations about appropriate media contents and measures of media competence within specific learning contexts of vocational (re)training. The focus is on trainees and students as well as on groups that are involved in vocational qualification processes, such as teachers, trainers, supervisors and pedagogic personnel. Hence, the competencies of trainees in dealing with digital media, in particular social media, are fostered. With context-sensitive and individually tailored recommendations of media contents and measures of media competences (e.g. training programs, tools, concepts / methods of education or teaching scenarios), the Social Navigator makes an important contribution to strengthening the learning capacities of each individual as well as involved training companies within vocational education.**

Index Terms—**Digital and social media, ontology evolution, proactive information delivery, web 2.0.**

I. Introduction

Digital media shape the living world in many ways. In particular social media applications, such as Twitter or Facebook have had a large influence in the way people communicate [1], [2]. Aspects like simplicity, affordability and flexibility of information and communication technology go along with an increase of its popularity in the application field of education (vocational as well as ongoing professional development) [3]. Social media is being used by more and more students, in particular in apprentice jobs and at universities, with the goal to contact other students to obtain the required information about specific tasks and exercises in educational processes [4]. However social media requires from each individual in the private sector as well as in the working world skills for being able to effectively use social media technologies in educational processes [5]. Hence, an efficient use of digital and social media represents an important factor for strengthening the education and learning capacity of each individual as well as an efficient organization of working processes. Studies of the European Commission (EC) have demonstrated that aspects like the development of teacher's qualifications, suitable learning environments as well as transparency and mutual recognition of competencies and qualification amongst learners and teachers represent current trends in vocational education and training (VET) [6].

The project KOMMIT presented in this paper aims at integrating aspects about media education into the chain of VET, especially in the field of jobs in information and communication technologies, such as IT administrators or qualified IT specialists. The goal of KOMMIT is the development of an IT-based tool ("Social Navigator for Media Competence", in brief Social Navigator) that supports each involved group of people in learning and teaching processes through advisory concepts and support frameworks. Hence, in particular supervisors and pedagogical personnel obtain assistance in using digital media and realizing didactically meaningful scenarios within educational processes. The primary goal of the project is to strengthen the cooperation between companies and vocational schools through the strategic use of social media for an efficient communication and collaboration of all personnel groups that are involved in VET. This paper shows a first architecture proposal about the technological concept to be implemented in KOMMIT.

The research design follows a design-oriented approach [7]. Based on a systematic literature review and expert interviews with several representatives in the vocational education sector (teachers, trainers, supervisors, pedagogic personnel and trainees), shortcomings about current learning concepts in VET are derived as requirements. These requirements serve as basis for the conceptual architecture and implementation of the Social Navigator.

The outline of the paper is as follows: First an overview of current technologies in the field of context sensitive learning is given in Chapter 2. Based on the State-of-the-Art, Chapter 3 presents a possible application scenario and an architecture proposal to consider each individual's preferences and the status of each participant within the educational qualification process. The paper closes with a summary and an outlook on future research in the field of context-sensitive learning.

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II. State of the Art in Context-sensitive Technologies

A. Context-sensitive recommendations of multimedia content

A basic functionality of the Social Navigator is the provision of context-sensitive recommendations about media contents and media competencies. These recommendations enable a problem related use of media applications in the context of VET [8], [9]. Training companies and institutions are characterized by a large number of information such as multimedia contents, semantic information, context information and curricula. For teachers and trainees, this goes along with the problem of searching and finding the right information. Existing portals (e.g. LibraryThing, YouTube, imeem) are able to provide contents to users, however recommendations offered by these portals are based on past usage behavior. Instead of reactive supply of information, the project presented in this paper is focused on proactive delivery of information by taking into account the current learning and working context (with minimal efforts for involved groups). The project builds upon existing ontologies like FOAF (Friend of a Friend), SIOC (Semantically Interlinked Online Communities) or MetaCafè. The conceptual framework consists of an upper level ontology that abstracts from the specifics of an integrated ontology by providing an easy and efficient infrastructure for semantic requests.

B. Ontology Evolution

Ontologies are often used for the representation of conceptual models, their constituent elements and their semantic relationships [10]. Ontology evolution comprises a consistent and continuous adaptation of ontologies over time [11], [12]. When carrying out modifications on ontologies, it is important to be aware about retaining their consistence [13], [14]. Hence, modifications on ontologies must be continuously traced and logged to be able to carry out a mapping between new versions and an evidence of used instances [13–15]. In the past years, several trends about ontology evolution have evolved: change management of distributed ontologies focuses on methods and tools that are needed to dynamically avoid changes within existing ontologies [12], [16], [17]. For the specification of the ontology, OWL (Web Ontology Language) is used. The Change Requirement Discovery supports exposing the reasons for changes within ontologies and on deriving requirements on these changes [11], [18]. KAON (Karlsruher Ontologie) is a middleware that supports a continuous distribution of ontologies during the entire lifecycle [19]. Belief Change comprises the automated adaptation of an ontology to new knowledge without the need of human intervention [20].

The architecture proposal presented in this paper builds upon the principles of ontology evolution to combine aspects from different information sources such as learning portals, social networks and multimedia data. Hence an interdependent knowledge network emerges [21]. Based on this infrastructure, several complex and multidimensional analysis are planned to be realized to link usage behavior to, for example, learning success. Hence, previously modeled best practices (e.g. referring to media competence) can be constantly monitored and incrementally improved.

III. Architecture Proposal of the Social Navigator

A. Application Scenario

A trainer plans to deploy his/her trainees in the Marketing department. Therefore, he/she wants to teach his/her trainees about how to use a YouTube channel to create videos and to moderate the corresponding blog of the channel in the context of public relations. One question that appraises in this context is: how can the trainer convey to his/her trainees the competence to create such a channel with a corresponding blog? Aspects like the creation of professional blog posts, a correct answering of comments and the professional communication via media, like, for example, YouTube, requires specific competencies that have to be taught to the trainees.

The Social Navigator can be used to search for similar projects or questions that have already been discussed by other trainers and/or teachers concerning a similar problem. By this means, the trainer is recommended projects in other training companies in which similar aspects have already been considered. Hence, the trainer gets insight and recommendations about training methods that have already been applied by other training companies. The trainer also finds teaching scenarios that are provided by the Social Navigator platform itself. These teaching scenarios can be individually integrated in the in-house training curriculum. His or her colleague (teacher) from vocational school who is responsible for the trainees in the company gets informed about this specific marketing project carried out with the trainees. Thus, the teacher uses the scenarios provided by the Social Navigator platform for the curriculum in the vocational school and additionally finds exercises that are needed to systematically teach the needed competencies at the trainees. Afterwards, these exercises can be given back to the community via the platform.

B. Consideration of the Learning Context

One important aspect about the Social Navigator represents the search and recommendation component. Thereby, the context of the involved groups represents the starting point for media recommendations. Figure 1 shows the interactions between a user and a concrete task within a specific teaching or learning process.

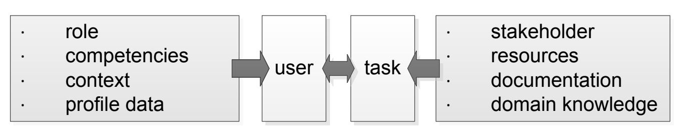

Fig. 1 Coherence between user and task

Within the Social Navigator, users are described by their role within the teaching or learning process (e.g. student, teacher, trainer, personnel development officers, pedagogic personnel or supervisors). Further aspects are the competencies that are assigned to each individual in the teaching and learning process. These competencies can be provided proactively by the user, but they can be also evaluated through collaborative filtering within the Social Navigator. Thereby profile-relevant data can be gained by readouts and semantic categorizations (e.g. evaluation of posts in Twitter). This additional information can be used to enrich the user profiles of all members within the Social Navigator. The consideration of the user's current context enables to provide information which is adapted at current requirements. In doing so, e.g. teachers can receive recommendations about teaching contents that match to the current situation within the training company as well as to the trainee's current state of knowledge. In addition, profile data gets continuously enriched by machine learning and additional information. Thus, users of the Social Navigator can be related to particular tasks. These tasks can be described by specific stakeholders, resources, documents or certain domain knowledge.

C. Architecture Proposal of the Social Navigator concept

The Social Navigator is going to be developed as web-based platform on the Web and represents a stand-alone solution which is interfaced to several social networks and to the Internet (e.g. via "Member Buttons" or via interfaces to social education apps from social networks, etc.). Furthermore, it is planned to implement specific parts of the Social Navigator in form of an app into social communities to ensure that the Social Navigator can be found and used by a large number of users. The Figure 2 depicts an architecture proposal of the system architecture.

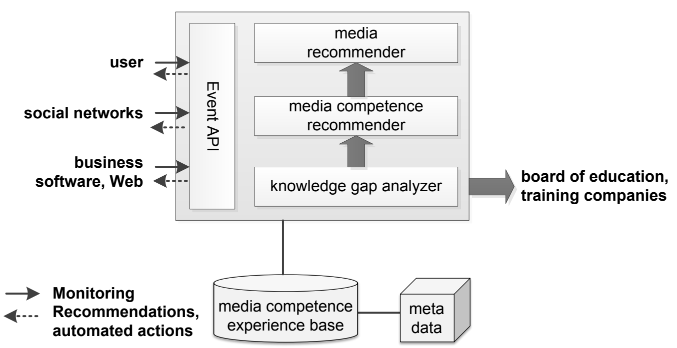

Fig. 2 System architecture of the Social Navigator

To access context-based and profile-based data, the Social Navigator is interfaced to several social networks (e.g. Facebook, Xing or Twitter). An event API ensures a continuous actualization of media contents within social networks and web portals (e.g. web portals of training companies and vocational training schools) as well as a continuous evaluation of relevant events (e.g. a trainee adds in his or her profile additional competencies and/or learning progresses; in a forum exist new entries concerning specific programming languages or developer platforms). This consideration of current lifecycle information enables supervisors, personnel development officers, pedagogic personal and trainees to receive information about suitable media contents that match to their demographic, social and knowledge-based situation. At the same time, trends and current topics in VET can be identified. Hence, the comparison of several contexts of different users can be ensured. By this means, collaborative media competencies of several users can be incorporated in teaching and learning processes, which plays in particular in a dual vocational system an important role. The gained knowledge can be, for example, used by vocational teachers to efficiently divide learning and working groups. This information can be provided by the Social Navigator either proactively or based on the user's search requests. Hence, trainees can be provided additional media contents in form of videos, presentations, forum discussions or interfaces to social networks, which represent an amendment of currently discussed course topics of the vocational training.

In addition to recommendations of media applications, the Social Navigator also supports the gain in competence of the involved groups by providing process recommendations and guidance of actions in form of best practices. Thus, media and contents can be provided that fit to the individual learning processes of trainees by considering current curricula at the same time (guidance of action within specific predefined curricula). The basic idea in this scenario is: curricula in most cases are predefined by the federal government and the federal states. However, every trainee has an individual approach to deal with specific topics and tasks. The Social Navigator individually supports students and trainees to work on specific tasks and learning contents the way they prefer to by providing recommendations, such as support in searching for media types or the derivation of best practices for the usage of multimedia contents in different types of documents. Thereby, recommendations will be generated about how social media can be applied for carrying out specific tasks.

D. Process of Recommendation

Figure 3 shows the generation of recommendations.

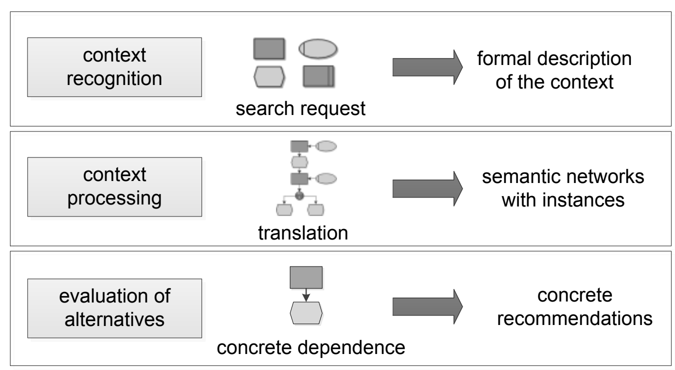

Fig. 3 Recommendation process of media content and media competencies

In a first step, the system captures the current context of the user. This is carried out by a formal description of current context data (e.g. Mr. Smith, a skilled accounting clerk, is working with a new table of accounts according to the accounting regulations IFRS. Mrs. Reid from the same company is an expert in IFRS). Every time a user interacts with an object within the system, several analyses are caused to identify the impacts these changes have on the learning process or the so far generated recommendations. For this reason, each event within the system is logged. This goes along with the interface within the platform of the Social Navigator.

In a next step, the current process of the learning and/or teaching person is recognized. Thereby, interdependencies within this process step are traced and current context data is processed. Based on a query translation, complete semantic sub-networks including their entities can be indicated at instance level. These semantic sub-networks depict the complete knowledge space of the current context. Finally, on instance level the system is able to evaluate alternatives by providing recommendations about different media types as well as persons and processes that match to the user's current context. These processes can be e.g. reference processes in form of best practices (either identified through global mining or indicated by teaching staff) or individual and collaborative best practices.

To be able to boost media competences, the identification of knowledge gaps plays a significant role. The Social Navigator must be able to recognize unsuccessful attempts of media use within document types as well as finding the most effective media type for each individual within the learning or teaching process. This is carried out by analyzing historic logs. Based on these historical logs, recommendations for searches, post-processing and the use of media and media types can be derived.

IV. Conclusion

This paper has presented an architecture proposal of a technological concept (Social Navigator) which provides individualized support to several personnel groups involved in teaching and learning processes within VET by providing context-sensitive recommendations. The Social Navigator will be implemented as an integrative component of several social networks. Thus, possibilities offered by these technologies can be used to promote and communicate competencies.

However, the presented approach is also characterized by several limitations. Section III has shown, that for an efficient use of the Social Navigator, concrete application scenarios have to be defined. One further aspect to be considered is that the Social Navigator has to be continuously used by the involved user groups to ensure a continuous expansion of the knowledge base.

References

[1] T. Michael and T. Howard, "Using new social media and Web 2.0 technologies in business school teaching and learning," *Journal of Management Development*, vol. 31, no. 4, pp. 358–367, 2012.

[2] C. Lattemann, S. Stieglitz, and S. Kupke, "Deutsche Unternehmen auf dem Weg zum Web 2.0?," *HMD - Praxis der Wirtschaftsinformatik*, vol. 267, 2009.

[3] J. Tondeur, H. van Keer, and M. Valcke, "ICT integration in the classroom: Challenging the potential of a school policy," *Computers & Education*, vol. 51, no. 1, pp. 212–223, 2008.

[4] C. Carrington, "Generation web 2011 - a report on business school websites (executive summary)," Surrey, 2011.

[5] D. Karahocaa, I. Duldaa, A. Karahocaa, A. Yücela, B. Gulluoglua, and E. Arifoglua, "Interactive e-content development for vocational and technical education," *Social and Behavioral Science*s, vol. 2, 2010.

[6] W. Friedrich, M. Körbel, and K. Müller, "Study on the impact of the Leonardo da Vinci programme on the quality of vocational education and training systems," Kerpen, 2010.

[7] T. Wilde and T. Hess, "Forschungsmethoden der Wirtschaftsinformatik - Eine empirische Untersuchung," *Wirtschaftsinformatik*, vol. 49, no. 4, pp. 280–287, 2007.

[8] J. Bughin, "The rise of enterprise 2.0," *Journal of Direct, Data and Digital Marketing Practice*, vol. 9, no. 3, pp. 251–259, 2008.

[9] D. Werth, C. Di Valentin, T. Burkhart, and P. Loos, "Towards A Design Proposal For Social Media Driven Business Process Management.," in *International Conference on Internet Technologies & Society (IADIS)*, 2012.

[10] A. Maedche, *Ontology Learning for the Semantic Web*. Norwell: Kluwer Academic Publishers, 2002.

[11] R. Djedidi and M. A. Aufare, "Ontology Evolution: State of the Art and Future Directions," 2008.

[12] A. Maedche, B. Motik, and L. Stojanovic, "Managing multiple and distributed ontologies in the Semantic Web," *VLDB Journal*, vol. 12, no. 4, pp. 286–300, 2003.

[13] L. Stojanovic, A. Maedche, B. Motik, and N. Stojanovic, "User-driven ontology evolution management," in *Proceedings of the 13th International Conference on Knowledge Engineering and Knowledge Management. Ontologies and the Semantic Web*, 2002.

[14] L. Stojanovic, N. Stojanovic, and S. Handschuh, "Evolution of the metadata in the ontology-based knowledge management systems," in *Proceedings of the 1st German Workshop on Experience Management*, 2002.

[15] R. Djedidi and M. A. Aufare, "Ontology Evolution: State of the Art and Future Directions," in *Ontology Theory Management and Design - Advanced Tools and Models*, F. Gargouri and W. Jaziri, Eds. Idea Group Reference, 2010, pp. 179–207.

[16] M. Klein and D. Fensel, "Ontology versioning on the semantic web," in *Proceedings of the first International Semantic Web Working Symposium*, 2001, pp. 75–91.

[17] N. F. Noy, A. Chugh, W. Liu, and M. A. Musen, "A framework for ontology evolution in collaborative environments," *LNCS*, vol. 4273, pp. 544–558, 2006.

[18] P. Cimiano and J. Völker, "Text2Onto - a framework for ontology learning and data-driven change Discovery," *LNCS*, vol. 3513, pp. 227–238, 2007.

[19] L. Stojanovic, "Methods and Tools for Ontology Evolution," Karlsruhe University, 2004.

[20] G. Flouris, "On belief change and ontology evolution," University of Crete, 2006.

[21] A. Emrich, A. Chapko, J. Gehlen, F. Ganz, D. Werth, P. Loos, and D. Campus, "Personalized and Context-Aware Visualization and Navigation of Ontologies for Mobile Services," *Computing*, 2010.

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Enhancing Learning Environments by Integrating External Applications

Carlos Alario-Hoyos, Miguel L. Bote-Lorenzo, Eduardo Gómez-Sánchez, Juan I. Asensio-Pérez, Guillermo Vega-Gorgojo and Adolfo Ruiz-Calleja

Abstract—**This paper discusses the lightweight integration of external applications in different learning environments like LMSs, PLEs or MOOCs using the GLUE! architecture. Also, the current status of GLUE! is presented, describing the particularities of integrating external applications in Moodle, LAMS and MediaWiki. Finally, the paper gives instructions to those interested in trying GLUE! or contributing to the integration of new applications or environments.**

Index Terms— **Learning Environments, External Applications, GLUE!, LMSs.**

I. Introduction

The centralization of contents, learning activities and assessment activities in one single learning environment became widespread during the last decade with the adoption of LMSs (Learning Managements Systems) like Moodle, LAMS, Blackboard or Sakai in most educational institutions [1]. These environments bring learners together when facing remote activities, facilitating their communication and also their work in collaboration by means of built-in tools such as chats, forums or discussion boards. However, the limited set of built-in tools that are offered by LMSs hinders the enactment of learning situations in which learners are intended to carry out a wide range of activities (e.g. drawing activities, simulations, etc.) [2]. Also, instructors and learners could prefer to employ the external applications they are used to, instead of using those built-in with an equivalent functionality (e.g. using the Facebook chat for the communication with their partners rather than the Moodle chat).

In this context, the GLUE! (Group Learning Uniform Environment) architecture [3] has been proposed to enable a lightweight integration of many external applications like Google Docs (now Google Drive) or Doodle in different learning environments. GLUE! (Figure 1) is made of a central software component called *GLUE! core* and two kinds of *adapters* [4]. The GLUE! core supports most of the integration functionality, including the creation, configuration, retrieval, update and deletion of application instances. The adapters wrap either learning environments or external applications connecting them with the GLUE! core. The selection of the external applications and the management of their instances are done within the learning environment GUI.

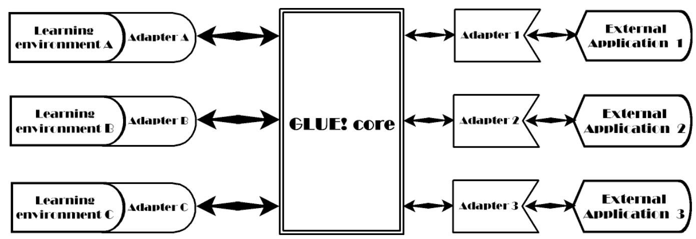

Fig. 1. **Overview of the GLUE! architecture,** including the GLUE! core and the adapters for learning environment and external applications.

II. Integration of External Applications in Different Platforms

In the case of institutional learning environments like LMSs, instructors can use GLUE! to automatically create and configure different instances of each external application for each learner participating in a given activity. Besides, since most LMSs support the arrangement of participants in groups, then every group could receive a different instance to work in collaboration. Afterwards, learners logged in the LMS would find all the applications they need to use (both built-in and external) particularized to carry out their learning activities, individually or in groups.

Ongoing trends on learning environments are fostering more learner-centered software alternatives grouped under the term PLEs (Personal Learning Environments) [5]. PLEs are not expected to replace LMSs, since both models may coexist, being PLEs dominant on informal learning, while LMSs could be preferred by institutions for formal learning [6]. PLEs can also be employed to centralize contents and applications in one single environment, but in this case according to learners' choice. Thus, learners could also employ GLUE! to integrate external applications within the PLE user interface. That integration would be possible due to the multi-tier architectural design of GLUE!, and would only require the development of an adapter wrapping each particular PLE. In this case, learners should be able to decide which applications to integrate in which learning activity. Besides, and if the PLE allowed learners to define group configurations, the own learners could create instances of external applications to be shared by each group with the GLUE! mediation.

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An intermediate approach between the institutionally-oriented LMSs and the learner-centered PLEs are the large-scale online courses also referred to as MOOCs (Massive Open Online Courses) [7]. In MOOCs instructors partially determine the learning and assessment activities, as well as the basic content of the course, while learners may add new content, creating connections with other learners. Users of open source environments supporting MOOCs like Class2Go or OpenMOOC might also benefit from the lightweight integration of external applications proposed by GLUE!, highly reducing the time to create and configure different external application instances for such a large number of participants. As an example, instructors may first create generic instances for all the participants in a MOOC, similarly to the case of LMSs. Then, learners might generate particular instances to work collaboratively in large or small groups, as an analogy to PLEs.

III. Current Status of GLUE!

Different adapters have already been developed to integrate external applications in the Moodle, LAMS and MediaWiki learning environments. It is important to note that the functionality offered by the GLUE! core to instructors and learners in order to select external applications and manage external application instances is equivalent no matter the learning environment employed. Nevertheless, the adapters connecting Moodle, LAMS and MediaWiki with the GLUE! core were designed according to the particular features offered by each of these environments, pursuing a more seamless integration as compared to built-in tools.

Taking Moodle as an example, the adapter adds a special *Moodle activity* that allows instructors to choose any available external application from a drop-down menu. Instructors can request the creation, configuration, update, retrieval and deletion of external application instances within the Moodle graphical interface. It is particularly relevant to say that these instances are automatically assigned to each Moodle group or grouping, providing instructors with high efficiency when managing a course that employs external applications (e.g. just by pressing a button within the Moodle interface instructors can create a different Google Documents instance for each of the groups defined in that learning activity). Also, instructors can reuse instances of the same application in different activities of the same Moodle course, so that, for example, a group may review their partners' work output of a former activity. Learners can access the instances depending on their group or grouping settings, in order to perform individual or collaborative activities (see Figure 2 top). Meanwhile instructors can monitor learners' performance at any moment by visualizing the available instances, and giving feedback as the learning activities are being carried out.

A similar process occurs in LAMS, where instructors can add external applications within the LAMS authoring environment. The LAMS adapter adds a new *LAMS tool* that allows instructors to select any of the available external applications, including them in the sequence of activities defined for a LAMS lesson, as usual. This sequence may comprise any of the LAMS built-in tools plus any available external application. Also, instructors using GLUE! can benefit from the LAMS features for creating groups, branches, conditions or stop gates no matter if they are adding built-in tools or integrating external applications. Afterwards, instructors deploy their lessons in the LAMS monitoring environment, being instances of external applications automatically created as defined in the LAMS authoring environment (see Figure 2 bottom). Here, instructors can also monitor learners' work by accessing external instances as in the case of Moodle. Interestingly, those LAMS lessons that include integrated applications can be exported and shared among instructors as long as they import them in the same LAMS installation or in another one with the same available external applications.

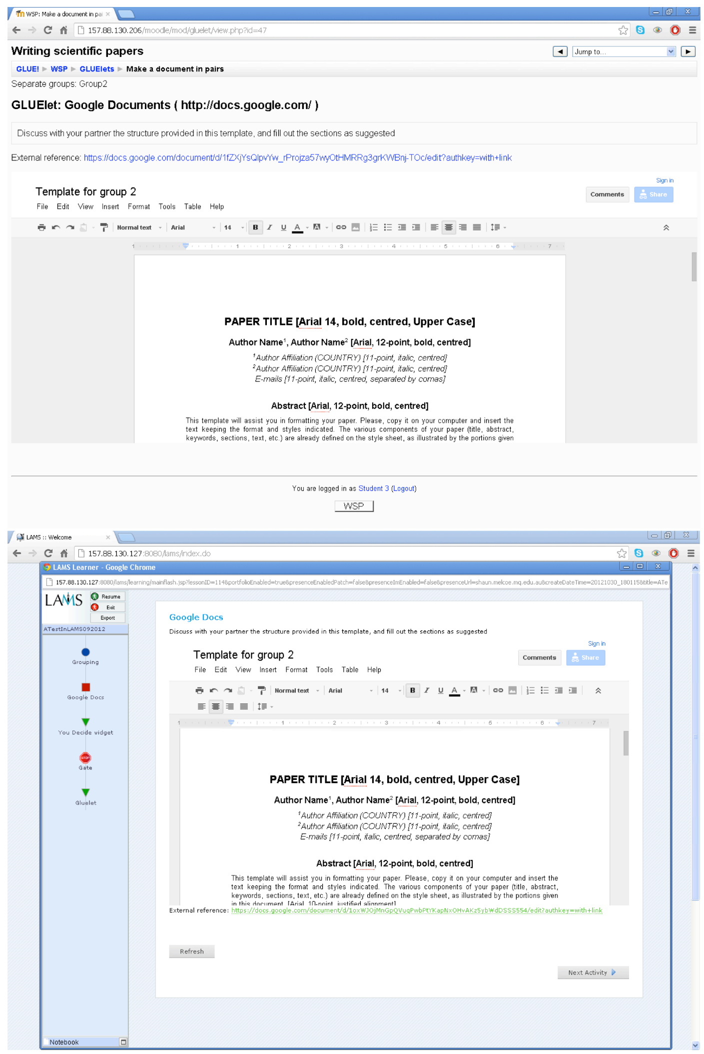

Fig. 2. Screenshots showing the integration of **Google Documents** in **Moodle** (top) and **LAMS** (bottom)

The case of the MediaWiki Content Management System is somewhat different, since it relies on a non-hierarchical generation of content and resources. The novelty in this environment is that any user (no matter if playing the role of instructor or learner) could request the creation and configuration of external application instances with the mediation of the GLUE! architecture. Thus, each learner would be responsible for the content published and the applications selected in order to carry out the learning activities, as an analogy to the case of PLEs.

Authentic experiments with real instructors and learners were conducted employing Moodle, LAMS and MediaWiki as the centralized learning environments, and GLUE! as the integration approach [3]. These experiments showed a significant reduction of the time demanded to instructors when deploying learning situations with a non-trivial group structure that require the integration of external applications. For example, instructors took 7.5 minutes to deploy in Moodle a complex course with five collaborative activities, three external applications, 36 different groups and groupings and 72 instances, thanks to GLUE! capabilities [3]. The same deployment is possible creating the instances through the application graphical interface and then copying and pasting URLs in Moodle, but that takes 42.5 minutes, almost five times more. Besides, these experiments evidenced that the integrated applications satisfied learners' needs, who particularly highlighted the benefits of having all the required applications in one single learning environment.

At this time, GLUE! has already been demonstrated in LMS-specific LAMS and Moodle conferences, with great interest from their respective creators. Anyone can try GLUE! using either of these LMSs and also MediaWiki, requesting a trial account in the GLUE! website (see http://gsic.uva.es/glue). Moreover, the binary code of the GLUE! core and several examples of adapters can be downloaded in a full package or in individual packages, and installed in order to run GLUE! within Moodle 1.9x or 2.x, LAMS 2.x and MediaWiki 1.x versions.

Finally, it is noteworthy that GLUE! is an open source project. The source code of GLUE! can be employed as the basis for those that want to develop new adapters or improve the existing ones. Interestingly, the development of new adapters for external applications that offer a web API is estimated in about one hundred new source lines of code and six to eight programming hours (if reusing the existing code) [3]. That is far less than what is needed to implement an ad hoc integration in for instance Moodle or LAMS.

IV. Conclusion

This paper has discussed how the GLUE! architecture can be useful to integrate third-party external applications in different learning environments. Depending on the particular environment this integration could be made by the instructor or by the learners. For instance, while in institutionally-oriented LMSs like Moodle, the instructor should select the suitable tools to be employed in the learning activities; in PLEs, learners should be responsible for these settings. In any case, the GLUE! architecture positions as an open source, lightweight and low effort alternative to integrate external tools, especially in scenarios where collaboration and group work are required.

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References

[1] Coates, H., James, R. and Baldwin, G., A critical examination of the effects of learning management systems on university teaching and learning, Tertiary Education and Management, 11(1):19-36, 2005.
[2] Bower, M. and Wittmann, M., A Comparison of LAMS and Moodle as Learning Design Technologies - Teacher Education Students' Perspective, Teaching English with Technology, Special Issue on LAMS and Learning Design, 11(1):62-80, 2011.
[3] Alario-Hoyos, C., Bote-Lorenzo, M.L., Gómez-Sánchez, E., Asensio-Pérez, J.I., Vega-Gorgojo, G. and Ruiz-Calleja, A., GLUE!: An Architecture for the Integration of External Tools in Virtual Learning Environments, Computers & Education, 60(1):122-137, 2013.
[4] Gamma, E., Helm, R., Johnson, R. and Vlissides, J., Design Patterns: Elements of Reusable Object-oriented Software. Addison-Wesley, Reading, MA, USA, 1995.
[5] van Harmelen. M., Personal Learning Environments, In Proceedings of the 6th IEEE International Conference on Advanced Learning Technologies, ICALT 2006, pages 815-816, Kerkrade, The Netherlands, July 2006, IEEE Computer Society.
[6] Wilson, S., Liber, O., Johnson, M., Beauvour, P., Sharples, P. and Milligan, C., Personal Learning Environments: Challenging the dominant design of educational systems, Journal of e-Learning and Knowledge Society, 3(2): 27-38, 2007.
[7] Martin, F.G., Will massive open online courses change how we teach? Communications of the ACM, 55(8):26–28, 2012.

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A Case Study on Multi-Modal Course Delivery and Social Learning Opportunities

B. Oyarzun and F. Martin

Abstract—**This case study examines how students attending an Instructional Technology master's program met their program goals through an innovative multi-modal class delivery system and social learning opportunities. Multi-modal delivery is defined as face-to-face and simultaneous synchronous online delivery with supplemental asynchronous online materials. Social learning opportunities include private chat, social network groups, and social gatherings.**

Keywords—online learning; multi-modal; social learning; sychronous.

I. Introduction

Higher education enrollment is steadily increasing according to the Institute of Education Statistics (IES). Currently, there are approximately seventeen million students enrolled in higher education institutions in the United States, that number is predicted to jump to over twenty million by 2021. Over 6.7 million students were taking at least one online course during the fall 2011 term, an increase of 570,000 students over the previous year. Online students account to 32 percent of students enrolled in higher education institutions [1]. Higher education institutions need to explore innovative learning environments that can accommodate the increase in learners without necessarily increasing space on campus. [2] investigated simultaneous delivery of face-to-face courses to on-campus and remote off-campus students for this reason. Their results indicated that each student population received a similar course experience and there were no significant difference in test scores [3].

The emergence of newer web-synchronous conferencing tools has provided the opportunity for a high level of students-to-students and students to instructor interaction which reduces the isolation that online student sometimes feel in an asynchronous course. These students feel part of the community and the level of interaction increases. Increased interaction during instruction results in increased student satisfaction in the course and learning outcomes [4].

The other concern about moving the program online either asynchronously or synchronously was the loss of social interactions which results in students feelings of isolation.

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Research states that online students feel isolated and that faculty should encourage different types of interaction to build a learning community [5]. To combat this concern, they developed groups on several social networks, required group projects in classes, and developed a student group to organize social events for students. Bandura's Social Learning Theory [6] states that individuals learn from one another through observation, imitation, and modeling.

II. Purpose Of Case Study

This case study describes the innovative methodologies implemented in an Instructional Technology master's program at a southeastern mid-sized four-year university. The setting of this innovative delivery, the technology, examples from the different social learning opportunities and student comments on using this delivery method are provided in the sections below.

III. The Setting

This southeastern mid-sized four year university is home to approximately seven hundred faculty and fourteen thousand students. The Instructional Technology master's program is housed within the college of education and currently has 40 students enrolled. Students enrolled in this program are of varying ages, backgrounds, and technical abilities. This program has been offered by the university since the fall of 1999. Initially, the program was only offered face-to-face, but as technology has evolved, so has this program's delivery strategies. During the early years of this century, the program was facing low enrollment issues. The faculty needed to come up with a solution that would increase enrollment or the program might have been cut. The faculty members were wary of moving the program fully online asynchronously because they felt there would be a loss of quality of instruction. They opted for the multimodal delivery where they will be able to reach a larger audience at the same time and maintain the quality of instruction. Multi-modal delivery is defined as simultaneous delivery of instruction both face-to-face and synchronously online with supporting asynchronous materials and activities.

This program is one of the first in the United States to offer its program and courses both face-to-face and in an online virtual classroom environment simultaneously. The option of attending classes in the traditional classroom while virtually communicating with students who are at distance using web conferencing technology has added a new dimension to the program and its courses and has offered further flexibility by allowing students to be at distance or be face-to-face on campus.

IV. The Technology

When a gap analysis was conducted it was found that to effectively deliver our courses face-to-face while transmitting it online to distance students, the program needed technology tools that could help achieve the following goals:

- Continue using a synchronous management tool with the following features: be able to archive, application sharing, use e-board, conduct text chat, use audio and video interaction, create breakout rooms for team collaboration, share content, communicate emoticons, conduct polling and use telephone dialing.
- Provide a secondary video transmission capturing the students in the face-to-face classroom in order to give the online students a feel of being with the other students in the class (social presence).
- Provide the video captures of the online students to the face-to-face students in order to connect students in different locations with the instructor and on-site students

The faculty evaluated various videoconferencing technologies as well as available synchronous and asynchronous management systems to deliver courses online and face-to-face simultaneously. The best solution for the program was the adoption of Cisco Telepresence along with using a synchronous virtual classroom (Webex training manager). Cisco Telepresence system allows the resident and distance students to feel as if they are all in the same room. It combines life-like ultra-high-definition video (1080p), quality audio, specially designed environment and interactive elements to create the feeling of being in person with students in distance locations.

This program's courses are all offered in the evening and are three hours in duration. The faculty members share a classroom that is outfitted with the Cisco Telepresence technology. The classroom also has an instructor station with a computer and dvd player that can be projected on to a screen. All students in the classroom have access to a laptop computer. Figure 1 is a picture of the classroom.

Fig. 1: The classroom

Students enrolled for the courses are given a choice of attending virtually or face-to-face. The initial decision is not a permanent one. The students can attend face-to face one week and virtually the next if they desire. Students have expressed positive feelings towards this ability to choose. The following quote is taken from a student survey inquiring about the benefits of the multi-modal delivery system.

> *"The option of learning face-to-face or synchronously online has been most helpful since I have a family and work full-time. If I am unable to attend face-to-face the instructors have done a great job designing their course for multimodal delivery."*

The instructor, classroom students, and distance students all log into a Webex virtual classroom for the duration of the class. The instructor can share files and websites with students as well as instant messages. Students can also private chat with one another in this program. Figure 2 shows some of the classroom technology in use.

Fig. 2: Cicso Telepresence classroom technology

Another benefit of using the wired classroom is the ability to record or archive the classes. This is done using a product called mediasite. The archive recording has a video screen and content screen so students can easily view the instructor or students talking as well as the content they are talking about. The recording is housed on a streaming media server and can be accessed via the web immediately after the course is complete. Students enjoy this feature because it gives them ability to review difficult material more than once. It also gives them the ability to make up for a missed class. Figure 3 is a mediasite screenshot from an archive recording of a class.

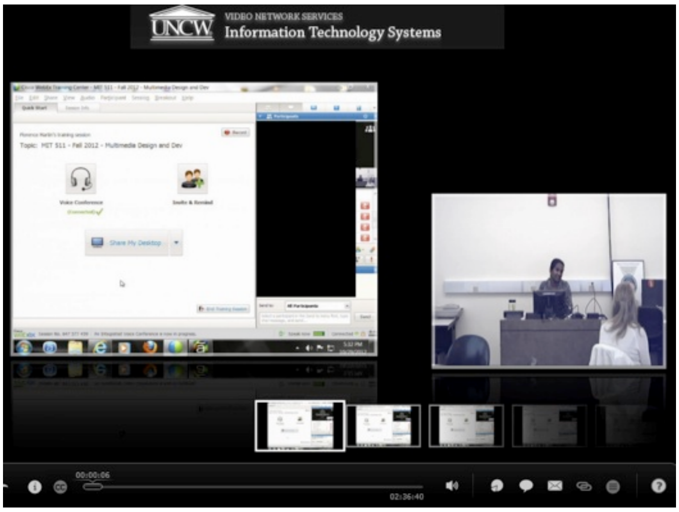

Fig. 3: Mediasite archive screenshot

Instructionally, the courses are delivered as a face-to-face class. The instructors are able to implement the same instructional strategies that they used when the classes were taught completely face-to-face. The only challenge was to learn to manage the new technologies. The students are able to communicate with one another and complete group activities during class time. The faculty and students have also had to adjust for sound delays and technical difficulties that arise on occasion, but there is a technician available to them during class time to help resolve these issues.

V. Informal/Social Learning Opportunities

Social learning opportunities can be defined as "learning by proximity or association". These opportunities often happen accidentally, but the faculty of this program wanted to create a digital and face to face environment that would be conducive to this type of learning and interaction.

Digitally, the students can interact via private chat messages during class or publicly in the social network groups. The private messaging is sometimes referred to as the back channel in literature. Students can use this back channel to clarify questions and communicate understanding of topics during class. This can also help build relationships with other students which in turn can facilitate the development of a learning community. The following student quote is from a survey inquiring about student use of private chat and if it helps their learning.

> *"Yes. Sometimes I have questions that a classmate could answer easily instead of interrupting the entire class. It also adds a social dimension to the class, allowing us to talk and get to know classmates we haven't met face to face."*

There are private groups set up on one popular social network. The faculty members are the administrators of these groups and must approve membership requests. Students are using these venues to share conference experiences, graduation photos, ask questions, and share resources. Figure 4 is an example communication clipped from the social network group page.

Fig. 4: Social network communication

There are also opportunities for students to gather face-to-face. The faculty members have charged several students to organize a social committee. These students plan several social gatherings throughout the academic year. The end of the semester socials are usually held at a faculty member's house and the mid-semester socials are usually held at a local restaurant. These do not typically involve faculty. Students that participate in these activities enjoy the opportunities to make connections with fellow students, faculty, and alumni. The alumni of the program are always invited to the socials and are part of the virtual activities as well. The current students express satisfaction with being able to interact with their peers and alumni in an informal/social manner. The following quote is from a survey inquiring if the socials benefit them.

> *"Yes, this builds community and an informal Q/A with peers helps to gain insight and build relationships with those who have similar interests within the field."*

VI. Student Comments

Evaluation of student satisfaction with the new delivery system indicates that we have been able to address the needs of both online and resident students while maintaining a high level of interaction and quality instruction. The following student quote comes from the graduation exit survey that asks what students think of the program's technological and instructional resources.

"I think the program's technological and instructional resources are very good. Our classroom resources as well as the ones introduced to us through our coursework provide us with ample opportunity to be prepared for entering the instructional technology field upon completion of our studies."

VII. Conclusion

This state of the art classroom and the creative methodologies that have been implemented have helped this program achieve their goals of increasing enrollment while maintain the desired level of quality of instruction. The multi-modal delivery and social learning activities have created more learning opportunities for students. The archives from the classroom help students review complicated content or content they missed during an absence. Social learning opportunities help students and faculty build connections with other students and alumni to ease distance students felling of isolation.

References

[1] Allen, E., & Seaman, J. (2012). Changing Course: Ten Years of Tracking Online Education in the United States. Babson Survey Research Group.

[2] White, C. P., Ramirez, R., Smith, J. G., Plonowski, L. (2010). Simultaneous Delivery of a Face-to-Face Course to On-Campus and Remote Off-Campus Students. Techtrends: Linking Research & Practice To Improve Learning 54, no. 4: 34-40. Academic Search Complete, EBSCOhost (accessed January 9, 2013).

[3] Chiu, C. M., Hsu, M. H., Sun, S. Y., Lin, T. C. & Sun, P. C. (2005). Usability, quality, value and e-learning continuance decisions. *Computers & Education*, 45, 399–416.

[4] Hughes, J. E., McLeod, S., Brown, R., Maeda, Y., & Choi, J. (2007). Academic Achievement and Perceptions of the Learning Environment in Virtual and Traditional Secondary Mathematics Classrooms. *American Journal of Distance Education, 21*(4), 199-214. doi: 10.1080/08923640701595365

[5] Lee, Y. K., Tseng, S. P., Liu, F. J. and Liu, S. C. (2007). Antecedents of learner satisfaction toward e-learning. Journal of American Academy of Business, Cambridge, vol. 11, 2.

[6] Bandura, A. (1977). Social Learning Theory. New York: General Learning Press.

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CritViz: Web-Based Software Supporting Peer Critique in Large Creative Classrooms

David Tinapple, Loren Olson, and John Sadauskas

***Abstract*— CritViz is an online framework for supporting real-time critique, conversation, and peer ranking of creative work in the classroom. In creative classes where student work cannot be entirely graded on objective criteria, classes often arrange critique sessions to provide direction and feedback to students, raise their level of performance, and teach them to give and receive constructive criticism. Critiques usually work best in classes small enough to sustain a single discussion. CritViz was created to scale up critiques for large classes whose size normally prohibits this activity. Through CritViz's countdown timers, assignment uploading, and randomized peer feedback, we can now run effective critiques in much larger classes and have seen changes in overall classroom "motivational structure." Typically with classrooms "Smaller is Better" but our work implies possibilities for increasing class sizes with little negative impact, and even leading to "Bigger is Better" in the classroom.**

***Index Terms*—Art, Collaborative Software, Computer Science Education, Educational Technology**

I. Introduction / Background

A. The Power of Critique

THE "crit", or critique session, in which students share work and engage in a structured critical discussion, is commonly used in art classes, but also in design, architecture, creative writing, and even engineering and science contexts. Because evaluating creative output in classroom settings can be complex and subjective, students benefit from hearing varied criticism from a diverse group, each with a unique perspective. Hearing feedback from multiple people allows the critique recipient to blend the feedback, discounting the outlying overly positive or negative comments, forming a better sense of the overall reception. Receiving feedback on creative work from a group of peers is not easy, and not always comfortable. Well run critique sessions are authentic, honest, and powerfully motivating. As teachers, finding ways to effectively leverage peer critique in the classroom can lead to more authentic student motivation, improved performance, and even improved attendance and participation. A critique-based environment fosters personally relevant learning because it focuses on improving skills and processes rather than on earning points towards the highest grade. Critiques also benefit instructors by providing valuable feedback on the reception of class content, allowing for rapid "reteaching" and retooling of instruction. Finally, through critiques, students hone communication skills, learning to give and receive constructive criticism, a broadly useful and valuable skill.

B. The Traditional Classroom Model

In many creative classes today, the prevailing classroom model consists of many students receiving feedback and evaluation from the single (or few) expert instructors. This model can be ideal at a certain small scale, but as the classroom grows, the amount of attention the instructors can provide declines linearly with the numbers of students in the classroom. More students simply means less time to spend evaluating each individual. With larger classes more teachers or assistants can be added, but the problem of scale persists. Shifting larger classrooms to use peer critiques can alleviate this problem by increasing the amount of feedback each student receives. "Because teachers do not have time to provide extensive feedback, peer conferences are a way to engage students in meaningful formative assessment dialogues with each other" [1]. This shift however only changes the nature of the problem from that of "instructor overload" to "critique management." The bottleneck is no longer the instructor's time and attention, but how to effectively manage a large, cohesive critical discussion. These discussions can of course be distributed over multiple groups or multiple class sessions, but this fragments the class and/or leaves little time for anything but critique.

At Arizona State University, we recently opened a new undergraduate major called "Digital Culture," which aims to combine technical and creative skills into a flexible curriculum geared towards preparing students for a rapidly changing cultural landscape. Our students are a diverse group with interests ranging from music, art, film, and architecture, to interaction design, engineering, social networking, gaming, entrepreneurship and the sciences. Our physical classrooms are very large reconfigurable "maker labs" in which it is not uncommon to have classes with up to 150 students in the same room, learning hands-on to create digital work. Classes this large present a logistical and pedagogical problem. As instructors, we want students to acquire and hone both

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technical and creative skills, and although students do receive traditional letter grades, individual assignments rarely have clearly “right” or “wrong” answers. We focus on experimentation, discussion, critical thinking, invention and creative risk-taking. In this setting, making mistakes is often the very best way to learn. Organizing our classes around peer critique is ideal for the kinds of material we teach, but the scale of our classes presents a logistical problem. Running fully-inclusive in-class critiques with 50 - 150 students is difficult in face-to-face settings. Using online tools to help facilitate large critiques is an obvious direction, so we sought a method for conducting peer critiques for our classes via the participatory web. We found existing technology for sharing and turning in students digital projects (e.g. uploading files to BlackBoard, blogs, message boards, email attachments) less than optimal for both instructor and peer evaluation. Often these tools caused more cognitive overhead, complexity, message overload, and confusion than they were worth. It quickly became clear that there are no existing online tools designed to facilitate a large classroom critique session. We decided to develop a system specifically intended for the purpose of facilitating large classroom critique sessions. CritViz was created out of a need to manage the process of providing students in large creative classrooms high quality real-time feedback on their work.

C. The Problem of Facilitating Critiques in Large Classrooms

Traditional critiques work best in smaller classrooms where everyone can take part in a single discussion. In developing CritViz, we first needed to identify what are the specific challenges to scaling up the critique session to large numbers of students. We identified several common problems in our larger classes which tended to thwart a sense of cohesion and community necessary for large scale peer feedback to be effective.

Anonymity

Smaller classes mean increased individual attention, a stronger sense of community, and tighter group cohesion. Likewise, large classes lead to less individual attention and more of a sense of anonymity. When students are aware that the instructor is the only person who will see their work (and that they will receive little feedback due to the high volume of work the instructor must evaluate), the all-too-logical strategy among many students is to try to earn the maximum grade for minimum time and effort. Students are essentially anonymous, and are fully aware that their work is practically invisible to their peers. The motivational structure of the classroom quickly becomes “grade maximization through mistake minimization.” In creative classrooms it’s often mistakes that offer the most valuable lessons, and not only to the one student, but when students see each others work, to all students. Accordingly, one of our goals in designing CritViz was to remove a sense of anonymity in large classrooms by having students critique each others work in a manner visible to everyone in the class.

Insecurity

Another concern with large classes is the feeling of insecurity that frequently comes with learning difficult new material, approaches and processes. When students do not see the output, struggles, and learning process of their peers when taking on challenging new material, it’s not uncommon for many students to simultaneously assume they are the worst student in the class—that they must be the only ones struggling. Many students tend to think their skills and abilities are fixed rather than malleable [2], [3] and that if learning does not come easily, it must be that the student “just isn’t cut out” for this kind of work. These self-imposed beliefs profoundly impact one’s actions [4], [5], and negative self-views are an especially difficult cycle to break, as low confidence likely produces low-quality work, further reinforcing low confidence in future work, and so on. With this in mind, another objective for CritViz was to allow all students to see every other student's work, as well as all the critiques that the student receives, in real-time. When students can simply see what each other student is working on (and struggling with), in addition to the critical feedback they are receiving from their peers, this misplaced insecurity might be alleviated.

Late Work

Another serious consideration in managing large-class peer critique is keeping the entire group on schedule with deadlines, doing the same work at the same time. Critiques need to start and stop on time, as they are group activities, and a lack of synchrony erodes community. If a large number of students come to a critique session without completed work, not only will they have no work to contribute to the conversation, they also have suboptimal perspectives to offer peers because they have not seen the process through to the end of the assignment. Furthermore, in disciplines where learning builds on learning (like computer programming), late work is like sand in the gears. A student is not in a position to move on to a subsequent project if he/she has not mastered prior foundational work. Accordingly, a third aim for CritViz is to foster social accountability for turning in assignments and offering peer feedback.

D. Social Media in the Classroom

In considering how we might engage such a large group of students in ongoing conversations about their work, we were naturally drawn to the features of social media. Students are already accustomed to communicating through web-based media and do so daily [6]. Furthermore, in contrast to a traditional classroom environment where the only evaluator is a teacher, today’s “digital natives” have become accustomed to sharing their thoughts and ideas with a “real” audience of peers who offer feedback through comments, likes, etc. [7–10]. In fact, social media research has even demonstrated that peer feedback received via social media can impact one’s self-esteem [11–13].

Findings such as these have spawned major interest among educators in how to learn from, integrate, and leverage social media to create a better classroom. This fascination with all types of social networking tools may stem from one central property common to social networks, and alien to the classroom: with social network tools, bigger means better. More users of social media platforms such as Facebook, Twitter, and Google+ mean more options, more connections, more data, and more richness for that network's users. However, social media's appeal to educators does not stem from the excitement of using any specific platform in the classroom-they simply want to repurpose the engagement that social media brings for educational purposes.

In opposition to the "bigger is better" of social networks, in the classroom, larger class sizes generally lead to less attention and bandwidth from instructors, more anonymity, and less peer interaction. Essentially, in classrooms, "bigger is worse." Yet, if there is a way to flip this equation and make classes improve as the number of students increase, there is potential to improve the quality of teaching and learning for large numbers of people.

E. Computational Peer Feedback Systems

We are not alone in attempting to facilitate peer feedback using the participatory web. Educators have attempted to use discussion boards, blogs, and wikis ever since Web 2.0's explosive popularity. However, in attempting to use these existing platforms for peer feedback, we found them difficult to manage in the classroom. Social media systems are noisy; the instructor has little control over which pages students visit and which peers they choose to comment on. As a result, student attention is not focused, and some students (often the most popular) receive more feedback than others. Accordingly, an additional consideration for CritViz was to ensure that all students received a sufficient amount of feedback.

An additional challenge is teaching students to give valid, informed feedback to their peers. "[W]hile peers can provide helpful feedback, they need training in strategies and group processes" [1]. Students will obviously be less adept at evaluating their peers' work than their instructors, so an obstacle to quality peer feedback is training students to recognize the differences between poor, average, and exemplary work. One system in particular that explicitly addresses this issue is Calibrated Peer Review (http://cpr.molsci.ucla.edu/), which trains students by having them practice evaluating exemplars of strong, moderate and weak writing before allowing them to evaluate actual peer writing [14], [15]. However, this calibration process is time consuming and asks students to adhere to a rubric or metric. We felt that within the scope of our classes, the time required for such a calibration would be especially amplified. It is a difficult undertaking to define a metric for evaluating subjective artwork, and because our assignments vary widely throughout the course, students would essentially need to "calibrate" for every assignment. Thus, in creating CritViz, we sought procedures for allowing the critiques to happen quickly and ways for the evaluations to be intuitive, rather than being contingent on an existing rubric.

II. CritViz, the System

Critviz was designed and implemented by two instructors whose initial motivation for creating it was the need to immediately use it in the classroom. For this reason the system was intentionally kept as brutally simple as possible, and the primary intention for the software was (and still is), to do one thing well--support peer critique in a large creative classroom. In the following section, we will outline how a typical assignment works within the CritViz framework, from its initial creation by an instructor to the final peer critiques whole-class rankings.

A. Courses, Users and Profiles

Critviz has a basic username/password system, where students and instructors are given accounts to access the system. After an administrator creates a "class" in the system and assigns an instructor to that class, the instructor adds all the students to the class by entering a list of email addresses. After this set-up, the students can log in and create a basic profile which shows their name, basic contact information and a profile photo. They can modify their profile information and photo at any time. In addition, the instructor can write a profile for the course itself, which may include a text description and links to important documents such as syllabi and a course schedule.

B. Step 1 - Assignment Creation

With the course's instructor, student accounts, and student profiles in place, the next step is for the instructor to create the first assignment. Critviz revolves around the students' completion of assignments. First, the instructor navigates to an assignment creation form which includes text fields for the assignment's title and a space for a brief text summary of the assignment's intent. Text fields support the lightweight markup language Markdown.

C. Step 2 - Assignment Questions

After summarizing the assignment, the instructor adds "questions" to the assignment. These questions are elements of the assignment which the students must answer in order for the assignment to be considered "complete." The concept of completeness is important in that only students who fully complete the assignment can be included in the critique. For each question, the instructor must add text describing the question for the students. We have implemented several types of questions available to the instructor, the first type of question being a simple text entry field. This allows students to respond to the question posed by the instructor with plain unformatted text of any length, and is often used for short or long essay answers. Another type of question allows students to upload a file. This allows students to upload a single file from their computer to the CritViz server. If the instructor needs students to upload more than one file, an additional question can be added to the assignment, or the students can be asked to compress multiple files into a single .zip file for uploading. The third type of question is a YouTube URL, with which CritViz can embed the YouTube video directly in the upload page. And the last type of question is for embedding “sketches” created using the Processing programming language, a variant of Java, used widely by artists, designers, and students.

D. Step 3 - Assignment Options

Once the questions are formulated by the instructor, there are optional settings for the assignment such as whether the assignment is a group assignment or not, and whether or not to use a critique. In addition, if there is to be a critique, we have several possible critique assignment algorithms and the instructor must select which kind to use.

E. Step 4 - Due Dates/time

Here the instructor indicates exactly what day/time the assignment is due. This due date is presented to the student both as a date/time, but more importantly as a prominent countdown timer visible at the top of the assignment page when students log in. The countdown time serves to remind students how many days/hours/seconds remain before the assignment closes. When the countdown reaches zero, the assignment closes and it is no longer possible for students to answer questions. At this point the entire cohort of students who have successfully completed the assignment moves on to the critique phase.

F. Step 5 - Critique assignments

After the countdown timer reaches zero on the assignment deadline, the pool of students who have successfully completed all assignment questions move forward into the critique phase. Students who did not fully complete the assignment (all questions answered) do not move forward to the critique phase. We created this constraint for several reasons, but the primary justification is that it’s not quite fair for any student who did complete the assignment to receive critical feedback from other students who did not complete the assignment. This constraint is understandable by students and serves as a powerful motivator. The implicit message to the class that we are a self critiquing group, and in order to be a part of the group, the whole group needs to observe the deadlines and treat them not as arbitrary time limits set by the instructor, but collective constraints and time boundaries used to structure the class and keep the critiques fair.

When the assignment deadline has passed and the instructor is ready to move into the critique phase, the instructor presses a button that assigns critiques to each student. Every student who completed the assignment is randomly assigned five other students to critique. These are not reciprocal assignments, or pairwise matches, rather they are one way random linkings of one student to five others. After the critique assignments are created, every student is presented with a critique page, listing the five works they are to critique, and shown another countdown timer, showing how much time they have remaining to complete their critiques. This is the first type of critique we designed, and still the one most commonly used, although it’s not required than an assignment use the critique stage at all. After using the system, we realized that there are other useful kinds of critique assignment we needed to occasionally employ. Sometimes we do in fact want all students (regardless of whether they completed the assignments) to take part in the critique. Other times we want every student to critique every other student in the class. The three types of critique currently used by CritViz are the following:

1) “Contributors only, Randomized 5” - Students that complete the assignment are assigned to critique five random classmates.
2) “All Students, Randomized 5” - Every student (regardless of whether they completed the assignment) is assigned to critique five random classmates.
3) “All Students, All Projects” - All students critique all classmates’ work.

G. Step 6 - Critique Format

Once the critique assignments are in place, and students begin looking at the 5 randomly selected pieces of work assigned to them, an important design consideration is the kinds of feedback are they asked to give? It’s important to simply have a way for a student to write down feedback for each of the 5 works. Critviz allows the instructor to design a “critique question” where for each assignment the instructor can provide some written instructions for the student-critics on how to approach their written critique commentary. Often students are unskilled at giving criticism resorting instead to throw-away comments like “good job” and “I love this project”. These comments are nice to hear but unhelpful as critique, and the critics need help with how to think through their own critiques.

We also wanted a quantitative aspect to the critique, such that each student receives a “score” of some kind from the overall response of their five reviewers. We debated and tried a number of different formats including a numerical score 1-10, or a five star system such as is used in iTunes music ranking, or restaurant reviews, or even simply allowing students to assign letter grades as part of their critical feedback. All of these systems suffer from the simple problem of calibration. How do you make it clear to each student what a 3 versus a 6 mean, or 2 stars -vs.- 5? This would require a very detailed rubric and would have to be modified for every type of assignment used. Other systems [14–16] use this approach and overcome the problem of calibration by first asking students to grade a single “fake” assignment. They use this response to calibrate each student’s future responses to their peers work. This calibration step must be taken for each new type of assignment, and for each new student.

However, beyond the question of how to make numerical critique function properly, we are also mindful that the reason we want quantitative feedback in the first place is not because we want to reinvent grading. The real reason is simply that we want the class to be able to reliably and quickly self organize so that the students know where to look next for good examples of peer work. In a large class where all the work is visible and open to all students, a problem of “overload” quickly arises. With 75 students all wanting to see the best works in the class, without any self organization, each student might have to look at every piece in order to see the best examples. With our basic ranking system, the class can efficiently approximate a global rank, enough to point students in the generally right direction to find strong work.

Rather than use a calibration step, or a detailed rubric, we simply ask each student, in addition to providing written feedback to their five randomly assigned peers, to place these five works in rank order from strongest to weakest (1 is best, 5 is worst). This means that every student will receive 5 scores from their peers, with a perfect score being (1, 1, 1, 1, 1) which would indicate that in all five groups of five, this student's work was ranked first place. This form of ranking can be considered a form of "autocalibrated peer review" and has similarities to how search engines index and rank web pages, in relation and connection to other pages. Whether this method is good as a grading mechanism remains to be studied, but its utility as a simple way for the class to "upvote" good work is clear.

H. Step 7 - Class Rank Calculation

Once the critique deadline passes, the critique is closed and the assignment finished. At this point the instructor can tell the system to calculate the overall class rankings for this assignment, at which point each student is given a rank score consisting of the average of their five individual numerical rankings. Averaging is a crude way of calculating overall class rankings and has the negative effect of removing information about the distribution of scores a student received (some works can be polarizing), but it has an important positive effect of being very transparent and easy to understand by students. More complex methods were tried but it was found that when students can't easily understand how their scores are calculated, overall trust in the system erodes. We have had to continually keep in mind that this quantitative ranking system we have is not designed as a grading mechanism, but rather for self organization and reflection as a class.

At this point, the overall full class rank has been calculated and students can see a ordered list of everyone in the class for this assignment. The student at the very top of the list typically has received all first place scores, resulting in a perfect score of 1, while the student at the bottom of the list typically receives the lowest score possible of 5. While this ranked list of all students is ordered by the average scores, we also include the full breakdown of the individual five scores received.

I. Anonymity and Visibility

A key design and pedagogical consideration was whether or not to show the identities of the authors of the five pieces of work each student is asked to critique. In the end we decided that during the critique phase we would hide the names of the students whose work is being critiqued, but after the critiques are over, the names of all authors, as well as names of the critics are visible. After a critique is over and the class can see the full ranking, everything is visible. Each student can see every other student's work, as well as the critiques they received, and the names of those critics. They can even click on the names of the critics and be linked directly to the actual work created by that critic, and the critiques they received.

III. Findings

To date, CritViz has had 412 total users, and has been utilized in 15 Arizona State University courses by 9 instructors and 5 teaching assistants, resulting in 119 assignments, 4195 student responses to assignments, and 7116 critiques. During this initial trial, we have not only found CritViz to be an extremely effective tool in orchestrating large-class critiques, but also that its use changes the "motivational structure" of large classes.

Students who have used the system report that having an audience of peers for their work is more "authentic." In reflecting on using CritViz, one student reported:

> *I think having a system like Critviz elevates the work in the class. When your work can be seen by everyone in class and not just the instructors you're going to turn in work you're proud of, not just something to get a grade. I think Critviz also held everyone accountable. It was very clear when things were due because you could always check the countdown timer.*

Another agreed:

> *I became much more serious with my projects and aimed to make it good in the 1st attempt. You take the work into account much more when you're aware that your peers will be reviewing it.*

Additionally, because all students in a class were able to view each other's assignments, CritViz has also become a valuable resource for students looking for examples and ideas when beginning new assignments:

> *I loved looking at what other people did with their assignments. Looking at other peoples' work gave me ideas for my work. It was also nice to reference other patches if there was something I didn't know how to do and someone else did.*

A second student shared:

> *I looked at others' work as much as possible. I found myself doing it a lot in the beginning to see how people were doing certain things and also towards the end with the larger projects. I really like to know what other people are working on…Looking at the work of my peers is a great way to get ideas or think about things differently. Sometimes you can be stuck on a certain problem because you're just not thinking about it the right way and seeing a fresh perspective can help a lot.*

Finally, CritViz has greatly enhanced the feeling of community in our classrooms. Despite their large class sizes, our students truly feel connected, and even feel they are part of a team. One student said:

> *It's amazing looking at all the different projects from the many creative minds in this class. I think this class taught us to take into account feedback and using that feedback to improve our projects. If I could describe this class as one word I think I would choose, "Teamwork." Every helps each other and we all share our results with one another.*

Another opined:

> *One thing I can guarantee is that you're onto something. This class had a sense of community which I think many college courses lack. When someone feels more comfortable in the class, they will do better in that class. They feel more of a need to impress those around them, as well as themselves.*

Essentially, we have found that CritViz's peer ranking and classroom self-curation allows students to not only share their creations and code, but also their ideas, best practices, frustrations, excitement, and even humor. As a result of their interactions on CritViz, our classes of 75 students naturally become a tight-knit community of learners who are deeply interested in helping each other improve their work.

IV. Future Work

CritViz is currently only used within Arizona State University. However, its staggeringly positive reception from students and instructors alike has encouraged us to broaden its scope. Several other institutions and K-12 schools have indicated interest in using CritViz, and so we are currently refining the system for piloting in a wide range of educational settings. In particular, we are preparing CritViz for use in writing classrooms at an interested Arizona high school. We are also developing several additional features allowing instructors to use CritViz as a class management tool, including grade-book-like views of class scores. Work is also being done on incorporating multiple grading options for the instructor, including the ability to add existing metrics and rubrics to the critiquing process, allowing students to reference them while critiquing and offer feedback based on the metric's explicitly-defined objectives.

V. Conclusion

We believe the future of grading is collaborative, social, transparent, statistical and real-time. While opaque grading systems lead to students logically trying to get the best grade for the least effort, transparency through feedback from the instructor and peers leaves no room to "disagree" with grades, "game" the grading system, or cheat. In fact, in creative classrooms, such transparency can entice hard work, time, risk taking, and creative thinking. Using CritViz in our own classrooms we have found a dynamic highly motivational experience for students. Knowing they have an authentic audience interested in helping them improve their work makes the educational experience less about grades and more about honing skills that students find valuable. By regularly sharing their assignments through CritViz and receiving a steady stream of quality feedback, students in large classes become part of a learning community who share their struggles and triumphs in ways similar to a smaller, more traditional critique-based environment. Although tradition suggests that "Smaller is Better" when it comes to classrooms, our work with CritViz points towards the possibility of erasing some of the negative effects of having a very large classroom and allowing professors to increase the sizes of their classes with little negative impact, leading to "Bigger is Better" in the classroom.

References

[1] B. Cope, M. Kalantzis, S. McCarthey, C. Vojak, and S. Kline, "Technology-Mediated Writing Assessments: Principles and Processes," *Computers and Composition*, vol. 28, no. 2, pp. 79–96, Jun. 2011.

[2] C. S. Dweck and A. Master, "Self-Theories Motivate Self-Regulated Learning," in *Motivation and Self-Regulated Learning: Theory, Research, and Applications*, D. H. Schunk and B. J. Zimmerman, Eds. New York, NY, USA: Routledge, 2008, pp. 31–51.

[3] F. Pajares, "Self-Efficacy Beliefs, Motivation, and Achievement in Writing: A Review of the Literature," *Reading & Writing Quarterly*, vol. 19, pp. 139–159, 2003.

[4] A. Bandura, "Self-efficacy: Toward a unifying theory of behavioral change," *Psychological review*, vol. 84, no. 2, pp. 191–215, Mar. 1977.

[5] F. Pajares, "Motivational Role of Self-Efficacy Beliefs in Self-Regulated Learning," in *Motivation and Self-Regulated Learning: Theory, Research, and Applications*, D. H. Schunk and B. J. Zimmerman, Eds. New York, NY, USA: Routledge, 2008, pp. 111–139.

[6] A. Lenhart, K. Purcell, and K. Zickuhr, "Social Media & Mobile Internet Use Among Teens and Young Adults," Washington, DC, USA, 2010.

[7] J. Atkins, "Reading and Writing with Purpose: In and Out of School," *The English Journal*, vol. 101, no. 2, pp. 12–13, 2011.

[8] S. M. Kitsis, "The Facebook Generation: Homework as Social Networking," *The English Journal*, vol. 98, no. 2, pp. 30–36, 2008.

[9] A. Pascopella and W. Richardson, "The New Writing Pedagogy: Using social networking tools to keep up with student interests," *District Administration*, vol. 45, no. 10, pp. 44–50, 2009.

[10] M. Prensky, "Digital Natives, Digital Immigrants Part 1," *On the Horizon*, vol. 9, no. 5, pp. 1–6, 2001.

[11] N. B. Ellison, C. Steinfield, and C. Lampe, "The Benefits of Facebook 'Friends:' Social Capital and College Students' Use of Online Social Network Sites," *Journal of Computer-Mediated Communication*, vol. 12, no. 4, pp. 1143–1168, Jul. 2007.

[12] B. Gentile, J. M. Twenge, E. C. Freeman, and W. K. Campbell, "The effect of social networking websites on positive self-views: An experimental investigation," *Computers in Human Behavior*, vol. 28, no. 5, pp. 1929–1933, Sep. 2012.

[13] C. Steinfield, N. B. Ellison, and C. Lampe, "Social capital, self-esteem, and use of online social network sites: A longitudinal analysis," *Journal of Applied Developmental Psychology*, vol. 29, no. 6, pp. 434–445, Nov. 2008.

[14] A. Han, "Using Calibrated Peer Review to Encourage Writing," in Proceedings of the 2012 Association of Small Computer Users in Education (ASCUE) Summer Conference, 2012, pp. 23–32.

[15] R. Robinson, "Calibrated Peer Review: An Application to Increase Student Reading and Writing Skills," The American Biology Teacher, vol. 63, no. 7, pp. 474–480, 2001.

[16] "Calibrated Peer Review: Web-based Writing and Peer Review." [Online]. Available: http://cpr.molsci.ucla.edu/. [Accessed: 04-Dec-2012].

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Attendance to Massive Open On-line Courses: Towards a Solution to Track on-line Recorded Lectures Viewing

Enrique Canessa, Livio Tenze, Enrica Salvatori

***Abstract*—Massive open on-line courses (MOOC) such as those by edX.org are digital courses where thousands students are dispersed across the Internet. This new variant for distance learning opens many new challenges including the need to verify the real vision of recorded lectures same as we control the physical presence of scholars in a traditional classroom. We review here a precursor study on the effectiveness of the new Pinvox system (*i.e., "Personal Identification Number by Voice"*), that aims to ensure *"on-line attendance"* by confirming that a particular student has actually listened to and watched a complete video lecture. The preliminary findings obtained during a trial period by students watching videos from home and enrolled at University of Pisa in Italy, indicate that the use of Pinvox can be one step towards, not only ensuring the integrity of on-line certification, but also to sustain student attention and memory retention. Pinvox is based on the injection of unique, randomly selected and pre-recorded integer numbers within the audio trace of a video stream that ideally would need to be identified by MOOC students.**

Keywords —Massive open couses, Education technologies and innovation, on-line learning..

1. INTRODUCTION

Remote attendance to massive open on-line courses (MOOC), such as those being organized by edX.org [1] are becoming popular, largely publicized by the media, and are becoming an interesting new field of learning research. These are on-line courses where thousands of students, and course materials, are all dispersed across the Internet. The first course by MITx: Circuits & Electronics, enrolled about 120 thousand students on-line of which about ten thousand students completed the mid-term exam [2]. These initial MOOC experiences may indicate that the open technologies used are still immature and the lack of more direct human interaction between the many learners and the Lecturer(s) might well affect the quality of this learning experience. MOOC relies on both, watching guided video content and interactive experiences which raise some new questions: i) how to figure out and how to assess the progress of a student at a distance, and ii) how to ensure that scholars completed the video lectures. Nevertheless these issues, the MOOC as a new variant for distance learning opens interesting and unexplored possibilities to offer equal educational opportunities for all for the first time. It makes e-learning really scalable.

Pinvox is our suggestion to certify *"on-line attendance"* as we certify attendance to a live event. It stands for *"Personal Identification Number by Voice" (vox* in Latin*)* and is a prototype system that aims to guarantee that scholars have followed*, i.e.,* listened to and watched, a complete recorded lecture with the option of earning a certificate or diploma of completion after attending courses virtually [3]. Pinvox is based on the (scalable and automated) injection of unique, randomly selected and pre-recorded integer numbers which need to be successfully identified by students from the video or audio files.

By *"attendance"* we do not mean here to understand or even to learn. Pinvox is just about providing a way to be able to tell whether someone has watched a video completely or listened to a whole audio file, such as a Podcast. In a closed environment it is easier to tell the difference between attending an event (*I.e.,* physical presence) and making the best of it (*I.e.,* student assessment). That is why signed certificates of attendance are given to everyone in the classroom and grades are only given to those that successfully complete (written or oral) examinations based on what was discussed inside that very same room. The idea behind Pinvox is to initiate this attendance certificate, for scholars that are at a distance and studying at their own pace (in particular, via m-Learning).

The possibility of awarding *"certificates of virtual attendance"* for academic activities beyond the physical classroom is being considered by renowned scientific institutions such as MIT and Harvard [1]. The idea is to motivate more scholars to watch educational videos and the scientific and educational material recorded during conferences, workshops and seminars. To achieve this goal it is necessary to implement a system that allows us to verify (then certify) the real viewing by students of the recorded material. This is an open field of experimentation.

Motivated by the need to ensure on-line attendance, this is our first study and implementation of the Pinvox method. We asked students to test, during their Summer holidays (prior to the Autumn examination in person), the Pinvox methodology as applied to the humanities course on "Cultura Digitale" organized by the MA course degree in “Informatica Umanistica“ (Digital Humanities) of the University of Pisa in Italy. Interestingly, we have found that the use of Pinvox can not only be one possible step towards ensuring the integrity of on-line certification, but it can also help to induce further attention and memory retention by the students.

Assessments mechanisms for students following on-line courses have been extensively discussed in the literature, whereas verified video viewing for on-line certification via MOOC has received little or no attention. This is the first study of this kind to our best knowledge.

2. The Pinvox Method

Pinvox is just about providing a way to be able to tell whether someone watched a video completely or listened a whole audio file. It stands for *”Personal Identification Number by Voice” (*from *Vox in Latin)* [3]. It is based on the (automated and scalable) injection of unique, randomly selected and pre-recorded integer numbers (or audio PINs) within the audio trace of a video stream, which need to be identified by the viewers. These numeric audio signals superimposed on the original video/audio stream in different formats cannot be easily spotted by students even by fast forwarded an rewound of the recordings or analyzing their audio signal plots.

Pinvox is easy to install and easy to use. It runs in any computer with MS Windows O.S. Or the free Ubuntu Linux O.S. And it can be downloaded from the website: www.pinvox.org In brief, the unique audio PIN codes within Pinvox are:

- composed of few pre-recorded numbers;
- generated on-the-fly for each video/audio input;
- superimposed into the audio trace of the speaker(s) at places where (in principle, but not necessarily) silence is detected by the algorithm after some default noise tolerance;
- only identified in most cases when watching the whole video only.

The Pinvox Graphics User Interface (GUI) is display in Fig. 1. It allows to select:

- the input audio or video file. The final video, audio plots and audio PINs (i.e., Pinvox general outputs) are created in the same directory than the original input file;
- the period of silence (in which the Audio PINs are injected by the algorithm);
- the number of copies to be processed that will contain the ”Personal Identification Number(s) by Voice”.

The Pinvox algortithm starts processing the input (audio or video) file by

- identifying first the format of the input file;
- extracting the audio trace of the input video file and making a copy of the video without audio (if the input file is audio then it does nothing);
- searching for time positions within the audio trace of all available period of silences according to the selected value. After this search, then
- the GUI algorithm selects randomly (up to 14) Audio PINs and finally,
- it re-injects back into the video with no audio the new audio trace with audio PINs.

All of these automated processes can take time to complete. The Processing status is indicated in the GUI by a red bar for each of the videos with Pinvox to be executed. The longer the video/audio input, the longer the algorithm takes to embed the audio PINs. The most time consuming processes are the extraction of the original audio trace from the video input, and the re-injection into the same video of the new audio file with the embedded audio PINs. The process of finding the selected period of silence and of choosing randomly pre-recorded numbers is by far faster. After all these processes complete successfully, then the file containing the audio PIN codes and the Pinvox audio data plot(s) (useful for preview and comparison against the original audio inputs) become available for distribution to the students.

3. Certified Vision with Pinvox

New opportunities for learning exist world-wide with the use of technology in education and the availability of broadband Internet at accessibile costs. Scholars can today study at their own pace via free rich-media material see *e.g.* MIT’s OCW, ICTP.tv, Khan Academy, University of the People [4], which can be watched or listened when, where and as often as chosen. Some necessary conditions for learning, even at a distance, are *I)* the *retention* of information, which can be improved by note taking while paying attention to a video or a classroom lecture, *ii)* the *focused attention* or *concentration* to encode knowledge in our memory and *iii)* the ability to

Figure 1 - Simple Pinvox GUI for video or audio input, processing and ouput.

consciously recollect previous experiences from memory (*i.e. Episodic memories*). The encoding theory of Tulving (1972) points out the importance of the "retrieval cues" in accessing the episodic memories needed in learning.

As in the case of education inside traditional classrooms or lecture halls, the aforementioned necessary conditions for learning remain unchanged for scholars attending classes virtually since they relate to the human nature, the psychology of learning and not much to the technology used. The technology, including the Pinvox tool, can just facilitate and improve the educational process [5].

We carried out the first '*in-situ'* implementation of Pinvox by asking two postgraduate students (*'in appello')* to test, during their 2012 Summer holidays (prior to the Autumn examination in person), the Pinvox algorithm as applied to the humanities course on "Cultura Digitale" organized by the MA course degree in "Informatica Umanistica" (Digital Humanities) of the University of Pisa in Italy. The course consisted of following 16 videos with an average length of 90 min each, recorded by different Lecturers in different topics ranging, *e.g.,* from the creation of eBooks to Cultural Heritage and Pervasive Information. Each student had to watch these educational videos at their own pace and identify the random audio PINs embedded in each of these by the Pinvox method. In total there were 142 audio PINs to be identified by student one and 165 by the second student, making an average of 10 audio PINs injected per video. Both students identified all these pre-recorded numbers with an error of only 2%, which could be due to some distraction or due to the lack of familiarity with the Pinvox method, since these errors of identification only appeared within the 3 first videos.

We then asked the students to complete a questionnaire to compare their attitudes towards Pinvox as a tool to ensure their on-line attendance as well as attention to the contents of the 16 video lectures. Analysis of the results of this study indicate that students believe that Pinvox helped them increase their attention to the lectures, not only on the subjects of their main particular interest, but specially in the topics that were of less interest to them. They also indicated that there is no difference in identifying the embedded numbers *per se,* or together with the timing in which these appear within the video. A higher attention level remains unchanged, since the ringtone that anticipates the injected recording numbers helps them to keep note on the timing and the PIN without losing concentration on the lecture.

In general, these findings suggest that the adoption of Pinvox, as a new and unique learning experience, could well became useful for other courses that use multimedia materials without having the physical presence of the student in the classroom, and which requires great attention and retention of information.

Information given in the middle is least remembered. Pinvox helps to increase attention.

Appropriate stimulus or "retrieval cues" may avoid retention loss (or forgetting), as opposed to the decay of memories over time or interference from other memories —which are stored in our short term and long term memory system [6]. The audio cues attached by the Pinvox algorithm into the digital contents aim instead to increase *attention* and *retention* throughout a lecture and to reduce the Primacy-Recency effect as shown in Fig. 3 [7,8]. During the learning episode, one not only remembers best what comes first, or what come last, but we also better retain the information which come with the video where attention is called up using Pinvox by means of audio PINs.

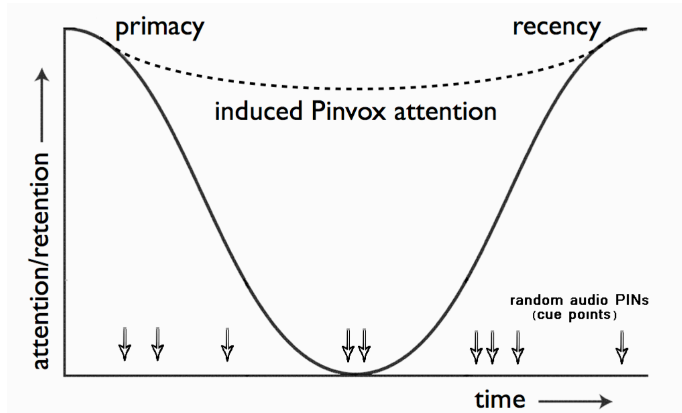

Fig. 3: *Primacy-Recency* effect -the earliest and latest information in a Lecture is best recalled.

Pinvox may therefore allows to:

1) Verifying attendance through the entire video/audio learning experience,
2) Increasing sustained attention across the entire video/audio learning experience,
3) Increasing retention between primacy and recency peaks.

From this study we can inititally deduce that Pinvox helps to ensure attentive viewing of educational video material or audio files which can be fast forwarded and rewound. Thus, conditions and facilitation of learning via guided contents within the CMS Moodle for student assessment and *ad-hoc* tools like Pinvox are the main ingredients for supporting the new era of self-paced education and learning.

On the other hand, Pinvox cannot substitute a Tutor for discussions, stimulus, answers, especially when the learner is in a remote place. But in the specific case of distance learning, Pinvox can guarantee the attention to what is being projected on the video since it offers better certainties on the student participation to the educational process, even if virtual. For courses with a large number of students (*e.g,* such as those organized by edX.org from MIT in which thousands scholars are being registered), the control of PINs delivered by the students would need to be automated. The findings reported in this first study support the view that the adoption of Pinvox can be a feasible step to assure the integrity of awarding on-line certification.

The use of Pinvox seems to offer clear benefits as perceived by our postgraduate students in terms of attention and attendance and how much they feel they learnt. Coupled with the advantages of flexibility in when, where and how videos or Postcasts are used, Pinvox appears to have significant potential as an innovative supporting tool for learning and on-line attendance certification. For the instructor, the most professional benefit is to use a tool that makes sure that his/her audio-video material has been completed by the student —a great advantage from the pedagogic point of view. Finally, we believe the adoption of Pinvox may also open the door to facilitate learning experiences with people who have disabilities and learning difficulties.

Evaluation mechanisms for students following on-line courses have been extensively discussed within e-learning, distance education and mobile learning programs, whereas verified video viewing for on-line certification via MOOC has received little or no attention. Both types of assessments are necessary to have a reliable mechanism that leads to obtain an academic certification on-line. So far as we know, besides Pinvox, there is no another way to guarantee that thousands of students (as those expected to attend future MOOC) have gone through the whole video lecture view. Even if the number of students participants may seen as not statistically sound, this is the first study of this kind. the results discussed open the path for further investigations on verifying attendance to MOOC.

Pinvox offers an original solution to track online recorded lectures viewing with the increasing emergence of Massive Open Online Courses (MOOCs) in higher education. Attendance assurance is greatly established, because the system is always generating a different Pinvox code for each student and video delivered. Students may pass their codes each other, but these are all randomly different.

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References

[1] edX (2012) partnership between the Massachusetts Institute of Technology (MIT) and Harvard University: http://www.edx.org

[2] Forbes Nagazine (2012), article by J.M, Crotty, "New Equation For Free Education: MITx + HARVARDx = edX", http://www.forbes.com published: 2012/05/06

[3] Canessa, E., Fonda, C., & Zennaro, M. (2012). On-line certification for all: the Pinvox algorithm. *Inter. J. Emerging Tech. In Learning (iJET), Inter. J. Emerging Tech. in Learning (iJET),* **7**, 43-45.

[4] Canessa, E., Fonda, C., & Zennaro, M. (2009). One year of ICTP diploma courses on-line using the automated EyA recording system. *Computers & Education* **53** (1): 183-188.

[5] Clark, D. (2011). Recording can improve a bad lecture! Surprising facts about recorded lectures. Author's blog: http://donaldclarkplanb.blogspot.com

[6] Miller, G.A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review* **63** (2): 81–97.

[7] Murphy, J., Hofacker, C., & Mizerski, R. (2006). Primacy and recency effects on clicking behavior. *Journal of Computer-Mediated Communication,* 11(2), 7th article.

[8] Sousa, D. (2011). How the brain learns. *SAGE Publications Ltd*, ISBN: 9781412997973 Tulving, E. (1972). Episodic and semantic memory. In E. Tulving and W. Donaldson (Eds.), *Organization of Memory*, 381-402. New York: Academic Press.